Report Prepared for Jellinbah Group Pty Ltd

MACKENZIE NORTH PROJECT

ANNUAL GROUNDWATER MONITORING REPORT - 2022 YEAR

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1.0 INTRODUCTION

This Annual Groundwater Monitoring Report for the Mackenzie North Project (the Project) has been prepared by JBT Consulting on behalf of the Jellinbah Group Pty Ltd (Jellinbah) to satisfy the conditions of the Project's Environmental Authority (EA) number EPML00516813, specifically:

- Condition I16 – an Annual Groundwater Monitoring Report (AGMR) must be completed by 1 March each year; and,
- Condition I17 – The AGMR required by condition I16 must include:
  a) a review of all the groundwater quality and SWL data of all groundwater bores listed within Table I1 – Groundwater quality monitoring locations and frequency and Table I4 – Groundwater standing water level monitoring locations, frequency and triggers;

     (Refer report Section 5.1.2 (groundwater quality data assessment) and Section 5.2.2 (groundwater level data assessment)

  b) an assessment of groundwater quality and SWL trends for all data from all groundwater bores listed in Table I1 – Groundwater quality monitoring locations and frequency and Table I4 – Groundwater standing water level monitoring locations, frequency and triggers;

     (Refer report Section 5.1.2 (groundwater quality data assessment) and Section 5.2.2 (groundwater level data assessment)

  c) an assessment of any impacts on groundwater level due to the mining activities; and

     (Refer report section 5.2.2)

  d) comparison with receiving environment surface water quality monitoring results to determine any interaction or impact from groundwater on surface water.

     (Refer report section 6.0)

This Annual Monitoring Report covers the period 1 January 2022 to 31 December 2022, but references earlier data as required for analysis of water level and water quality trends.

2.0 GEOLOGY AND HYDROGEOLOGY

The geology and hydrogeology of the Mackenzie North Project area has been reported in AGE (2013)[1]. Relevant elements are summarised below to provide background and context to the groundwater data review.

The Project is located within the central part of the Bowen Basin, an early Permian to middle Triassic-age basin that covers an area of approximately 160,000 km^2 and which contains the majority of the mineable coal in Queensland. Table 2-1 shows the stratigraphic relationship and description of sediments that occur within the Project Area, which include Bowen Basin sediments (Late Permian Burngrove Formation and Rangal Coal Measures and the Triassic Rewan Group) that are overlain by Quaternary alluvium. Figure 2-1 shows the Bowen Basin solid geology[2] for the Project area. From Figure 2-1 it is evident that the Project area is underlain predominantly by sediments of the Rangal Coal Measures, with the underlying Burngrove Formation occurring in the west of the Project area and the overlying Rewan Group sediments occurring in the eastern and south-eastern area of the Project. The Rangal Coal Measures contain the target coal seams for mining at Mackenzie North, i.e. the Pollux Upper seam and the Pollux Lower seam. Underlying the Rangal Coal Measures are sedimentary sequences of the Burngrove Formation.

The Permian and Triassic units are overlain by unconsolidated Tertiary and Quaternary-age sediments, with the Quaternary-age alluvial sediments associated with current and prior channels and flood plains of the Mackenzie River. The surface geology of the project area is shown on Figure 2-2. From review of Figures 2-1 and 2-2 it is evident that the Project area is underlain by Quaternary alluvium, which is deposited directly over sediments of the Permian Rangal Coal Measures in the central part of the Project area (the majority of the proposed disturbance area for the Project).

