ENV-PLN-0003v3

Groundwater Monitoring Management Plan (GMMP)

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1 Introduction

Foxleigh Management Pty Ltd (FoxMan) operates Foxleigh Mine (Fox) on behalf of the Foxleigh Joint Venture (FJV). A Groundwater Monitoring Management Plan v4 dated 14 Apr-2016 (GMMP-16) was developed, submitted, and approved (18 Apr-2016) to meet the Fox Environmental Protection, Biodiversity and Conservation Approval (EPBC 2010/5421 15 Apr-14) conditions 9-13.

EPBC 2010/5421 was reviewed, and a Variation approved 30 Sep-21. The only change to GMMP related conditions (9-13) was the change in condition 13b from 60 business days to 90 calendar days in relation to reporting exceedances. So, requirements for a GMMP are ostensibly the same.

GMMP-16 was also submitted (19 Apr-2016) for compliance with the State Environmental Authority (EPML00744813) condition E3.

GMMP-16 contemplated model and plan review and there was evidence, recorded in GMMP-16 following baseline studies, that some of the installed infrastructure may require review over time:

- *Predictive modelling of potential impacts is mentioned in the EPBC (Condition 10) as a standard tool and so the requirement to amend the numerical model (JBT, 2013) will be reviewed on a periodic basis as more monitoring data is collected and assessed (s4.2.5)*
- *that data from FPVWP02 appears to be very 'noisy' with recorded values showing spurious changes and trends that suggest the data's quality may be compromised … If the readings continue to be considered unrepresentative, consideration should be given to replacement of the VWP or substitution with a standpipe screened in the Quaternary alluvium (s4.2.3)*

This GMMP-23 is the result of review of data collected in the baseline period and the last six years, including a review and upgrade of the Hydrogeological Conceptual Model (HCM).

References to sections throughout GMMP-23 (e.g. s4.2.3) are sections in GMMP-16 unless otherwise noted. GMMP-23 is a stand-alone document with relevant sections of GMMP-16 referenced or included in the Appendices.

This GMMP-23 is to be submitted for Federal Minister approval – until a new plan is approved GMMP-16 is being followed by FoxMan.

Mapping of EPBC 2010/5421 (30 Sep-21) is in Table 1 below.

Table 1 EPBC 2010/5421 (30 Sep-21) condition mappings

EPBC #	EPBC Condition	GMMP-23 section
9	The approval holder must submit a Groundwater Monitoring and Management Plan (GMMP) for the Minister's approval. The approved GMMP must be implemented.	1
10	The GMMP must include information provided in the Groundwater Monitoring Plan required in Queensland Environment Approval (EPML00744813). The GMMP must also:	Appendix C
10a	include groundwater quality triggers and limits as defined in the Queensland Environmental Approval	5.5
10b	detail a monitoring program (including monitoring locations, parameters to be measured and monitoring frequency) that will enable groundwater drawdown and changes in groundwater quality to be measured. This program must also enable identification of local and regional cumulative impacts where groundwater impacts associated with this project can be attributed	5

EPBC #	EPBC Condition	GMMP-23 section
10c	discuss what risk-based threshold responses the approval holder will take and the timeframes in which those actions will be undertaken if groundwater quality triggers and limits are exceeded or likely to be exceeded	5.8
10d	provide commitments, including timeframes, to periodically review and update the numerical groundwater model once two, five and 10 years (or sooner if required) of groundwater monitoring data is available	6
10e	how outcomes of the updated numerical groundwater model will be used to update the GMMP	4.2.2
10f	demonstrate commitments to working with other groundwater users within the footprint of predicted groundwater impacts for this project to create a better understanding of the water balance in the region	3.2
10g	include provisions to make groundwater monitoring results publicly available on the approval holder's website. The results must include	5.9
10gi	the methods used to collect data	5.4
10gii	the assumptions and uncertainties that were incorporated into the numerical groundwater model	4.2.4
10giii	a discussion of the results and how groundwater is being impacted locally and regionally	4.2.5
11	The GMMP must be peer reviewed by a suitably qualified expert who must be approved by the Minister in writing. The peer review must be submitted to the Minister at the same time the GMMP is submitted to the Minister for approval	7
12	The approval holder must not substantially commence the action until the GMMP has been approved by the Minister in writing	1
13	The approval holder must:	
13a	report exceedances of groundwater quality triggers and limits to the Department within 10 business days of the monitored exceedance; and	5.5
13b	provide written advice to the Department, within 90 calendar days of the occurrence of the monitored exceedance, stating the direct cause of, and the actions taken in response to, the exceedance and management responses.	5.5

2 Background

2.1 Geological Setting

Relevant geological information from GMMP-16 has been included in Appendix A.

2.2 GMMP-16 design objectives

Groundwater monitoring is to ensure changes in groundwater level and water quality do not have a negative effect on the environment (FoxMan must not release contaminants to groundwater).

GMMP-16 was built on a field program undertaken in 2013 (Golder Associates) to install groundwater monitoring infrastructure and collect baseline data. This program utilised 3 constructed bores (GMP1-3) with Vibrating Wire Piezometers (VWPs) installed at 4 strata depths plus an additional shallow manually monitored bore (GMP4) for water levels and quality sampling (Appendix B). This infrastructure has been used as the basis for ongoing monitoring. These bores and the EPBC project area are shown in Figure 1 with distance to active mining areas shown.

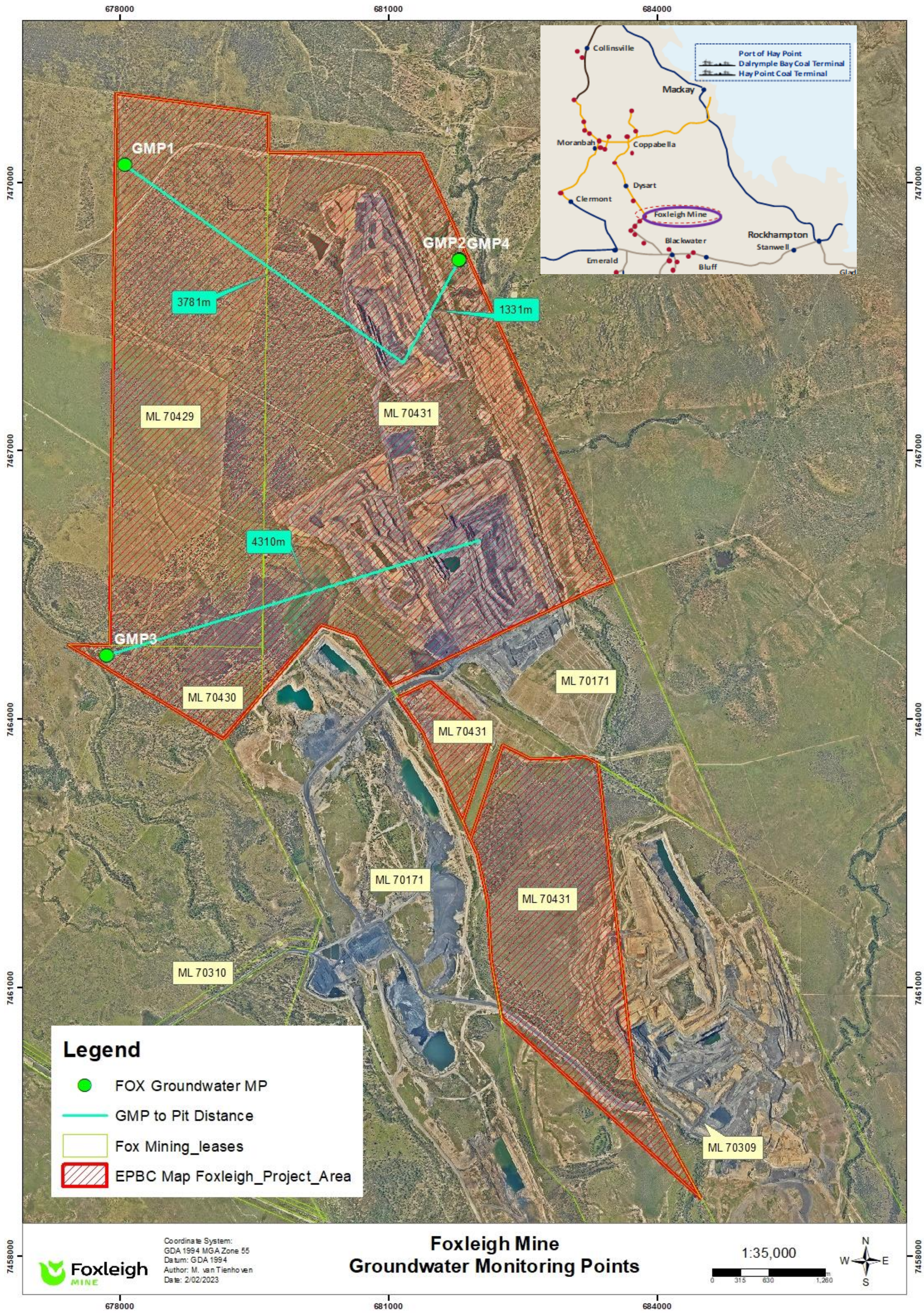
The design of the initial monitoring program included the following elements (*s4.2.2*) to enable additional quantitative groundwater data to be obtained:

1. *to identify the presence, associated aquifer properties and baseline water quality data profile for Quaternary alluvium*
2. *develop an understanding of potential hydraulic connectivity between the Quaternary alluvium and deeper Permian strata*
3. *determine groundwater flow processes within the study area*

The primary objective (*s5.1*) was to establish baseline conditions and monitor for changes that might be associated with mine activities. The original objectives (*s2.2*) were to

a. *establish an appropriate monitoring program*
b. *develop a background data set to assess potential impacts against*
c. *enable identification of potential impacts to groundwater from mining activities in a timely manner so that they can be managed proactively*
d. *enable detection of long-term trends and potential cumulative effects from current and future mining operations*
e. *gain an appreciation of natural groundwater variability in the project area*
f. *verify and refine understanding of the project-scale hydrogeology*
g. *outline a process for collection of data to facilitate verification and calibration of assessments made in previous and future groundwater modelling work*
h. *outline a process for acquisition of sufficient data to develop trigger thresholds, values for key parameters; and*
i. *provide an investigation and response process (e.g. risk based management actions) should there be a breach in triggers, thresholds, or values (or landholder complaints).*

Figure 1: EPBC Project Area and location of VWPs



2.3 GMMP-16 Hydrogeological Conceptual Model (HCM) hypotheses

Several hypotheses were formed and summarised in a conceptual model (*s4.2.5*) and over the last six years there has been no contra-evidence to change these positions:

a. *All data indicates that a continuous groundwater system is not likely to be present in the shallow unconsolidated sediments* (*s4.2.3*)

b. *Groundwater within the study area is extremely saline (and thus of limited environmental value). Surface water is relatively fresh, which indicates separation (hydraulic disconnection) between the surface water and groundwater systems* (*s4.2.3*) *"Therefore, it is also concluded that a reduction in regional water level due to mining will not impact permanent/ semi-permanent water bodies (such as those on Cockatoo Creek to the north of the Plains Pit) as a reduction in regional water level will not induce downward drainage from the hydraulically separate system comprising the stream channels and Quaternary alluvium (s4.2.6)"*

c. *The hydraulic conductivity of coal measures (coal seams and interburden) in the area of Foxleigh Mine and the study area is low, and the seams do not contain significant volumes of water. Observations at Foxleigh Mine indicate that groundwater inflow to the mine is not generally seen. When new areas are opened up and inflow is observed, the flow is of short duration* (*s4.2.3*)

d. *Low hydraulic conductivity and structural isolation will lead to a steep cone of depression with drawdown of limited lateral extent. Drawdown may coalesce with that caused by operations at Foxleigh Mine but cumulative impacts are expected to be hydraulically isolated within the local, faulted, syncline structure* (*s4.2.3*)

These are discussed further in section 3.

2.4 Environmental Values (EV) of groundwater

The *Environmental Protection (Water) Policy 2009* (EPP) provides a framework to protect and/or enhance the environmental values (EV) and hence suitability of Queensland waters for various beneficial uses. Groundwater resources within the Fox project area lie within the Mackenzie River Sub-basin as listed in Schedule 1 of the EPP.

This policy guides the setting of indicators that will protect the EVs of any resource. The EPP states that the EVs for groundwater within the Mackenzie River Sub-basin that need to be considered are:

1. aquatic ecosystems;
2. cultural and spiritual values;
3. drinking water;
4. farm supply;
5. industrial use;
6. irrigation; and
7. stock water.

The EPP provides general water quality objectives (WQOs) to support and protect the various EVs identified for waters within the Mackenzie River Sub-basin. The WQOs are long-term goals for water quality management.

The specific EVs and WQOs applicable to the Mackenzie River Sub-basin are presented in a document prepared by Queensland Department of Environment and Heritage Protection (DEHP) (2011). Where DEHP (2011) indicates more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the adoption of the most stringent WQOs for each water quality indicator will then protect all identified EVs.

A key objective of monitoring groundwater is to track and quantify any change in groundwater conditions, to then quantify any potential unauthorised environmental harm and associated environmental impacts which may occur to the Project area groundwater values. This information is required for the management of any impacts (prevention, mitigation and responses). Therefore, an understanding of the actual groundwater values across the Project area is required and a review of the relevance of each EV to determine qualities to be protected and therefore monitored under the GMMP is conducted in sections 2.3.1 to 2.3.8 of this document.

2.4.1 Aquatic ecosystems

Given the highly saline nature of groundwater in the project area and the relatively fresh nature of surface waters, groundwater does not have a good hydraulic connection to surface water. **No** surface water features in the area are considered to be fed by a baseflow component.

2.4.2 Irrigation

Groundwater is **not** used for irrigation within (and neighbouring) Fox. No bores licensed specifically for irrigation purposes are located within a 10km radius of the site.