Table 2-1: Stratigraphy of the Mackenzie North Area (after AGE 2013)

Geological Age	Unit	Lithology	Thickness (m)
Quaternary / Tertiary	Alluvium	Unconsolidated soil, silty clay, sand, and gravel. Basal sand and gravel thickens towards the Mackenzie River.	~14 m to 42 m
Triassic	Rewan Formation	Green-grey claystone, siltstone and sandstone with a minor pebbly conglomerate unit at its base.	0 m to 100 m
Late Permian	Rangal Coal Measures	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff, and coal seams. Coal seams include:	100 + m
		- Aries	0 – 2.2 m
		- Castor	0 – 1.1 m
		- Pollux Upper	0 – 7.6 m
		- Pollux Lower	0 – 6.4 m
	Burngrove Formation	Sandstone, siltstone, mudstone and banded coal seams, frequently interbedded with tuff and tuffaceous mudstone	>200 m

1 Mackenzie North Groundwater Assessment. Report prepared for Australasian Resource Consultants Pty Ltd (AARC) by Australasian Groundwater and Environmental Consultants (AGE). Project No. G1512, May 2013.

2 In the Bowen Basin solid geology map the surficial unconsolidated Quaternary and Tertiary geology has been stripped off to reveal the relationship of the underlying Triassic and Permian sediments. Data source: Bowen Basin Structural Geology 2008. Geological map and digital dataset prepared by Sliwa, R., Hamilton, S., Hodgkinson, J. & Draper, J., copyright CSIRO and Queensland Department of Mines and Energy, 2008.