2.4.3 Livestock watering, farm supply or domestic use

Groundwater is **not** used for farm supply, or domestic use within (and neighbouring) Fox. See section 3.2 of GMMP-23 for review of surrounding bores with no bores identified for active stock use or other. Stock water supply is predominantly from surface water sources (dams).

2.4.4 Primary recreational use

Groundwater is **not** used for primary recreation within (and neighbouring) Fox.

2.4.5 Drinking water

Groundwater is **not** used as a drinking water supply within (and neighbouring) Fox.

2.4.6 Industrial use

No WQOs are provided by the EPP for industrial uses. Water quality requirements for industry vary within and between industries. Also, the ANZECC guidelines do not provide recommendations to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis.

2.4.7 Cultural and spiritual values

There is no known EV in relation to cultural-spiritual values of groundwater within (or neighbouring) Fox.

2.4.8 EVs requiring protection or monitoring

As per above, due to the nature of the groundwater there is currently no EVs that require protection or monitoring under the Mackenzie River Sub-basin EVs of the EPP.

2.5 GMMP-16 independent data reviews

FoxMan has commissioned several independent reviews of GMMP-16 data:

- 1 Jun-21: Memorandum: Review of groundwater monitoring data – Foxleigh Mine (*AGE*)
- 21 Jan-22: Preliminary assessment of VWP monitoring data (*Groundwater Functions*)
- 4 Mar-22: VWP Inspection (infield) (*ALS*)

- 10 Apr-22: VWP Spurious readings (*Groundwater Functions*)
- 22 May-16 EPBC 2D GW Model review (*Groundwater Functions*)

In summary the reviews determined

- There were numerous VWP readings that did not make sense in the context of other data/activity;
- There was no evidence of credible drawdown movements in excess of GMMP-16 trigger levels;
- The GMMP-16 2D model predictions were still valid, albeit mining sequence was different to initial modelling, and model predictions were presented as all-time maximum impacts only; and
- Some of the VWP sensors could no longer be relied upon to provide data that could be interpreted to deliver the objectives of GMMP-16.

3 Conclusions from six years of data

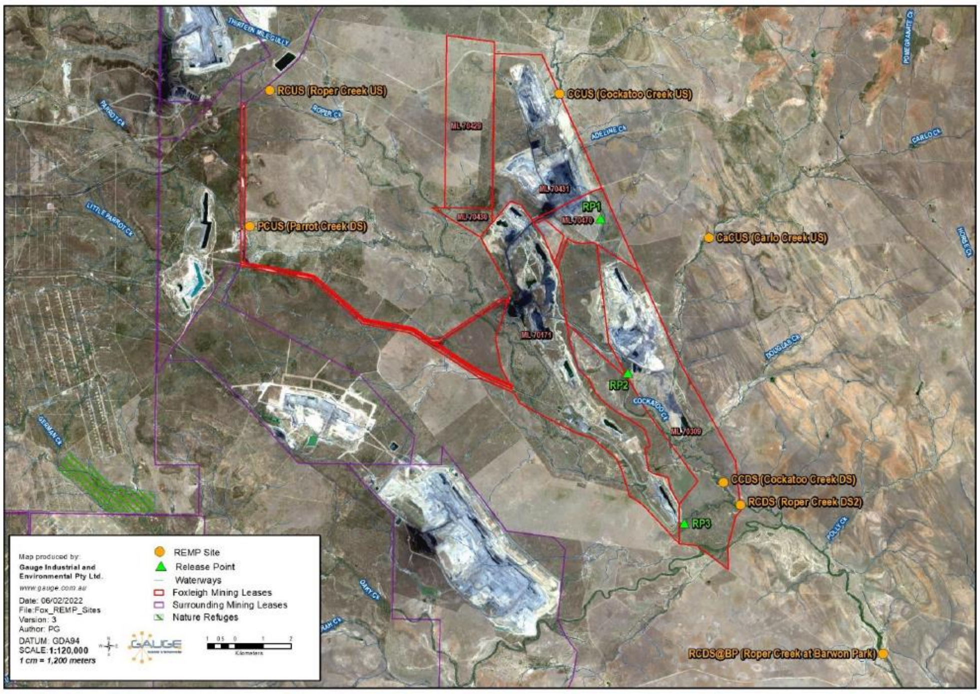
3.1 Separation between surface and groundwater

As part of the Fox EPML00744813 an annual Receiving Environment Monitoring Plan (REMP) Design Document is in place that defines measurement of surface waters in the surrounding creeks on an annual basis. The monitoring points are shown in Figure 2 and the electrical conductivity measurements (EC) in Table 2. The median of all EC measurements over the four years is 219µS/cm.

Table 2 Fox REMP EC measurements

	Electrical conductivity (µS/cm)			
Location	**2022**	**2021**	**2019**	**2018**
CCUS	208	161	111	170
RCUS	Dry	214	1,080	818
PCUS	Dry	Dry	238	1,540
CaUS	335	185	112	219
CCDS	366	187	198	370
RCDS	518	187	213	297
RCDS@BP	698	214	338	346

Figure 2: Fox REMP surface water monitoring points



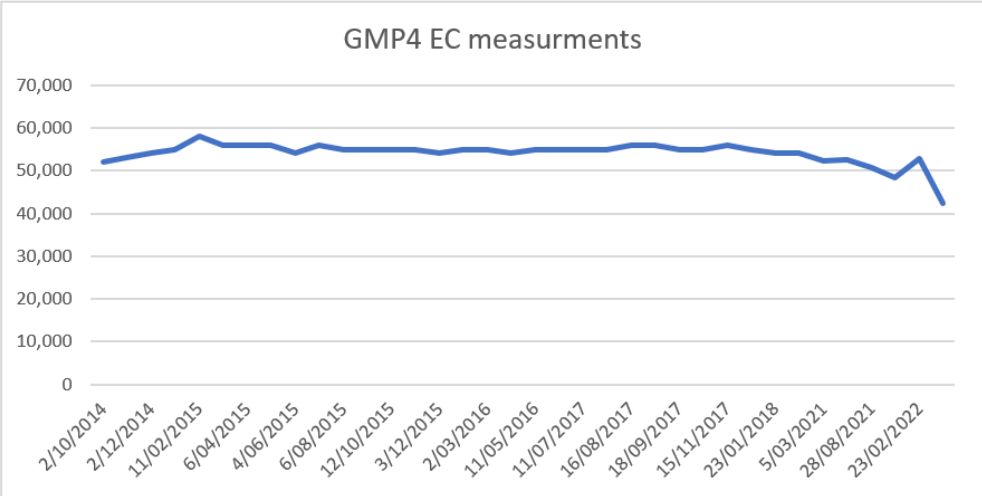
Electrical conductivity measurements have also been taken of underground water since 2014 in GMP4 (15m deep and 312m from Cockatoo Creek Up Stream (CCUS) monitoring site) with the results graphed in Figure 3.

The median EC since 2014 is 55,000 µS/cm.

Conclusion:

The huge disparity between surface water and groundwater EC suggests that there is no connectivity between the two.

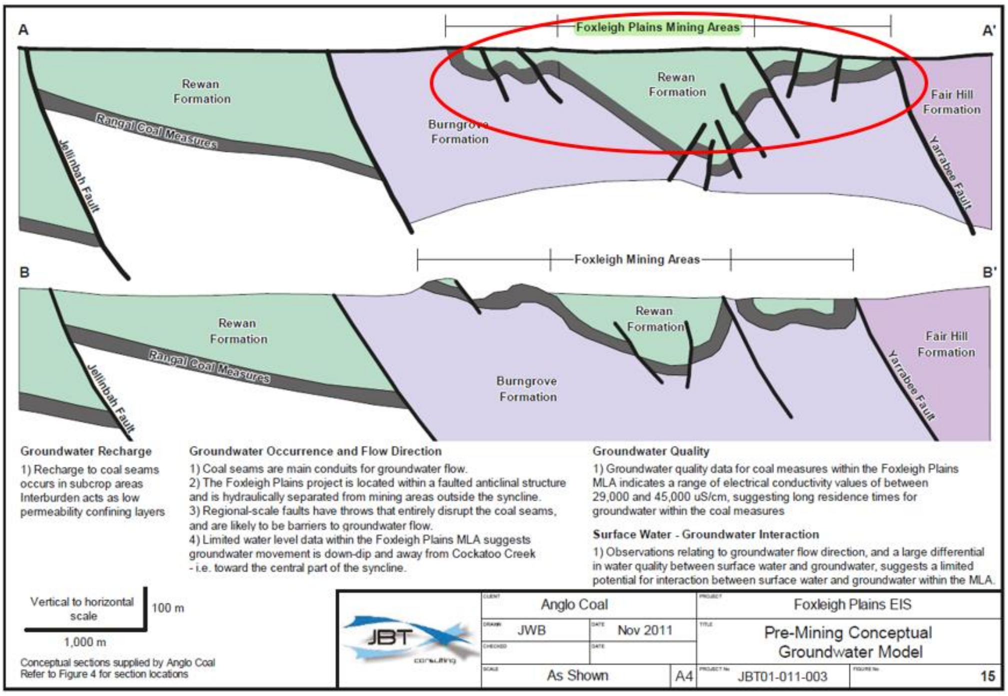
Figure 3: Fox GMP4 groundwater electrical conductivity (µS/cm) monitoring



3.2 Groundwater impact predicted footprint and other stakeholders

The *Foxleigh Plains Project – Environmental Impact Statement* (Fox EIS) and initial groundwater model (JBT 2013) identified that t*he Fox project is located within a faulted synclinal structure* and inferred that it *is hydraulically separated from mining areas outside the syncline.* This is shown in Figure 4 - red ellipse.

Figure 4: Groundwater impact area confined to syncline area (after JBT,2013)



A review of available data from the Department of Environment and Resource Management (DERM) groundwater database indicates that the closest registered groundwater bore (RN43737, Carlo Creek No1) is on the Carlo property, approximately 6.5 km from One Tree mining area (Figure 5).

Discussions with the landowner and measurement returned the following information:

- Key bore and water measurements for registered bore RN43737 are in Table 3
- They have not pumped from the bore in over a decade, as always had good dams around the place and didn't need groundwater for livestock

Table 3 Bore RN43737 details (3 August 2022)

HoleID	Total Depth (m)	Casing depth (m)	Water Level (m)	pH	Specific Conductivity (µS/cm)	Total Dissolved Solids (ppt)	Turbidity (NTU)	Temperature (°C)
RN43737	51.8	13.1	5.2	7.9	3,938	2.6	28.2	24.9

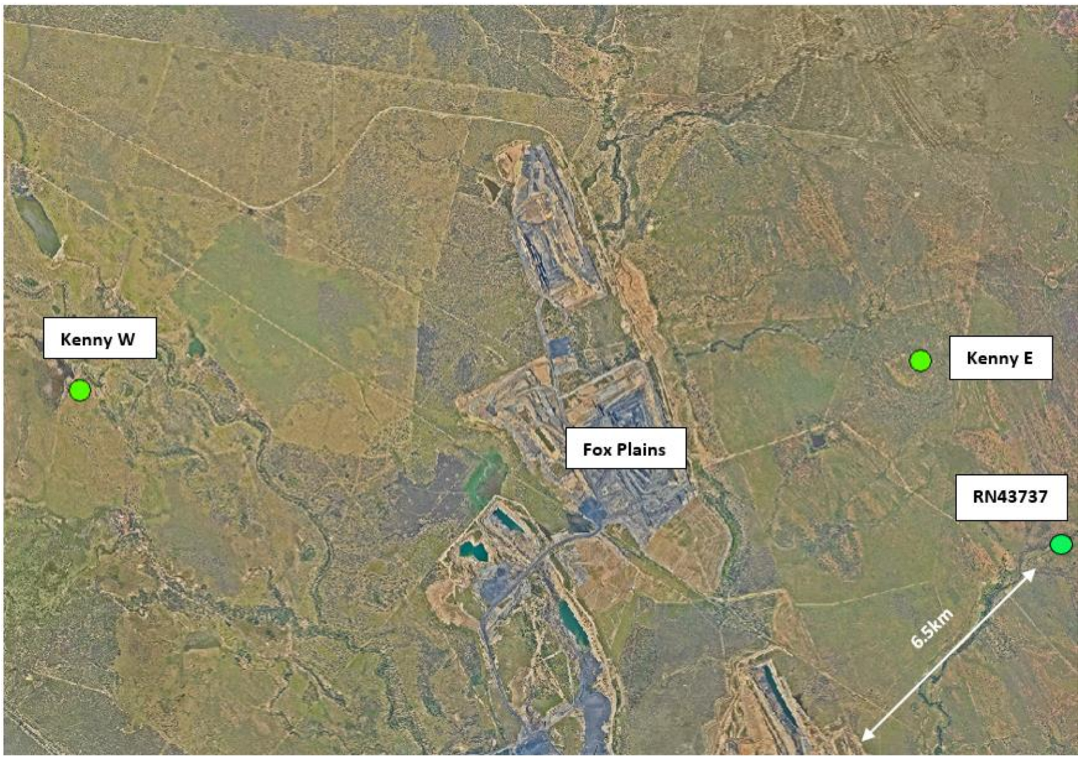
A bore survey identified two private groundwater bores (Kenny E and Kenny W) on the Tralee property (Figure 5), which lies on and adjacent to the study area.

- Kenny E is drilled to 40m with a pump installed but has not been used for over 10 years.
- Kenny W is drilled to 120m, water at 20m depth capped with initial measurements of pH 6.86 and EC 403 µS/cm. While not currently used Kenny W may be used for livestock water in the future.

All 3 bores are outside the synclinal structure that the project lies within and therefore outside the expected limit of significant impact on groundwater from mining.

Additionally, based on discussions with landholders it is concluded that there is no significant water supply from these bores. The lack of groundwater users fits with the information collected to date regarding poor groundwater quality (due to salinity) and low yields.

Figure 5: Landowner bores in proximity to Fox



Conclusion:

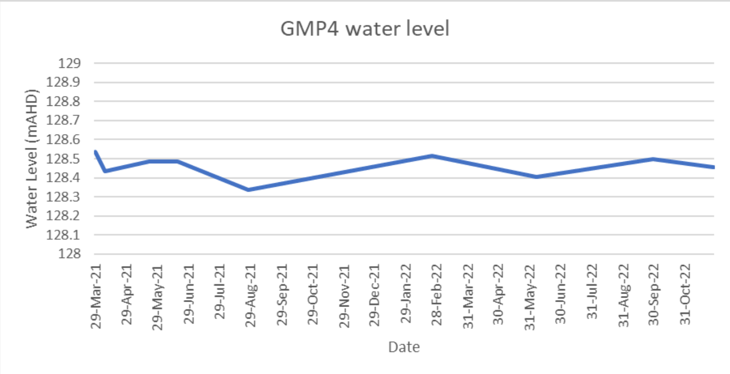
This evidence supports that the hypothesis in section 2.2d above, that groundwater impacts are confined to the immediate area to Fox and not far-field.

3.3 Summary VWP trend data and issues

Figure 6 shows standing water levels in GMP4, maintaining a steady level over 18 months. Figure 7 shows the trend data for the 3 VWPs over a six-year period. While a number of trend lines demonstrate stability, there is significant and sharp variability in others. Independent reviews noted that, *If faulting does provide a hydraulic connection between the Burngrove Formation and the Rangal Coal Measures, we would still expect a more delayed response given that the bulk permeability of the interburden's rock is still inferred to be low.* Additionally, the thermistors in VWP1-s3 showed a drop from 25°C to negative 15°C over a 12-month period, further suggesting issues with measuring devices.

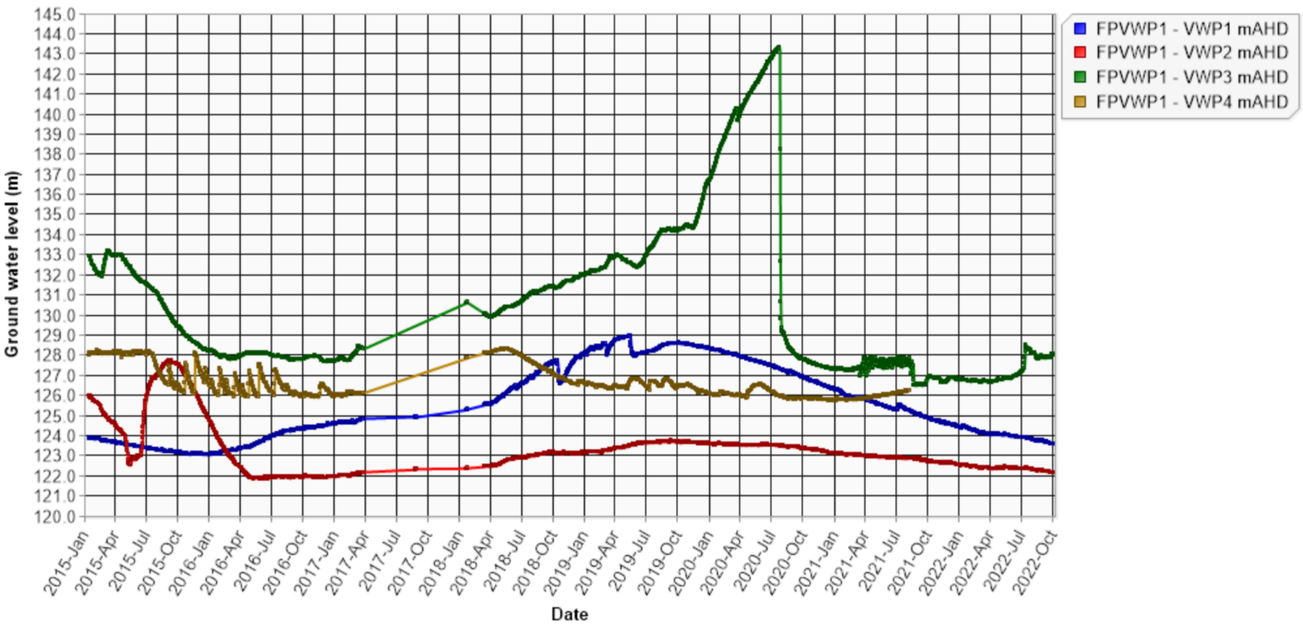
For cross-reference: GMP1 contains VWP3; GMP2 contains VWP1; GMP3 contains VWP2

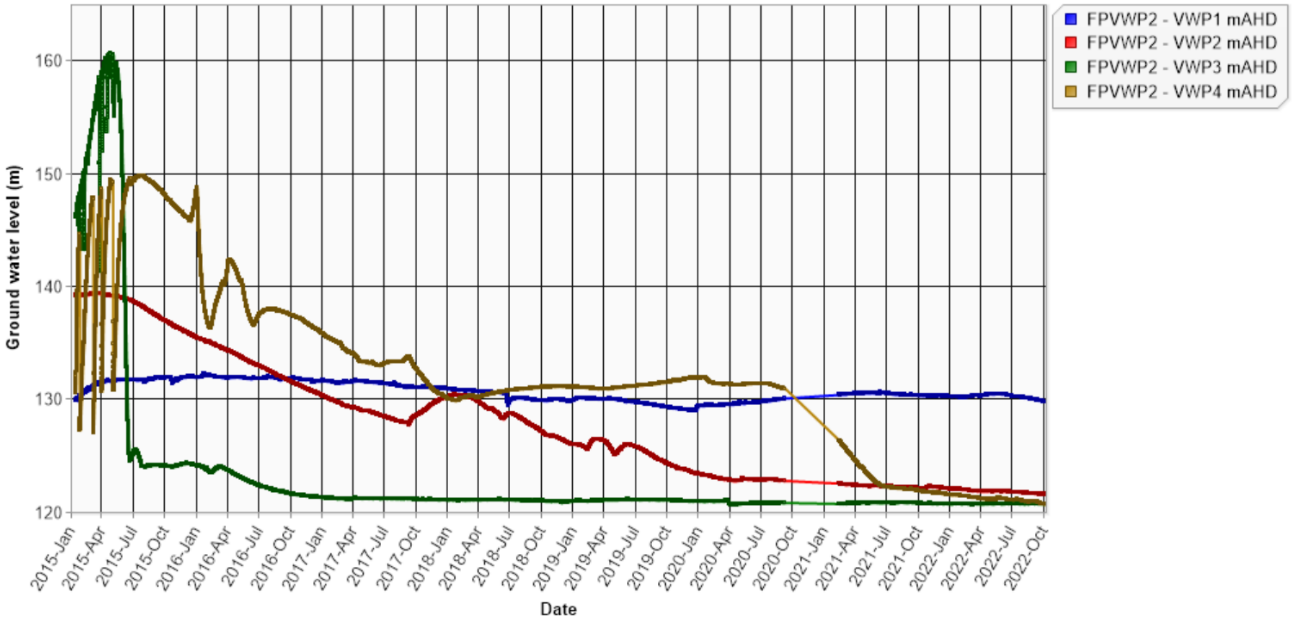
Figure 6: GMP4 standing water level

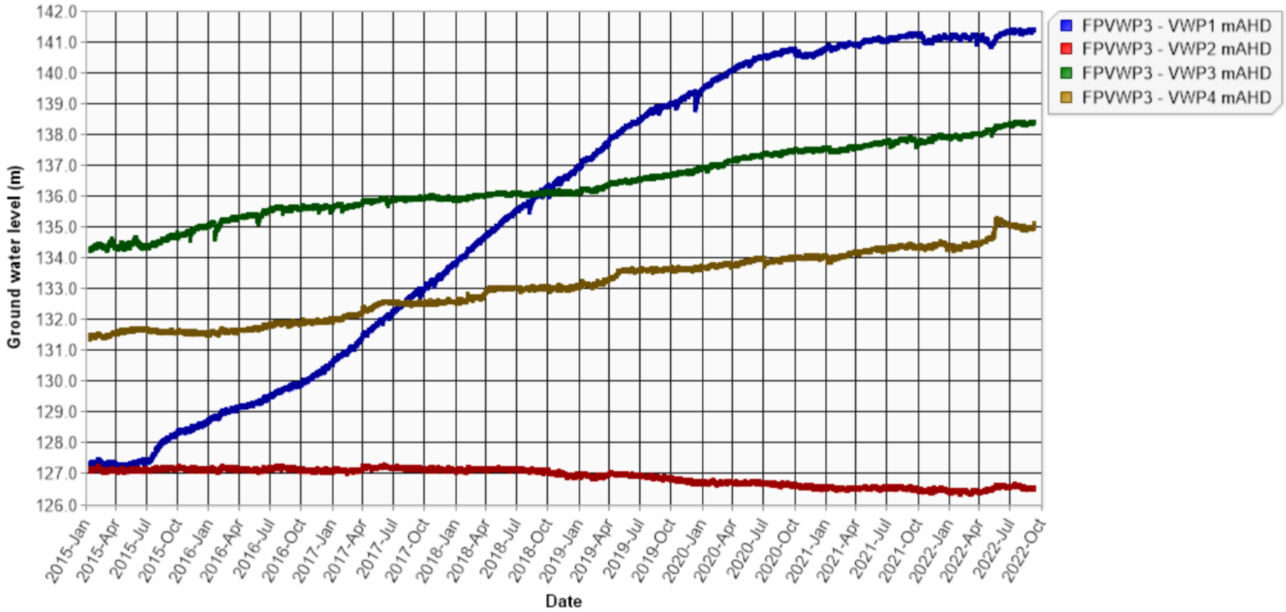


Independent reviews indicated while readings were spurious there was no indication to support significant changes in water level (piezometric head in strata at various depths) due to the influence of mining activities.

Figure 7: VWP trend data 2015-21







Note: Ground water level (m) axis is mAHD

3.4 Additional CY21 bore trends

In mid CY2021 an additional 13 groundwater bores were installed, mostly to the south of the project area (Figure 8).

Details on these bores are:

- Table 4 contains the construction detail for the boreholes
- All the bores are fitted with data loggers and manually downloaded periodically
- The bores target different Hydrostratigraphic Units (HSU):
    - HSU1 - Alluvium (Quaternary): P3, P12
    - HSU2 - Rewan Formation: P6, P8
    - HSU3 - Permian overburden, interburden and Burngrove Formation: P1, P2, P9, P10, P11S
    - HSU4 - Permian Rangal Coal Measures coal seams: (P4, P5, P7, P11D)
- EC measurements are shown in Table 5 and with the exception of shallow bore P9, confirm high EC levels for groundwater beneath the site