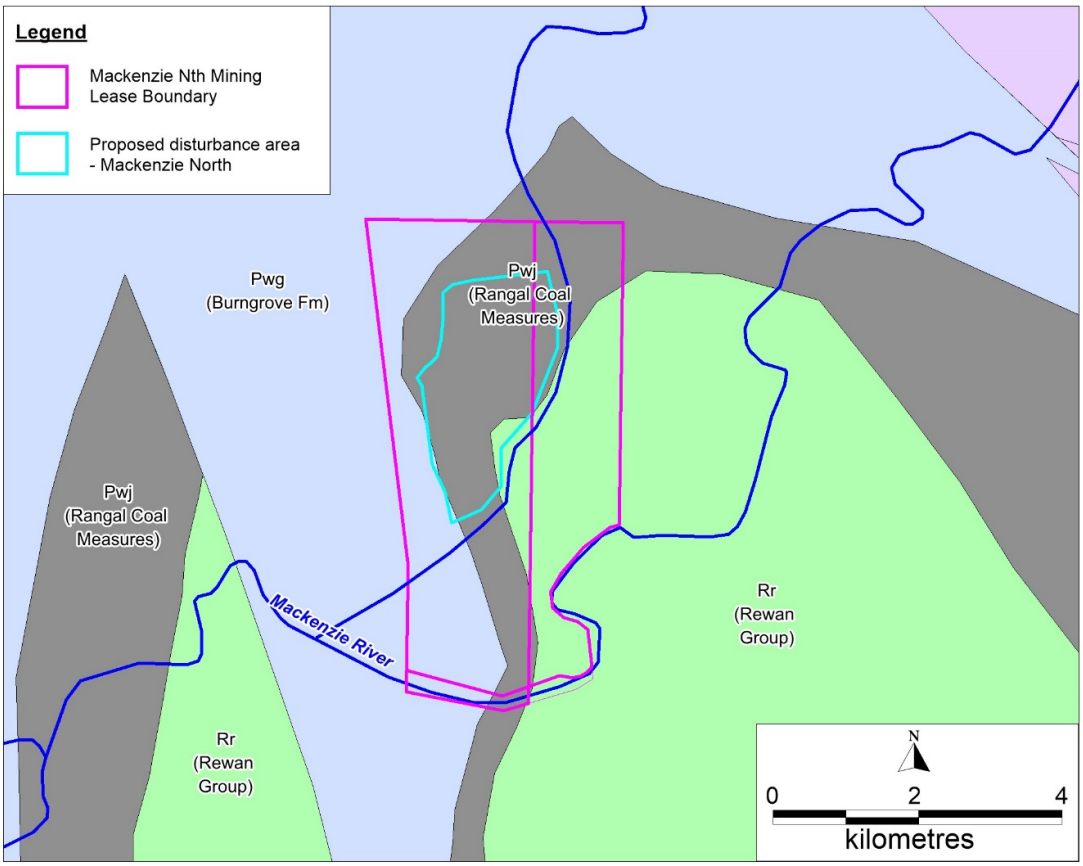

Figure 2-1: Solid Geology

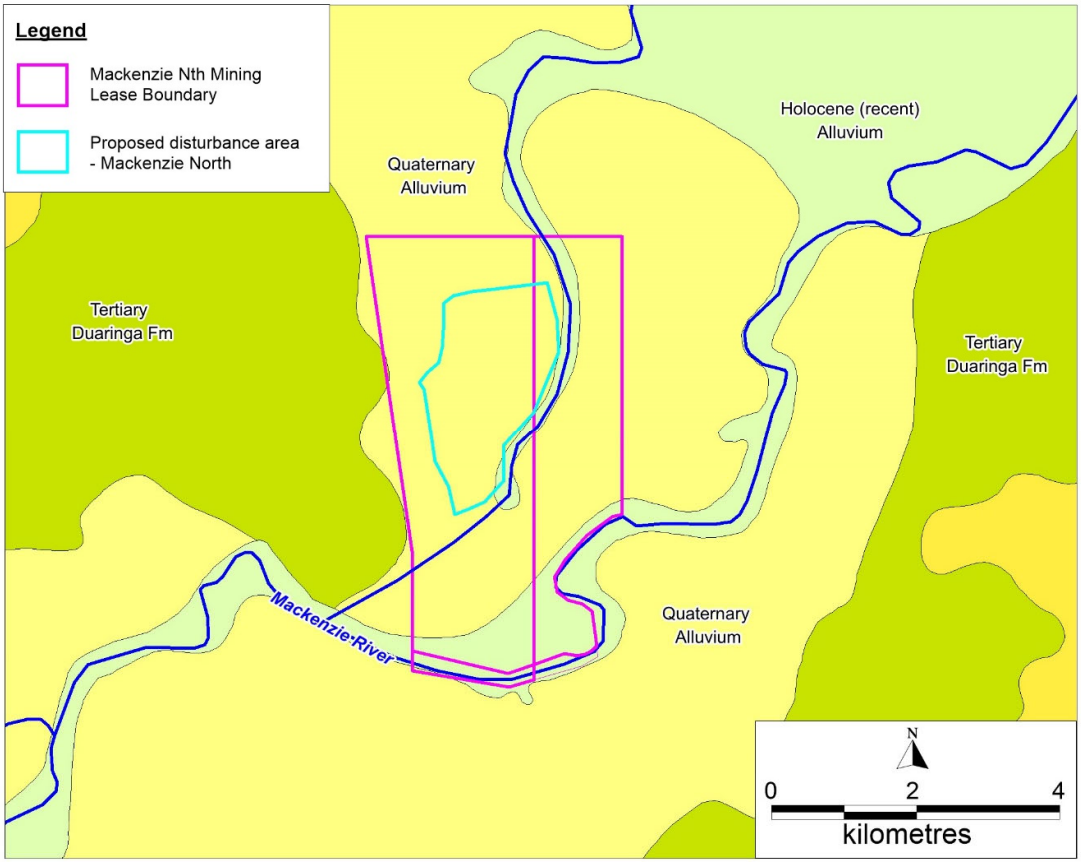

Figure 2-2: 1:100,000 Scale Surface Geology

3.0 RAINFALL DATA

Rainfall data for the Project site has been obtained from:

- the Queensland Government SILO Data Drill website, for a location that corresponds to the centre of the Project area. The Data Drill accesses grids of climate data available from surrounding Bureau of Meteorology (BoM) point observations and then creates interpolated climate values for the requested location. The interpolated climate data are calculated for the requested location using splining and kriging techniques, based on the proximity of surrounding BoM point observations. SILO data has been used for the period prior to June 2018 (when site data became available) and also to provide the monthly average rainfall data against which the recorded data has been assessed; and,
- For the period June 2018 to present, data is available from the automatic weather station (AWS) at Mackenzie North.