Figure 8: CY21 bore locations

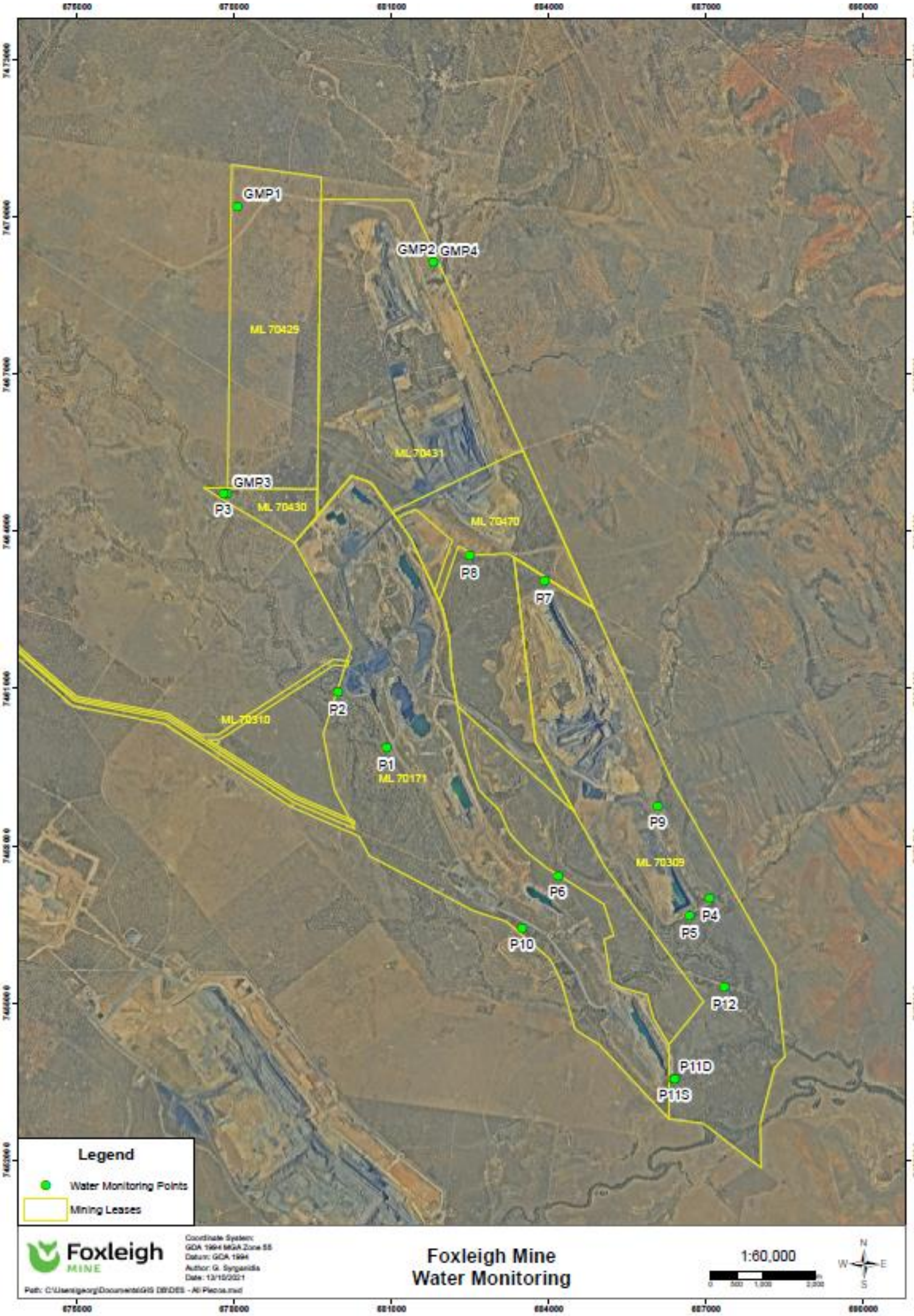


Table 4 CY21 bore construction detail

Location					Construction			Filling				
HoleID	Easting	Northing	Elevation	TD	Sump	Slotted PVC	PVC	Backfill	Bentonite	Gravel	Bentonite	Grout
P1	680903	7459872	133.57	29m	24.3m - 24.9m	18.3m - 24.3m	0m - 24.3m	26.5m - 29.0m	25.5m - 26.5m	12.9m - 25.5m	11.0m - 12.9m	0m - 11.0m
P2	679971	7460933	134.42	25.5m	24.0m - 25.0m	18.0m - 24.0m	0m - 18.0m	-	25.0m - 25.5m	16.0m - 25.0m	15.0m - 16.0m	0m - 15.0m
P3	677791	7464725	143.20	21m	17.0m - 17.5m	11.0m - 17.0m	0m - 11.0m	17.8m - 21.0m	17.5m - 17.8m	10.0m - 17.5m	8.0m - 10.0m	0m - 8.0m
P4	687058	7456993	124.48	58.8m	57.8m - 58.8m	51.8m - 57.8m	0m - 51.8m	-	58.0m - 58.8m	45.0m - 58.0m	43.0m - 45.0m	0m - 43.0m
P5	686679	7456664	123.53	109.3m	108.0m - 109.0m	102.0m - 108.0m	0m - 102.0m	-	109.0m - 109.3m	100.0m - 109.0m	98.0m - 100.0m	0m - 98.0m
P6	684167	7457430	128.98	22.6m	21.3m - 22.3m	15.3m - 21.3m	0m - 15.3m	-	22.3m - 22.6m	14.3m - 22.3m	13.0m - 14.3m	0m - 13.0m
P7	683905	7463055	129.29	57.0m	39.0m - 40.0m	33.0m - 39.0m	0m - 33.0m	41.0m - 57.0m	40.0m - 41.0m	32.0m - 40.0m	30.0m - 32.0m	0m - 30.0m
P8	682487	7463532	130.88	33.0m	28.0m - 29.0m	22.0m - 28.0m	0m - 22.0m	30.0m - 33.0m	29.0m - 30.0m	18.0m - 29.0m	16.0m - 18.0m	0m - 16.0m
P9	686071	7458764	127.04	11.0m	8.4m - 9.4m	5.4m - 8.4m	0m - 5.4m	10.0m - 11.0m	9.4m - 10.0m	4.6m - 9.4m	3.6m - 4.6m	0m - 3.6m
P10	683484	7456427	127.15	26.0m	22.0m - 23.0m	16.0m - 22.0m	0m - 16.0m	24.0m - 26.0m	23.0m - 24.0m	10.0m - 23.0m	8.0m - 10.0m	0m - 8.0m
P11D	686366	7453547	123.17	93.4m	91.0m - 92.4m	85.0m - 91.0m	0m - 85.0m	-	92.4m - 93.4m	83.4m - 92.4m	81.4m - 83.4m	0m - 81.4m
P11S	686392	7453555	122.88	27.2m	25.0m - 26.2m	19.0m - 25.0m	0m - 19.0m	-	26.2m - 27.2m	18.0m - 26.2m	16.0m - 18.0m	0m - 16.0m
P12	687347	7455303	122.52	12.0m	-	8.3m - 11.3m	0m - 8.3m	-	11.3m - 12.0m	6.8m - 11.3m	5.8m - 6.8m	0m - 5.8m

Slotted PVC	50mm CL18 1mm Apperture Slotted PVC Screen with 2 x centralisers
PVC	50mm CL18 PVC
Sump	50mm CL18 PVC Sump
Gravel Pack	3mm Gravel

Table 5 CY21 bore EC measurements (µS/cm)

Bore	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	Jun-22	Jul-22	Median
P1	25,633				23,808	23,971	24,219	14,131	13,667	23,889
P2	47,369	46,474	46,047	42,589	45,859	47,904	47,020	45,505	46,295	46,295
P3										
P4	32,041	32,736	33,227	30,609	32,701	33,451	32,688	13,607	26,646	32,688
P5	38,870	38,689		36,220	39,609	39,658	39,095	38,670	38,791	38,831
P6	38,575	37,886	38,642	37,355	38,016	37,735	37,134	39,871	34,135	37,886
P7										
P8	32,994	33,648	33,019	30,501	32,725	33,685	32,412	31,559	33,226	32,994
P9	3,139	3,761	4,826	7,376	8,418	8,188	8,608	8,730	9,353	8,188
P10	55,289	55,079	53,343	51,583	56,396	56,872	55,478	54,772	55,882	55,289
P11D	41,616	38,822	38,844	35,755	39,587	39,401	38,204	37,300	38,375	38,822
P11S	43,059	43,217	43,474	39,746	43,225	43,505	42,986	41,358	42,350	43,059
P12				42,921	44,936	46,353	46,696		45,433	45,433

- Groundwater monitoring data over the 12 months has been converted to elevation to assist in comparison and presented in a composite hydrograph at Figure 9.
- The hydrographs indicate
  - groundwater is typically absent in the **alluvium** (P3, P12) and present only following significant recharge events
  - P4 is some 200m East and depth at 65mbgl with response zone at 66mAHD and reports a groundwater level of approximately 114mAHD (11mbgl). It is understood that this bore lies east of the Yarrabee Fault and hence isolated from the mining area and P5.
  - P5 close to the pit yields a water level of 39-40mbgl or 86-85mAHD. Floor of pit (assessed using available LiDAR) is approximately 34.1mAHD and standing water level in pit is 61mAHD (provided by survey 2022). Hence level in P5 does not reflect a dewatered coal seam connected to the floor of the pit. The response zone of P5 is at approximately 16mAHD, significantly below the floor of the pit and it seems likely that the piezometer is reporting the confined piezometric surface of coal measures at this depth - distinct from influences by mining of the pit or water stored in the pit.
  - P4 and P5 show negligible variation despite being adjacent to active or former open cut pits implying that groundwater within the Middlemount seam at these locations has been

reduced to close to the floor of the respective pits which may now be controlling groundwater levels locally in the seam.

- P5 indicates no level fluctuations except those caused by periodic groundwater extraction for water quality sample collection, which appears to have resulted in the otherwise flat trend falling slightly over the 12 months
- there is no apparent response to, nor correlation with, rainfall events or notable surface water flow events in the **Rewan** (P6, P8). The sampling-effected declines and irresponsiveness to recharge events imply the Rewan is hydraulically isolated from and/or irresponsive to surface recharge events by the nature of its composition and hence can be considered an effective aquitard.
- Bore P7 lies at the northern end of pipeline pit. P7 collar is approximately 130mAHD and response zone is at 73mAHD; groundwater level is at 90mAHD. Floor of pit is approximately 27mAHD and in Dec 21 pit standing water level was 59.5mAHD. Pipeline pit is being dewatered during 2022 and current level is approximately 42.6mAHD. If P7 was hydraulically connected to pipeline pit (through the conduit of the Middlemount seam, for example), we would expect for the groundwater level in P7 to be dropping, consistent with the drop in pit water level, or even before the dewatering commenced, consistent with the former standing water level observed in 2021. However, P7 groundwater level has remained resolutely stable, approximately 15m above the base of the borehole. This strongly suggests that bore P7 is isolated from Pipeline pit, probably by a fault.
- P11D appears to reflect the influence of significant rainfall experienced at the site during November 2021 and May 2022 climbing (1.5m) and then returning to pre-rain event levels.
- P9, P10 in Burngrove Formation show very muted responses to rainfall events (0.1-0.2m)
- Few of the bores show any response to rainfall events. P11S, the RCM interburden shallow monitoring bore shows a very slow (lagged) response confirming a poor connection of the strata with rainfall activity.

Figure 9: CY21 bore water level trends

Conclusion:

- Additional bore quality measurements support regional high EC of groundwater.
- Groundwater levels, while showing some recharge after large rainfall events show relative stability and isolation from surface water.

4 An Updated Hydrogeological Conceptual Model (HCM)

Since the Fox EIS and GMMP-16 development there has been several changes that mean extra data and technology can be used to update the model that is providing predictions. Additionally,

- while the original premise on mining layout remains valid, exploration and re-evaluation has extended the mine life.
- the requirement under the State legislation for a Progressive Rehabilitation and Closure Plan (PRCP), has resulted in additional bores and modelling (section 3.4 this document), which can be used to inform GMMP-23.

4.1 GMMP-16 numerical model

JBT (2013) developed a numerical groundwater model to support the Fox EIS. To predict the extent of groundwater level impact from mining, modelling was undertaken using the program SEEP/W. Two models were prepared as 2-dimensional cross-sectional seepage models. These included:

- Model 1 – a model oriented approximately north-south; and
- Model 2 – a model oriented approximately west-east.

The cross-sectional models were based on the site geological model and geological mapping data and incorporate observed structural features (faulting) at the mine and regional scale. The numerical groundwater models were developed to assess the extent of groundwater level impact in response to the proposed mining. The groundwater modelling predicted:

- an extent of impact (for the 5m drawdown contour) of approximately 4 km from the edge of pit in the north direction and 3.8 km in the east-west direction after 25 years; and
- an extent of impact (for the 2m drawdown contour) of approximately 4.4 km from edge of pit in the north direction and 4.1 km in the east-west direction after 25 years.

4.1.1 Original Mine Plan: GMMP-16

Modelling was based on the mine comprising 3 individual open pits with a strike length up to 5km long.

- the Fox Plains (FP) project boundary area will be approximately 3,363 ha and is predicted to extend the life of Fox by approximately 15 years (circa 2028);
- the mine pits will be developed over 10 years and will be the sole active mining area within Foxleigh expanded operations;
- the mine pits will advance towards the NW;
- the final pit depths will average about 150 m below ground level; and
- the out-of-pit dump areas will be located immediately to the S, E and W of the open-pits.

It should be noted that the major changes between the Original Mine Plan modelled and what has occurred over the last nine years are:

- Commencement of Fox Plains North (FPN) in May 2018 at the northern most extent of mining, progressing to the south; and
- the extension of the mine life beyond 2028.

The opening of FPN meant a pit void and potential focus for drawdown was introduced earlier in the mine life and forming potential sink in the northern area of the mine. During this operational period there has been no significant influxes of water and in fact between Apr-20 and Oct-20 no operations occurred in FPN with around 9 days of pumping with a 100l/s pump required to clear both ground and rain-water collected from that time period, once mining was recommenced.

4.2 GMMP-23 conceptual and numerical model

To develop a new HCM a review was undertaken of:

- Existing GMMP-16 numerical model
- Data from 12 months of new monitoring bore network
- VWP and sampling data (albeit some questionable and spurious data is not reliable); and
- REMP data

As per section 3.3, significant uncertainty has surrounded the data obtained from various of the piezometers in each of these strings and hence they have not been relied on to assess either regional or local groundwater levels or vertical fluxes between strata.

4.2.1 Updated hydrogeological conceptualisation

Visual representation and a summary of HCM processes has been included in Appendix D.

4.2.1.1 Hydrostratigraphic classification

The various geological strata can be classified based on their hydrogeological characteristics into four hydrostratigraphic units (HSUs) (Table 6).

Table 6 Hydrostratigraphic units

HSU	Stratigraphy
1	Alluvium/colluvium & Duaringa Formation
2	Rewan Formation
3	Permian overburden, interburden and Burngrove & Fair Hill Formations
4	Permian coal seams (Roper, Middlemount, Tralee & Pisces 1 & 2)

4.2.1.2 Surface water – groundwater interaction

Monitoring for the site's annual REMP has confirmed that the median surface water quality during the previous four years is approximately 219 µS/cm (Table 2). Monitoring of water quality in the alluvium in P12 has confirmed salinity exceeding 40,000 µS/cm. P3, also in the alluvium, has typically been dry.

Periodic monitoring of groundwater quality in GMP4 since 2014 (Figure 3) has indicated that Permian groundwater is highly saline, typically exceeding 50,000 µS/cm. Monitoring has also been conducted recently across the new standpipe groundwater monitoring network. The Rewan Formation (P6, P8) has indicated salinities between 30,000 – 40,000 µS/cm, whilst the Rangal Group and Burngrove Formation exhibited variable salinities between 30,000 – 54,000 µS/cm.

The 2011 Cockatoo Creek groundwater study reported in JBT (2013) comprising eight shallow bores in the Rangal Coal Measures as two transects from the Cockatoo Creek, indicated a hydraulic gradient falling away from the creek. More recent groundwater level monitoring in P12 (alluvium) and P5 and P11D (Rangal Coal Measures) to the north and south respectively of P12 has indicated that groundwater in the coal measures is typically 25-30 m below that in the alluvium.

Leakage of water temporarily present in the creek network to the underlying alluvium is inevitable but, due to the variably clayey character of the alluvium, is likely to be partial and, due to the ephemerality of surface flows in the creeks, only occasional. Consequently, the magnitude of recharge to the alluvium from creek leakage is not likely to be great and hence dilution of alluvial groundwater by creek water is expected to be minimal. It is expected that direct rainfall recharge is the predominant source of recharge to the alluvium. However, this is likely to result in significant evapotranspiration and concentration of salts. Coupled with the potential exchange of groundwater with the underlying Permian strata (subject to subcrop topography), this is likely to result in significant concentrations of salts within alluvial groundwater. Saline Permian groundwater does not contribute to baseflow in the creek network due to the contrary groundwater gradient.

4.2.1.3 Foxleigh Syncline

Permian and Triassic strata within the site have been subjected to tectonic folding resulting in the formation of the Foxleigh Syncline. The axis of the syncline runs approximately north-south, plunging northwards at a shallow angle. Strata comprising the limbs of the syncline may outcrop to the west and east, converging at depth at the synclinal axis, with Rangal Coal Measures coal seams subcropping or outcropping closer to the synclinal axis than the underlying Burngrove Formation strata and with younger Rewan strata present in core of the northerly extension of the syncline. Opencut mining occurs on the synclinal limbs where the coal seams are relatively shallow and whilst groundwater flow is likely to occur from outcrop towards the open pits along strata bedding, flow is likely to be very limited from distal parts of the syncline. This is because strata outcropping at the edges of the syncline are stratigraphically older strata than the overlying synclinal core strata and the very low vertical hydraulic conductivity of the Permian strata prevents significant vertical groundwater exchange with overlying beds. In the same way, this structural limitation to groundwater flow also inhibits the progression of drawdown from the opencut pits to the outer limbs of the syncline.

4.2.1.4 Groundwater flow directions

Historically, groundwater flow directions have been understood to flow from west to east regionally and locally have been conjectured to flow from the peripheries of the Foxleigh syncline towards its axis, although the direction of axial groundwater flow has not been considered.

Whilst there are four standpipes monitoring groundwater in the Burngrove Formation and five in the Rangal Coal Measures (four in the Middlemount seam and one in overlying interburden), the geological compartmentalisation of the site wrought by extensive faulting and the synclinal structure of the Permo-Triassic strata, together with the presence of current and historical pits, has made the determination of groundwater flow directions in the various formations difficult to assess with a high degree of confidence.

Monitoring indicates that groundwater is not consistently present in the Quaternary Alluvium or Tertiary Duaringa Formation and thus when groundwater is present following significant recharge events, the groundwater flow direction is likely to follow the pathway of the surface drainage network. A hydraulic gradient also persists from the alluvium into the underlying Permian strata.

The Rewan occupies the centre of Foxleigh syncline and hence lateral flow perpendicular to the axis of the syncline is not expected to be significant. Hence the flow direction is interpreted as south-southeastward based on groundwater levels during 2020-2021 of approximately 120.25 mAHD in the northerly P8 and 116.1 mAHD in the more southerly P6.

Monitoring in the Burngrove Formation along the western side of the mine is considered likely to reflect a prevailing groundwater flow direction because the sites are close to subcrop and occupy a geological position stratigraphically underlying the lowest seams targeted in the adjacent pits. Hence a south-easterly groundwater flow direction is inferred along the western side of the mine in these strata, from P2 (132.5 mAHD) through P1 (122 mAHD) west of NT pit, to P10 (117 mAHD) west of WC pit. Because of potential historical mining influences and the arrangement of monitoring bores, it is not possible to determine with confidence the groundwater flow in the same strata on the east side of the mine, although the north-south structural alignment of the Foxleigh syncline is likely to encourage a southerly flow direction.

4.2.1.5 Role of faulting

Several major fault structures occur in the area running parallel or sub-parallel to the axis of the Foxleigh syncline, including the Grasstree Fault Zone (in the German Creek Mine area), the Jellinbah Fault to the west of the study area, and the Yarrabee Fault, which disrupts the stratigraphic sequence within the study area. These faults significantly disrupt the stratigraphic sequence and therefore have the potential to significantly impact groundwater occurrence and movement, limiting the flow of groundwater perpendicular to the fault and inhibiting the transmission of drawdown.

Numerous small faults have been mapped in the exposed Permian strata within the various pits. Typically, these faults are orientated normal to the axis of the syncline and exhibit throws of a few metres or tens of metres at most. Seepages commonly occur on pit faces where these faults intersect coal seams, implying that minor flows, in seams close to but beyond the pit wall, are interrupted by the fault plane and directed toward the open pit.

4.2.2 Revised numerical groundwater flow model

As part of the PRCP process for the State EA, FoxMan commissioned the development of a Groundwater Model which is documented in Report on Groundwater Modelling (Dec-22).

4.2.2.1 Model objectives

The model is designed with two principal objectives:

(1) To predict groundwater levels and fluxes beneath former opencut pits to assist in Progressive Rehabilitation and Closure Planning; and,
(2) To predict changes in groundwater levels and fluxes over time as a consequence of opencut mining at Foxleigh.

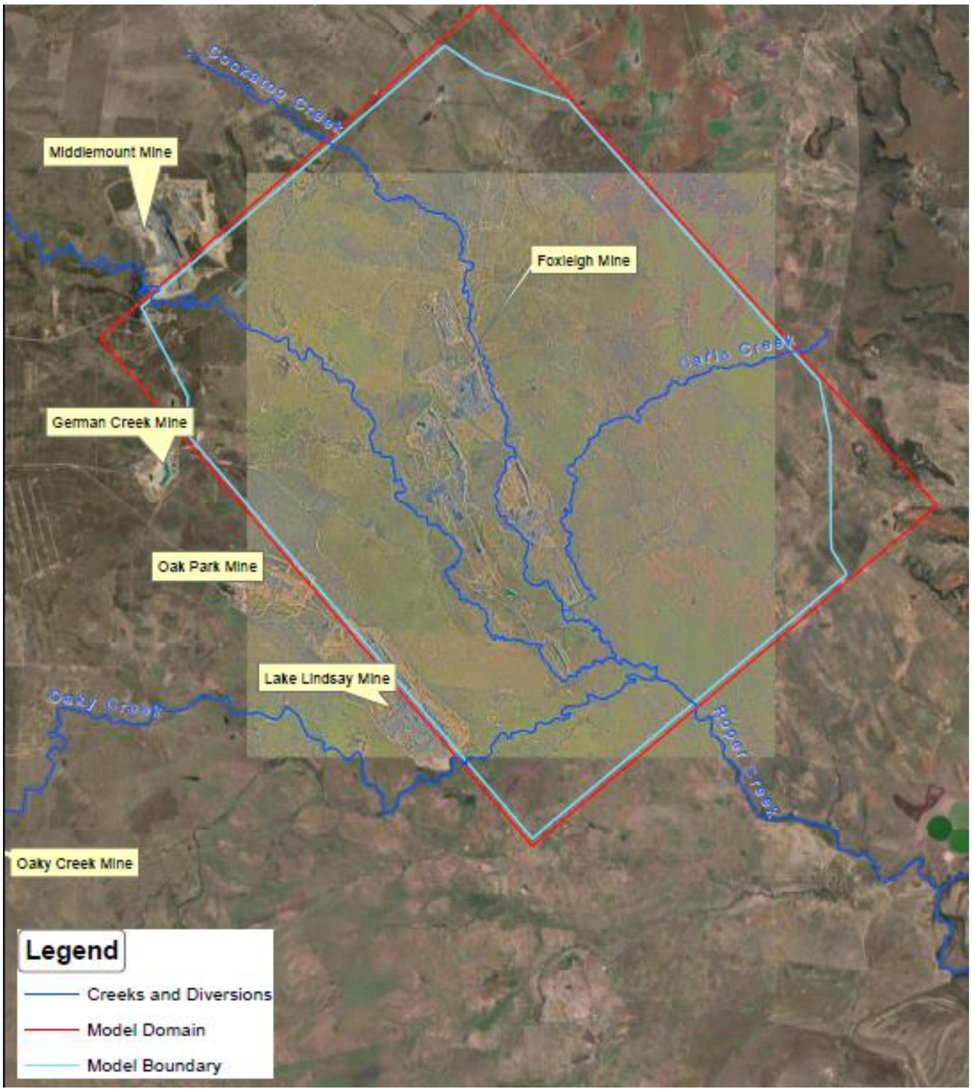
4.2.2.2 Modelling code selection

The model has been constructed using MODFLOW-USG within the graphic user interface Groundwater Vistas® version 8 by Environmental Simulations Inc™. Modflow-USG was selected as the modelling code due to the flexibility of the code to efficiently accommodate multiple and irregular features within the model domain. Modflow-USG is widely accepted by industry and regulators for the prediction of groundwater flow.

4.2.2.3 Domain extent and boundaries

The model domain comprises a rectangular area extending 20 km wide and 29 km long, rotated 42 degrees west of north, centred on Foxleigh mine as illustrated in Figure 106. The model boundaries are defined by the extent of the Fairhill Formation to the northeast, the Lake Lindsay mine to the southwest, the Middlemount mine to the northwest and closure of the Foxleigh syncline to the southeast near the confluence of Cockatoo and Roper creeks.

Figure 106: Numerical model extent



4.2.2.4 Layering, parameters and structural considerations

The model comprises 15 layers (Figure 71). The numerical model uses a quad-tree refinement approach to development of an unstructured grid to generate an irregular mesh with 14,337 cells per layer. The cell size varies from 50 m x 50 m, within the vicinity of the mine operation area, waste rock dumps and backfill and major watercourses, to a maximum of 400 m x 400 m at the regional extents of the model domain.

Modflow-USG permits pinching out of model layers and this can be an efficient approach to simulating some structural problems. In this case, model layers have not been pinched out when the stratum that they represent has pinched out at outcrop or against a fault, but instead has been preserved at minimal thickness with the properties of the next appropriate extant layer.

The model domain includes a number of major faults which significantly disrupt bedding and geological structure, together with numerous smaller faults with lesser throws. Major faults have been represented in the model as zones of low hydraulic conductivity cross-cutting layers 4-15. Minor faults have not been represented explicitly in the model.

Figure 7: Model layering

Layer	Zone	Formation	Unit
1	1\2	Alluvium	Alluvium/Tertiary regolith
2	2	Duaringa	Weathered (Triassic and Permian)
3	3		Rewan Formation
4	4	Rangal Coal Measures (Pbj)	Roper interbed
5	5		Roper Coal Seam
6	6		Middlemount interbed
7	7		Middlemount Coal Seam
8	8		Tealee interbed
9	9		Tealee Coal Seam
10	10		Pisces Interbed
11	11		Pisces Coal Seam 1
12	12		Pisces Interbed/ Yarrabee Tuff
13	13	Burngrove	Pisces Coal Seam 2
14	14		Burngrove Fm1
15	15		Burngrove Fm2
	16		Fairhill Formation
	17		Blackwater - Blenheim Fm

4.2.3 Numerical model and interface with GMMP-23

The purpose of the numerical model is to predict the extent and nature of impact on the groundwater environment because of mining. Comparison of predicted and measured water level data at selected locations within the model domain provides a mechanism to validate the predictions of the model in other parts of the domain. Should measured data deviate significantly from predicted outcomes in parts of the model domain, this may indicate that the model requires revision to accommodate unforeseen local conditions or recalibration to adequately simulate groundwater responses to mining-induced stresses.

Hence, the numerical model will be used to predict the occurrence and magnitude of impacts arising from future mining activities. The GMMP-16 numerical model, developed in Seep/W in 2013 as two 2-dimensional models, although capable of predicting transient outcomes, as documented in JBT (2013), only presented the spatial extents of drawdown maxima. The GMMP-23 model will present predicted drawdown maximum all time horizontal extents in addition to hydrographs of groundwater head and drawdown at specific locations. Comparison of measured and predicted water levels at these sites will validate model predictions of impact.

4.2.4 Assumptions-uncertainties in numerical model

Whilst quantitative uncertainty analysis has not been conducted during the current stage of numerical modelling, it may be appropriate following the acquisition of additional data with which to describe more fully the probable range of model parameter values. However, it is possible to assess qualitatively the uncertainty arising in model predictions from variations of parameter values or the incomplete knowledge of a parameter range of variation.

In designing and constructing numerical models to represent the form of geological structure and behaviour of groundwater flow through it, simplifications are made both due to lack of data and due to the need to limit model complexity for computational demand. Hence it is recognised that structural geological uncertainty arising from the lack of geological data or precision of measurement and the need to extrapolate between sample points, will lead to uncertainty in groundwater flow behaviour in areas of reduced geological confidence.

Calibration data obtained from monitoring of piezometric heads in discrete bores will be subject to uncertainty regarding the distribution of piezometric head predicted by a distributed model where the spatial cell dimensions significantly exceed the dimensions of the asset and there is an imperfect match between the geometry of the asset in its environment and the geometry of the model cell representing the asset. Effort has been made to reduce this uncertainty by ensuring that the grid mesh is suitably refined at the locations of transient calibration points, although it is noted that regional steady-state calibration points may remain in areas of unrefined grid mesh.

The transient calibration model is currently calibrated over approximately one year using site-based data. Currently the predictive operational model is runs for 32 years. Australian Groundwater Modelling Guidelines recommend where possible limiting predictive time frames to five times the period of calibration (section 6.2). However, this is currently not possible due to the relatively short period over which the mining operation has been present and that environmental (groundwater) monitoring has been conducted. As more data becomes available in successive years, the calibration period may be extended and predictive modelling for the life of mine will become more certain.

4.2.5 HCM and numerical model predictions and impacts

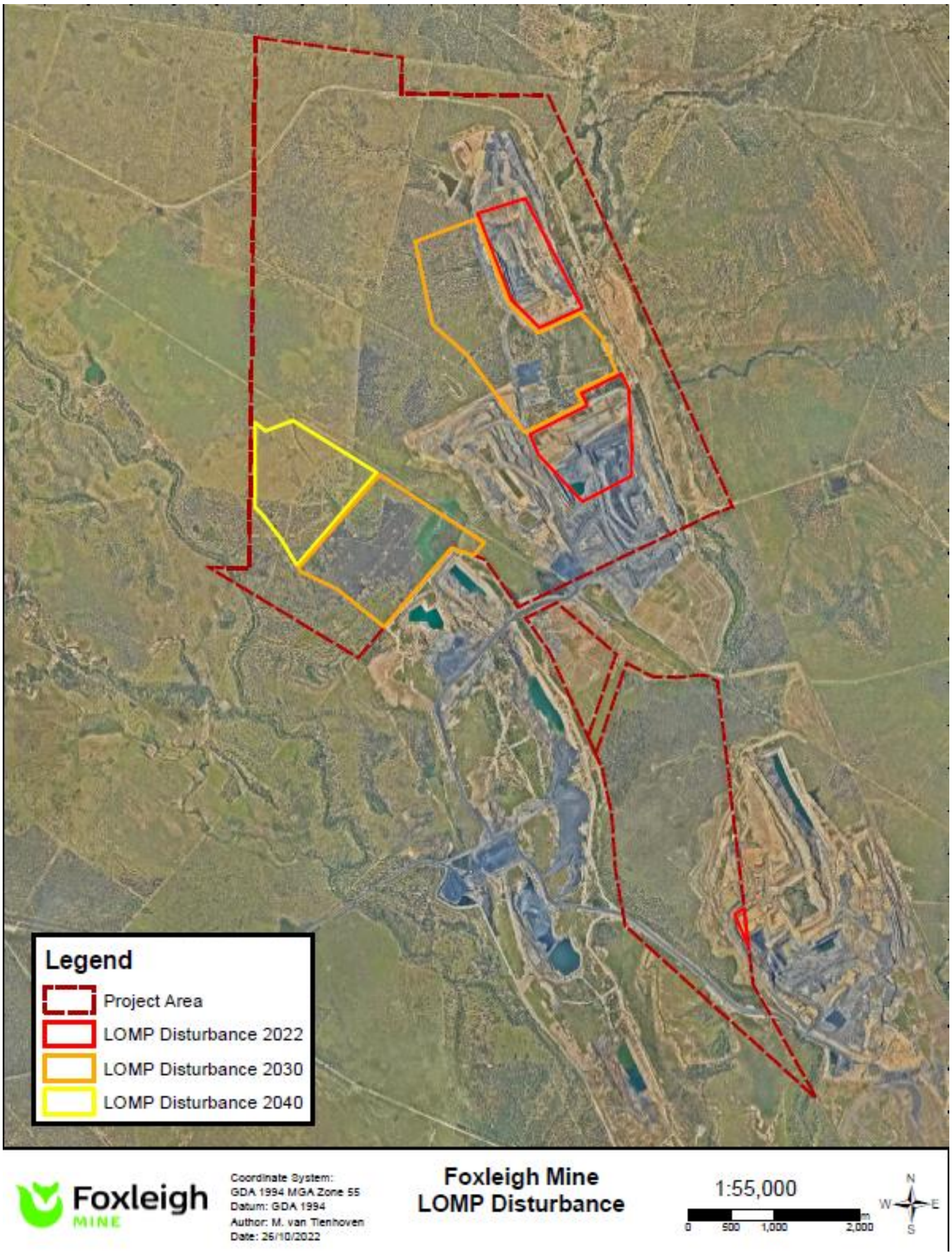
HCM is a descriptive document setting out our current understanding of the physical and hydrogeological environment. From it we can infer what impacts to expect but it is NOT a predictive tool. (Hence, we state that impacts are not expected in the alluvium because Permian GW levels are typically below the floor of the alluvium and ditto for the SW quality). The numerical model is a tool to quantitatively estimate potential impacts.

4.2.6 Current Life of Mine Plan for the Project Area

The Life of Mine Plan (LOMP) still comprises 3 individual open pits with a strike length up to 5km long.

- the FP project boundary has not changed but with exploration is now predicted to extend the life of Fox to 2055 (27 years more than originally planned);
- the mine pits will generally advance towards the north-west, albeit in May 2018 a decision was made to start FPN (northern extent of FP) and work south-east to join up with FP
- the final pit depths will average about 185 m below ground level; and
- a terrace mining approach will be continued to be used whereby waste material is tipped back in pit after coal extraction so the void moves in the direction of mining; out-of-pit dumps will be located immediately outside of the advancing footprint.
- Figure 12 show snapshots of the Project Area void footprint over the next 3 decades.

Figure 12 CY22 CY30 CY40 Project Area footprint



5 Groundwater Monitoring Program

5.1 Monitoring locations

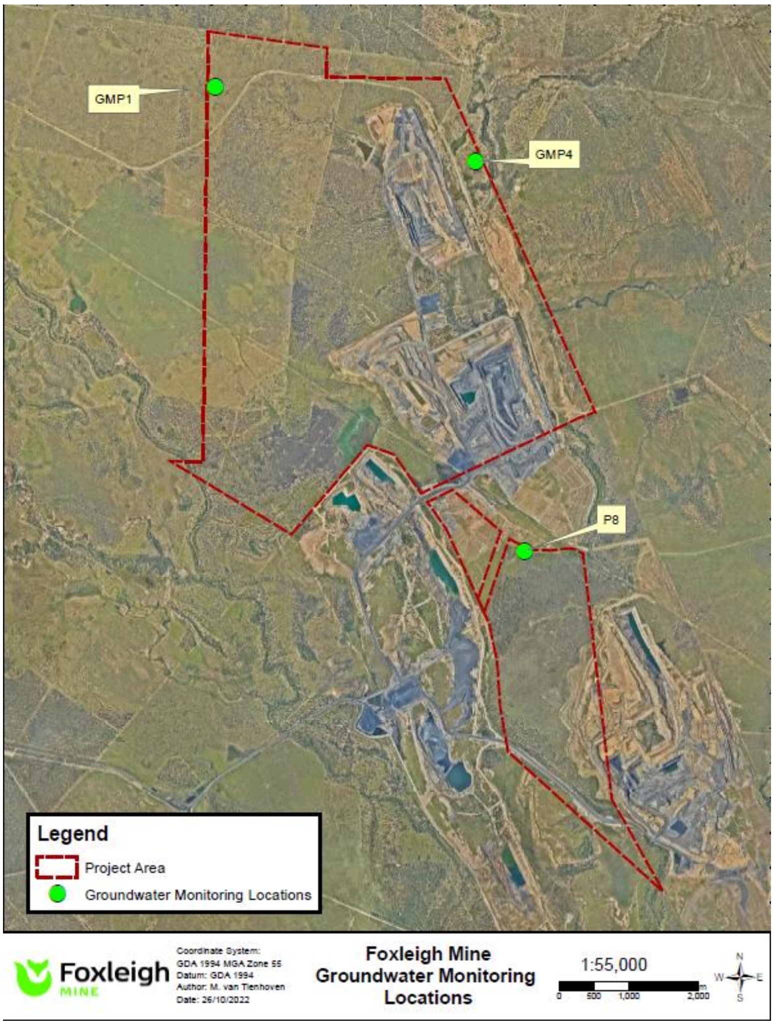
As indicated in section 2.3.8 there are no current EVs applicable or impacted that require monitoring or measurement.

However, it is felt prudent that some monitoring occurs to ensure that there are no significant changes over time.

A review of the existing usable infrastructure and additional bores that monitor the Project Area considered which bores could provide useful information for the extension of the FP void to FPN and the introduction of the EN pit, recommend the following be used for EPBC compliance monitoring (Figure 13).

- Water quality
  - GMP4 (existing)
  - P8 (Rewan HSU – CY21 addition)
- Water levels:
  - GMP1 sensors 2, 3 and 4 only (existing)
  - P8 (Rewan HSU – CY21 addition)
  - GMP4 (existing) - manual

Figure 13 GMMP-23 Bore locations and nomenclature



5.2 Parameter Selection

5.2.1 Water levels

The groundwater level monitoring objective is to assess groundwater level trends relative to changes in the mining footprint by measuring the water level within the monitoring bore, by a system of automated logging (VWP and data logger) or manual measurement. Requirements for monitoring of water levels are stipulated in EA Condition E3 and E4.

Depressurisation within the Permian coal measures is predicted as part of normal mining activities. The rate of change associated in groundwater level is the critical consideration, so the monitoring data will be assessed in consideration of this conceptual understanding.

5.2.2 Water quality

The potential to impact groundwater quality is limited as any potential groundwater flow induced because of depressurisation will be towards the mining operation. Also, the groundwater quality in the area is poor, due to high salinity levels, and indicates very low risk of detrimental impact to water quality because of any potential mining induced groundwater flow.

The groundwater quality monitoring objective is to use the Water Quality Indicators (WQIs) of EC and pH to determine change (if any) in groundwater quality. Requirements for monitoring of water quality are stipulated in EA Conditions E3 to E8 (Appendix C) and EA Table 3 (which lists prescribed parameters). These water quality parameters are presented below in Table 7. Should EC or pH measurements trigger an investigation, then the whole suite of WQIs will be measured as part of this process.

All determinations of groundwater quality and biological monitoring must be performed by an appropriately qualified person. Section 564 of the Queensland Environmental Protection Act 1994 under suitably qualified persons defines as *has qualifications and experience relevant to performing the function.*

5.3 Frequency of data collection and review

The data loggers used for water level monitoring collect data on a continuous basis. Quality sampling is a manual basis using Water Sonde Troll 500 or equivalent. Considering safe access, sampling or download of automatic data will be undertaken on a quarterly basis.

5.4 Groundwater data collection methodology

Compliance monitoring bores in GMMP-23 have the following equipment:

- GMP1 – VWPs 2, 3, 4
- P8 – data logger
- GMP4 – requires manual measurement

VWPs detect the piezometric pressure acting on the sensor which is grouted into place at a specified depth within a borehole. Pressure transducers are also installed in open standpipes, in which case, the transducer detects the hydrostatic head of water representing the water level in the borehole. Both devices can be equipped with a datalogger, programmed to record the pressure (and temperature) at specific intervals or at specific times.

In the case of the VWP, the datalogger records the frequency response which can be converted to a pressure using a calibration specific to the sensor and the temperature recorded at the same time. The pressure can then be converted to a head of water. The VWP datalogger is connected by telemetry to an online portal from where the data may be downloaded and inspected periodically.

In the case of the standpipe water level transducer, the pressure is converted into a head of water, corrected for barometric pressure by reference to a barometric pressure transducer installed in the same locality. The water level datalogger stores successive records and is periodically downloaded manually to a laptop computer before uploading to the FoxMan network for inspection, analysis and storage.

Installation / downloading of data / servicing / maintenance / calibration of data loggers should always be in accordance with the manufacturer’s instructions and software requirements.

Groundwater quality samples will be collected using manual methods. Data will be collated from field measurements and laboratory measurements of water quality parameters where triggered. Sampling will be as per *ENV-PRO-0002 Water Sampling Procedure*

5.5 Groundwater quality and level threshold levels

The EA Table 3 contains the groundwater quality triggers and limits, or more specifically the WQI and a requirement for limits to be defined. Based on the baseline data set to November 2015, the approved groundwater quality trigger values in GMMP-16 Table 14 are replicated in Table 7.

Several WQIs in Table 7 were identified in GMMP-16 as *too few detections, requires re-evaluation with two years of data* (green shaded cells). A review of water sampling over the last six years has indicated that these WQIs were not detectable and detection levels have been added in the final column.

Table 7 EPBC 2010/5421 groundwater quality triggers

Water Quality Indicator (WQI)	Units	LTV	MTV	UTV**	Detection level
Electrical Conductivity (EC)	us/cm	56,528	58,055	59,583	
Total Dissolved Solids (TDS)	mg/L	45,129	47,841	50,553	
Carbonate (CO_3)##	mg/L				
Bicarbonate (HCO_3)#	mg/L	316	346	377	
Chloride (Cl)	mg/L	23,789	25,886	27,983	
Sulfate (SO_4)	mg/L	922	1,079	1,237	
Calcium (Ca)	mg/L	1,229	1,334	1,439	
Magnesium (Mg)	mg/L	1,580	1.691	1,802	
Sodium (Na)	mg/L	10,584	11,530	12,475	
Potassium (K)	mg/L	19	22	25	
Aluminium (Al)	mg/L				<0.05
Antimony (Sb)	mg/L				<0.005
Arsenic (As)	mg/L				<0.005
Iron (Fe^{2+})	mg/L				<0.05
Mercury (Hg)	mg/L				<0.0001
Molybdenum (Mo)	mg/L	0.014	0.019	0.023	
Selenium (Se)	mg/L				<0.005
Silver (Ag)	mg/L				<0.005
pH*	pH	6.5-9.0			

*Reported as mg/L of CaCO3*
*Only measure if pH>8.3*
***** pH outside this range would trigger and investigation
****** contaminant limits are defined as three consecutive values greater than the UTV *s8.2 GMMP-16*.
Trigger value categories: UTV - upper trigger value, MTV - middle trigger value, LTV - lower trigger value.
With respect to metals, analysis should be undertaken for dissolved metal concentrations

It is important to recognise that groundwater quality triggers are simply a threshold value, above which some further consideration of the data should be given. The trigger values are not a pass or fail assessment; rather they act as a warning system that initiates further investigation.

These investigations may result in a review of the environmental risk posed by the impacted groundwater quality and, on limited occasions, may result in a change of site practices and/or remediation.

Three (3) categories of trigger levels have been calculated: an upper (UTV), middle (MTV), and lower (LTV) category. These values are generally defined respectively as one, two, or three standard deviations above the mean value in the baseline data set. The purpose of the trigger value categories is to allow for natural variability within the data and have escalating response protocols.

Response protocol:

- Any exceedance greater than LTV, undertake a **sample retest of that WQI** within a month to confirm result magnitude and increase test frequency to monthly
    a. If retest sample is > LTV and <MTV:
        i. 2 consecutive results >LTV, continue monthly sampling, else return to normal frequency interval (Table 7)
        ii. 5 consecutive results >LTV, trigger an investigation
    b. If retest sample is >MTV and <UTV:
        i. 2 consecutive results >MTV, trigger an investigation, else return to a.
    c. If retest sample is >UTV, trigger an investigation

Exceedances of groundwater quality triggers and limits will be:

a. reported to DCCEEW within 10 business days of the monitored exceedance; and
b. written advice to DCCEEW, within 90 calendar days of the occurrence of the monitored exceedance, stating direct cause of, and actions taken in response to, exceedance and management responses.

In relation to groundwater level triggers, Table 8 defines the reporting requirements under the EPBC approval.

Table 8 EPBC 2010/5421 groundwater level triggers

HSU	Groundwater level triggers
1	Groundwater levels must be monitored, and groundwater draw down fluctuation in excess of **two (2) metres per year**, not resulting from the pumping of licensed bores, pumping for water sample collection, seasonal variation, or instrument error, must be notified as per conditions 15A and 15B of EPBC 2010/5421
2, 3, 4	Groundwater levels must be monitored, and groundwater draw down fluctuation in excess of **five (5) metres per year**, not resulting from the pumping of licensed bores, pumping for water sample collection, seasonal variation, or instrument error, must be notified as per conditions 15A and 15B of EPBC 2010/5421

5.6 Monitoring requirements summary

Tables 9 and 10 summarise the monitoring program.

Table 9 Water level measurements

Bore	Measurement	Frequency Download/sample/review	Triggers
GMP1	VWP 2, 3, 4	Quarterly	Table 8
GMP4	Manual	Quarterly	Table 8
P8	Datalogger	Quarterly	Table 8

Table 10 Water quality measurements

Bore	Measurement	Frequency Download/sample/review	Triggers	WQI*
GMP4	Troll 500	Quarterly	Table 7	EC; pH
P8	Troll 500	Quarterly	Table 7	EC; pH
GMP4	Laboratory	At least once annually	Table 7	Full suite
P8	Laboratory	At least once annually	Table 7	Full suite

* Investigation triggers laboratory sampling of all WQI in Table 7

5.7 Complaints

Should a groundwater related complaint be received, an investigation (as per section 5.8) will be triggered. Each new complaint will be compiled into *ENV-REG-0003 Environmental Complaints Register*.

5.8 Investigations – thresholds and complaints

FoxMan will undertake risk-based management actions in the event that groundwater quality triggers and limits are exceeded or likely to be exceeded. The groundwater impact investigation and response process will be initiated in the event that:

- groundwater level trigger thresholds (Table 8) are exceeded;
- groundwater quality trigger levels (Table 7) meet investigation response protocol (section 5.5); or
- a legitimate complaint from a landholder (groundwater related) is received.

The relevant data set will be reviewed by a suitably qualified specialist who will determine if further investigation and notification to the administering authority is necessary.

Investigations and responses will be entirely dependent on the particulars of the trigger exceedance (or complaint), but as a minimum, they should aim to:

- Identify an exceedance:
  - verify the results by re-sampling / re-measuring all parameters in Table 7 (if quality)
- Define the exceedance:
  - location of bore and date of the sample / measurement / logged data point; and
  - the exceedance result itself, comparison against trigger thresholds and values.
- Identify the cause:
  - non-mining causes may include sampling / measurement error, climatic influences, natural variation (e.g. comparison against historical datasets); and
  - mining related causes may include mine seepage / dewatering, contaminant spills, etc.
- Assess the environmental impact:
  - has the exceedance resulted in any unauthorised environmental harm and associated environmental impact?
- Identify actions required / taken to prevent environmental harm:
  - what actions (if any) are required to minimise / mitigate / manage the impacts associated with the unauthorised environmental harm?; and
  - what additional measures (if any) are required to be implemented to aid the prevention of further occurrences of the unauthorised harm and associated environmental impact?

5.9 Reporting of measurements

Under EPBC Condition 15a Fox is required to *publish each compliance report on the website within 60 business days following the relevant 12-month period*. When the compliance report is uploaded water monitoring data for the relevant 12-month period will also be uploaded. Commentary will also be provided in relation to any changes observed in the following areas

- Separation between surface and groundwater
- Groundwater impact predicted footprint and other stakeholders
- Summary VWP trend data and issues and
- Additional groundwater bore trends.

6 GMMP-23 review frequency

GMMP-23 updates the original GMMP-16 and hence a body of data and analysis already exists. To ensure that the modelling and monitoring remain appropriate, a review of this GMMP-23 should occur five years after approval, or earlier if more data or results indicate a review is necessary. The GMMP should continue to be reviewed on a five yearly basis post this review.

7 Peer review

Dr Noel Merrick undertook a third-party peer review of GMMP-23. Dr Merrick also undertook the peer review of GMMP-16 so has previous familiarity with the GMMP and local conditions. His report is at Appendix E.

8 References

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JBT Consulting Pty Ltd, (2012), *“Foxleigh Plains Project – Appendix F of the EIS Groundwater Report.”* JBT01-011-003

JBT Consulting Pty Ltd, (2013), *“Foxleigh Plains Project – Groundwater Modelling Study.”* JBT01-011-006

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Appendix A: Geological Setting (GMMP-16 excerpts)

4.1.3 Regional geology

The project site is situated on the eastern flank of the Bowen Basin, which formed as a depositional centre during the Permo-Triassic. A dominant depositional environment during the basin evolution was one of mixed fluviatile-lacustrine-paludal-deltaic conditions that led to coal-bearing formations (Anglo American, 2012). Two major coal-bearing formations in the project area are the Burngrove and Rangal coal units, both of late Permian age.

Volcanism occurred during deposition of the Burngrove Formation, leading to the presence of tuffaceous material in this unit. Igneous activity in the Cretaceous has resulted in the regional presence of dykes and plugs. Dykes are known to occur in the northern parts of the project area, and are understood, from anecdotal evidence, to locally provide significant groundwater yields if they are fractured.

Crustal shortening during the Triassic resulted in significant structural features in the form of low angle thrust faults, back thrusts, and accommodation faulting and folding. Structural complexity in the region increases from west to east, this is mirrored by increasing coal rank from west to east.

The Grasstree Fault, Jellinbah Fault, and the Yarrabee Fault are all major structural features within the project area. These faults are known to offset the local stratigraphy and are likely to affect groundwater flow, although it is unknown if the fault zones are sealing or transmissive.

4.1.4 Hydrogeological units

The FP project site is located within a faulted syncline that locally contains Permian Rangal Coal Measures and Triassic Rewan Formation units. The syncline plunges to the north resulting in corresponding strata occurring at greater depth in the northern part of the project site compared to the south. Other major geological units include the Permian Burngrove Formation, Tertiary sediments, and Quaternary alluvium. Numerous dykes and faults occur within the project site.

To the east of the project area, up-thrusting by the Yarrabee Fault has created a faulted synclinal structure that is considered to hydraulically isolate the target coal seams at Foxleigh Mine from other mines in the region.

The stratigraphic sequence at the project area is summarised in Table 4.

Table 4 Stratigraphy of project area

Age	Unit	Lithology	Hydraulic characteristics
Quaternary	Alluvium	Clay, silt, sand and gravel	Moderately transmissive, isolated and interconnected sandy lenses connected to creeks
Tertiary	Undifferentiated Sediments	Poorly consolidated sandstone and mudstone	Moderately transmissive isolated and interconnected sandy lenses connected to creeks
Triassic	Rewan Formation	Sandstone, siltstone and mudstone	Considered a regional aquitard in the Bowen Basin. Structurally, and probably hydraulically isolated at FP.
Permian	Rangal Coal Measures (mining seam)	Feldspathic sandstones, siltstones, shales and coal	Unconfined to confined, depending on depth. Interburden acts as confining layer.
	Burngrove Formation	Siltstone, claystone, sandstone and coal	N/A

4.1.4.1 Rangal Coal Measures

The Rangal Coal Measures includes four major coal seams that will be extracted during the life of the project. These are the Roper, Middlemount, Tralee, and Pisces coal seams. The coal seam interburden consists of feldspathic sandstones, siltstones, and shales. The Rangal Coal Measures dip from the west to the east between 1º and 10º. JBT (2012) state that *"the dip of the coal seams within the project site is….highly variable, depending on localised effects of folding and faulting"*.

The JBT (2012) report (a technical appendix to the EIS report) states that groundwater within the Permian coal seams is unconfined to semi-confined in outcropping or sub cropping areas, with the coal seams confined at depth. The interburden is regarded as a confining layer. Groundwater preferentially flows within the Permian strata (particularly the coal seams), where faulting (and hence fracturing) is present, and within fractured sills and dykes.

4.1.4.2 Rewan Formation

The Rewan Formation comprises sandstone, siltstone, and mudstone and is generally considered to be a regional aquitard in the Bowen Basin. Within the project area the Rewan Formation occurs within the limbs of the synclinal structure and is considered to be hydraulically isolated to the east and west from other occurrences of these sediments (JBT, 2012).

4.1.4.3 Tertiary and Quaternary units

The Tertiary sediments are understood to be locally confined to the north-west of the study area and consist of poorly consolidated sandstone and mudstones. The Quaternary alluvium is associated with deposition from Roper Creek and Cockatoo Creek.

Appendix B: GMMP-16 VWP Construction Details

Bore ID			Coordinates*		Geological unit	Elevation		Sensor / screen (mbGL)	Bore depth (m)	Year installed	Purpose
Foxleigh Register	GMMP reports	Vibrating Wire Piezometer	Easting	Northing		TOC	Ground				
GMP2	FPVWP01	VWP4			Rangal CM			50			Multi-depth groundwater pressure monitoring
		VWP3			Rangal CM			115			
		VWP2			Rangal CM			140			
		VWP1	681789	7469150	Burngrove Fm	-	136.79	207	216	2013	
GMP3	FPVWP02	VWP4			Rangal CM			56			Multi-depth groundwater pressure monitoring
		VWP3			Rangal CM			104			
		VWP2			Rangal CM			144			
		VWP1	677853	7464717	Burngrove Fm	-	142.51	202	210.8	2013	
GMP1	FPVWP03	VWP4			Rewan Fm			78			Multi-depth groundwater pressure monitoring
		VWP3			Rangal CM			125			
		VWP2			Rangal CM			150			
		VWP1	678052	7470201	Rangal CM	-	154.69	200	210	2013	
GMP4	FPMB01		6817792	7469139	Quaternary alluvium	137.14	136.57	12.1 - 15.1	15.1	2013	Water quality sampling and water table elevation monitoring

*Note: *coordinates - GDA MGA94,z55*
mbGL - metres below ground level
mAHD - metres above Australian Height Datum
TOC - top of casing

Appendix C: EPML00744813 (dated 17 Feb 2017) Conditions E1-E8

EA #	EA Condition	GMMP-23 section
E1	The holder of this EA must not release contaminants to groundwater.	2.1
E2	All determinations of groundwater quality and biological monitoring must be performed by an appropriately qualified person.	5.2.2
E3	The holder of the EA must develop and implement a groundwater monitoring (GM) program to monitor groundwater quality and levels by 31 August 2016. GM locations and frequencies as per Table 2: GM locations and frequency, quality triggers and limits as per Table 3: Groundwater quality triggers and limits and level trigger thresholds as per Table 4: Groundwater Level Monitoring must be finalised based on background GM program defined in condition E4 and be submitted to the administering authority by 31 August 2016.	GMMP-16 5.5

EA #	EA Condition	GMMP-23 section
E4	A background GM program must be developed to include the following: a) GM locations (bore(s)) that are located an appropriate distance from potential sources of impact from mining activities and are representative of the aquifers potentially affected by mining activities b) representative groundwater samples from each of the bores; c) containment parameters, background groundwater levels , quality triggers and contaminant limits must be determined; d) sampling at a frequency of not less than monthly must be undertaken to determine groundwater levels and quality; e) finalise the required information relating to groundwater under Table 3: Groundwater quality triggers and limits, Table 2: GM locations and frequencies and Table 5: Mine affected water release points, sources and receiving waters of this EA; Review of the results from the GM program must occur to determine if further assessment on the following aspects below would be warranted: a) groundwater interactions with surface waters of Cockatoo Creek; b) impacts on potential shallow alluvial stygofauna; c) impacts on potential groundwater dependent ecosystems across the site; and d) the role of the Rewan formation and groundwater storage in associated sediments. Note: If a review of the results indicate deficiencies in data recorded, or, warrants that further assessment is required, the holder of the EA must undertake a more detailed assessment and present a report to the department outlining associated risks within the time period specified by the department.	GMMP-16
E5	The groundwater level and the water quality indicators specified in Table 3: Groundwater quality triggers and limits must be monitored for at the locations in Table 2: Groundwater monitoring locations and frequency and Appendix 1, Figure 2: GM locations (bores) at the frequencies in Table 2: GM locations and frequency.	5.6
E6	Groundwater levels when measured at the monitoring locations specified in Table 2: GM locations and frequency and Appendix 1, Figure 2: GM locations (bores) must not exceed the groundwater level trigger thresholds specified in Table 4: Groundwater level monitoring.	5.8

EA #	EA Condition	GMMP-23 section
E7	If water quality indicators listed in Table 3: Groundwater quality triggers and limits are found to exceed any of the contaminant limits stated in Table 3: Groundwater quality triggers and limits, or, groundwater levels stated in Table 4: Groundwater level monitoring are found to exceed any of the level trigger thresholds, the holder of this EA must complete an investigation in accordance with the ANZECC and ARMCANZ 2000.	5.8
E8	Results of monitoring groundwater from compliance bores identified in Table 2: GM locations and frequency must not exceed any of the contaminant limits defined in Table 3: Groundwater quality triggers and limits.	5.8

Table 2: Groundwater monitoring locations and frequency

Monitoring point	Easting (GDA 94)	Northing (GDA 94)	Surface RL (m)[1]	Monitoring frequency
GMP1	678180	7465000	To be supplied to the administering authority in accordance with condition **E3.**	Levels collected from Rewan and underlying coal measure formations and analysed monthly for the initial twelve (12) months of baseline data collection and following that, quarterly.
GMP2	678370	7470200	To be supplied to the administering authority in accordance with condition **E3.**	Levels collected from Rewan and underlying coal measure formations and analysed monthly for the initial twelve (12) months of baseline data collection and following that, quarterly.
GMP3	681400	7470100	To be supplied to the administering authority in accordance with condition **E3.**	Levels collected from underlying coal measure formations and analysed monthly for the initial twelve (12) months of baseline data collection and following that, quarterly.
GMP4	681400	7470100	To be supplied to the administering authority in accordance with condition **E3.**	Samples collected from alluvium and analysed monthly for the initial twelve (12) months of baseline data collection and following that, quarterly. Standing water levels to be measured monthly.

Table 3: Groundwater quality triggers and limits

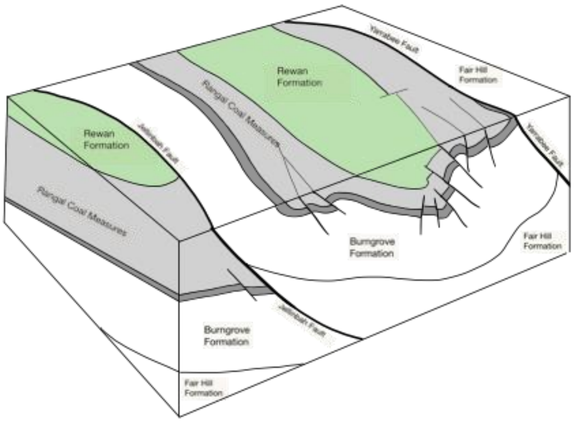
Water quality indicator	Unit	Contaminant triggers	Contaminant limit
Aluminium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Antimony	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Arsenic	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Calcium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Chlorine	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
CO_3	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Dissolved Solids (Total)	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Electrical Conductivity	µS/cm	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
HCO_3	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Iron	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Magnesium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3.
Mercury	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
Molybdenum	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
pH	pH Units	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
Potassium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
Selenium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
Silver	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
SO_4	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3
Sodium	µg/L	To be supplied to the administering authority as required by condition E3	To be supplied to the administering authority as required by condition E3

Table 4: Groundwater level monitoring

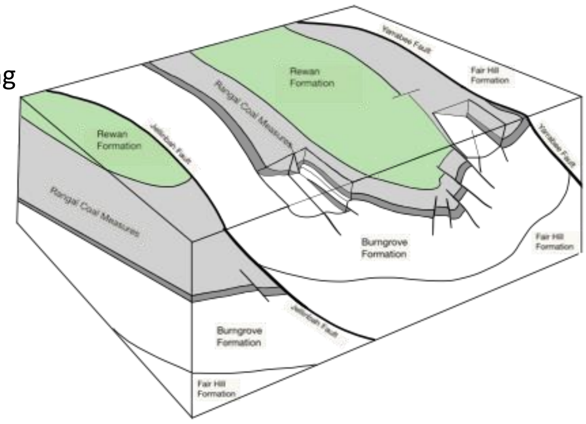
Monitoring point	Level trigger threshold
GMP1	To be supplied to the administering authority as required by condition E3
GMP2	To be supplied to the administering authority as required by condition E3
GMP3	To be supplied to the administering authority as required by condition E3
GMP4	To be supplied to the administering authority as required by condition E3

Appendix D: New HCM Block Models

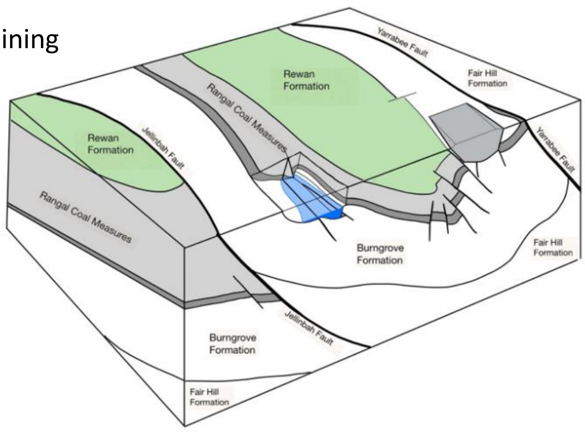
Pre-mining



Mining



Post-mining



Groundwater Recharge:

1. Recharge occurs to coal seams in subcrop areas.
2. Interburden acts as low permeability confining layers

Groundwater Occurrence and Flow Direction:

3. Coal seams are main conduits for groundwater flow.
4. The Foxleigh Mine is located in a faulted synclinal structure and is hydraulically isolated from mining areas outside the syncline (Grasstree, Lake Lyndsay).
5. Regional scale faults have throws that entirely disrupt coal seams and are barriers to groundwater flow (P4/P5).
6. Groundwater flow occurs down limbs of syncline.
7. Recent water level monitoring indicates gentle southerly groundwater flow direction beneath alluvial cover.

Groundwater Quality:

8. Groundwater quality data for the coal measures at Foxleigh is in the range 30,000 to 35,000 uS/cm suggesting long residence times.
9. Surface water quality is typically <1000 uS/cm. Alluvial groundwater quality is typically >40,000 uS/cm due to limited surface flow recharge and evaporative concentration of salts.

Surface Water – Groundwater Interaction

10. Observations relating to groundwater levels in the alluvium and underlying Permian strata, together with the extreme differential in water quality between surface waters and alluvial/Permian groundwater, suggests a very limited potential for interaction between surface water and groundwater within the Foxleigh mining areas.

Post-mining Conditions:

11. Backfilled mining areas designed to shed rainfall.
12. Residual voids form pit lakes that are perpetual groundwater sinks.

Appendix E: Peer review report

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PO Box 241, Gerringong NSW 2534. Phone: +61(0)424 183 495

noel.merrick@hydroalgorithmics.com

DATE: 28 April 2023

TO: Foxleigh Management Pty Ltd
Middlemount/Dysart Road
MIDDLEMOUNT QLD 4746

FROM: Dr Noel Merrick

RE: Foxleigh Mine Groundwater Monitoring Management Plan - Peer Review

YOUR REF: PO J165981

OUR REF: HA2023/1a

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1. Introduction

This memorandum provides a peer review of the Groundwater Monitoring Management Plan (GMMP) prepared by Foxleigh Management Pty Ltd which operates Foxleigh Mine on behalf of the Foxleigh Joint Venture. An independent review of the GMMP is required to satisfy an EPBC approval condition:

> *"The GMMP must be peer reviewed by a suitably qualified expert who must be approved by the Minister in writing. The peer review must be submitted to the Minister at the same time the GMMP is submitted to the Minister for approval."*[1]

The review has been conducted by Dr Noel Merrick who was approved as a suitably qualified expert by the Minister in a letter dated 9 February 2016 when the initial GMMP-16 was prepared and reviewed.

2. Documentation

The review is based on the following report:

1. Foxleigh Mine, 2023. Groundwater Monitoring Management Plan. Report ENV-PLN-0003. 18 April 2023. 32p (main) + 5 Appendices.

This document has the following major sections:

1. Introduction
2. Background
3. Conclusions from six years of data
4. An Updated Hydrogeological Conceptual Model (HCM)
5. Groundwater Monitoring Program
6. GMMP-23 review frequency
7. Peer review

[1] EPBC 2010/5421 (30 September 2021) Condition 11

8. References

The Appendices are:

A. Geological Setting (GMMP-16 excerpts)
B. GMMP-16 VWP Construction Details
C. EPML00744813 (dated 17 Feb 2017) Conditions E1-E8
D. New HCM Block Models
E. Peer review report

The review has also considered previous reports associated with GMMP-16:

- AGE, 2016. *Foxleigh Plains Project – Groundwater Monitoring and Management Plan.* Project No. G1793 report prepared for Anglo American. Draft_v3a dated 11 March 2016. 61p (including 31 figures & 20 tables) + 5 Appendices.

- HydroSimulations (Heritage Computing Pty Ltd), 2016. *Foxleigh Plains Project – Groundwater Monitoring and Management Plan Peer Review.* Report HC2016/06 dated 15 March 2016, 7p.

No other documentation or information has been relied upon in framing this review.

3. Discussion

Report Structure

The GMMP-23 report builds on the previous GMMP-16 but does not repeat material that has not changed, such as:

- Geology
- Climate
- Baseline water quality charts
- Borehole logs for original bores.

For these matters, GMMP-16 has to be consulted. Detail on the geological setting is reproduced in Appendix A as two pages of excerpts from GMMP-16.

For material that has been updated, the GMMP-23 report is considered to have sufficient content that meets the requirements of the EPBC and EA reporting requirements for a GMMP.

Conceptualisation

GMMP-23 has the benefit of an additional six years of data on which to base the Conceptual Hydrogeological Model (CHM). The summary in Section 2.3 and the detail in Section 3 indicate that the original CHM is still appropriate. This is illustrated in Figure 4 of GMMP-23 and Figure 25 of GMMP-16 for pre-mining conditions; the earlier GMMP also includes a post-mining CHM (Figure 26). Informative CHM block models are included in Appendix D of GMMP-23 for pre-mining, mining and post-mining conditions.

Data Analysis

Five data reviews have been commissioned by Foxleigh Mine since GMMP-16, acting in part on recommendations of the previous peer review. The findings are summarised in Section 2.5 of GMMP-23.

It is clear from the data presented in Section 3 of the GMMP-23 that groundwater salinity is much greater than surface water salinity and, consequently, there is no evidence for any significant interaction between surface water and groundwater. For paired upstream/downstream surface water samples, there is an increase in salinity by about 4% per kilometre in 2022 (at CCUS and CCDS; RCDS and RCDS@BP).

The use of dual bore names can be confusing, as GMP notation is used on maps and FP notation is used on charts. The association between the two is given in Section 3.3 and in Appendix B.

There is an opportunity to verify VWP levels against standpipe levels at bores GMP2 and GMP4. GMP2 (VWP4 at 50 mbgl) has groundwater levels of 126-128 mAHD which accords reasonably well with the GMP4 standpipe at 12 mbgl, which has a steady groundwater level of about 128 mAHD.

None of the three VWP bores displays consistent vertical gradients upwards or downwards. It was stated in the previous peer review that "data at FPVWP03 seem to be reliable but the data at FPVWP02 are erroneous". This is still the case. It was also judged at that time that "the data at FPVWP01 have been unstable since installation" but "might be approaching equilibrium". That has not eventuated, and those sensors are now regarded as unreliable – except perhaps for the shallowest sensor (VWP4) which is compatible with measurements at standpipe GMP4.

An additional 13 groundwater bores were installed during 2021, mostly to the south of the project area (named P1 to P10, P11S, P11D, and P12). From this dataset, bore P8 in the Rewan Formation is recommended for inclusion in the monitoring network for the northern mine as it forms a suitable quadrilateral with the GMP monitoring sites. It has fairly stable groundwater levels between 120 and 121 mAHD.

Given the poor reliability of VWP measurements, groundwater flow directions have had to be inferred from conceptualisation of topographic and structural geology controls. I concur with those inferences.

Groundwater Model

GMMP-16 included two 2-dimensional cross-sectional seepage models using SEEP/W software. GMMP-23 introduces a regional numerical groundwater flow model using MODFLOW-USG software. Only regional numerical models are able to address the full range of predictive expectations during mining and post-closure.

The model is discretised into 15 layers that represent the four dominant hydrostratigraphic units (listed in Table 6 of GMMP-23).

As the detail in the modelling is documented elsewhere, this review should not be regarded as a peer review of the groundwater model. Nevertheless, sufficient information has been included in the GMMP to demonstrate that a model is under development with satisfactory objectives (Section 4.2.2.1), code (Section 4.2.2.2), model extent (Section 4.2.2.3), layering (Section 4.2.2.4), impact assessment goals (Section 4.2.3), and assumptions (Section 4.2.4).

The water level data for the new bores to the south will provide an essential dataset for calibrating regional groundwater behaviour.

Groundwater Monitoring Network

GMMP-23 recommends ongoing monitoring of groundwater levels at these bores:

- GMP1 (sensors 2, 3, 4)
- GMP4
- P8.

I concur with this set, but GMP2 (sensor 1) could be added.

As water quality sampling is limited to standpipes, the only candidates for ongoing monitoring of groundwater quality are:

- GMP4 (screen at 12.1 – 15.1 mbgl)
- P8 (screen at 22.0 – 28.0 mbgl).

The procedures for measurement of baseline data, and handling of samples, are consistent with best practice.

The procedures for field and laboratory documentation, and data management, are consistent with best practice.

Upper (UTV), middle (MTV), and lower (LTV) trigger levels are generally defined respectively as one, two, or three standard deviations above the mean value in the baseline data set. The response protocol for exceedances of the various trigger levels is defined unambiguously.

4. Conclusion

It is clear from the material presented in GMMP-23 that the Foxleigh Mine is a very low risk development in terms of groundwater impacts, given the very high salinity of natural waters and the natural synclinal confinement of the coal measures.

Having this in mind, the reviewer endorses GMMP-23 as an adequate document in compliance with the stated EPBC and EA conditions.

It is of concern that very little of the baseline groundwater level dataset is reliable. Fortunately, this deficiency has been offset recently (since mid-2021) by the installation of 13 standpipe bores. One of these (P8) is directly relevant to groundwater responses in the northern precinct, but all 13 are valuable in restraining the calibration of the regional numerical model that is being developed.

Dr Noel Merrick