Monthly rainfall data using the data sources described above is shown below in Figure 3-1. Figure 3-1 also presents a rainfall residual mass (RRM) curve for the data. The RRM is calculated by subtracting the long-term average monthly rainfall from the actual monthly rainfall, to provide a monthly "departure" from average conditions. If the monthly rainfall is above average, the resulting rainfall departure number is positive, whereas if the rainfall is below average, the number is negative. A number of below-average rainfall months will result in a falling RRM curve, while a number of above average rainfall months will result in a rising RRM curve. The RRM curve is used extensively in groundwater investigations due to the strong correlation in many locations between the RRM and groundwater level trends.

The RRM curve shows an upward trend from 2010 to 2012 due to above-average rainfall over that period, but has been in decline due to generally below-average rainfall conditions from 2012 to 2021; this indicates a potential for falling shallow groundwater levels over that period. The overall trend of the RRM curve has been rising in the period between January 2021 and December 2022, mainly due to above-average rainfall events in November 2021, when 295.0 mm was recorded from the Mackenzie North AWS compared to average rainfall (based on SILO data) of 54.8 mm, as well as May, October and November 2022, when 190.5 mm, 154.4 mm and 103.5 mm was recorded for those months, compared to an average of 27.5 mm, 35.3 mm and 54.8 mm respectively.

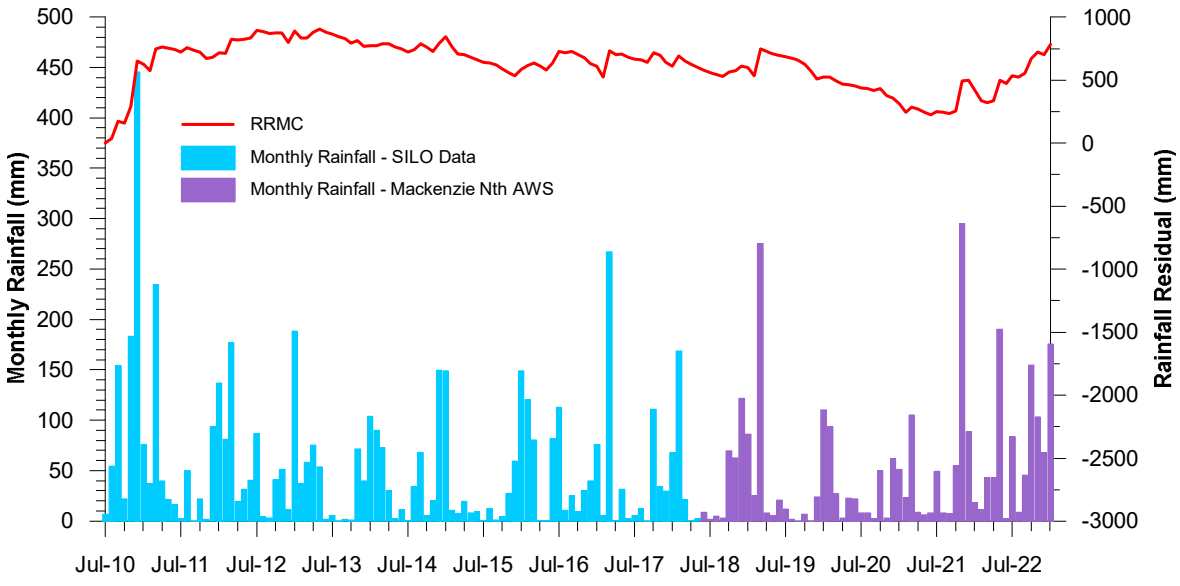

Figure 3-1: Monthly Rainfall Data and Residual Mass Curve

4.0 GROUNDWATER MONITORING BORES

4.1 Description of Monitoring Network

The Mackenzie North EA groundwater monitoring network comprises twelve bores at nine sites as shown below in Table 4-1. Eight bores monitor groundwater within the Quaternary alluvium, with four bores in the Permian coal measures – three within the Pollux seam and one within the Permian overburden. In accordance with Conditions I18 and I19 of the EA, replacement monitoring bores will be constructed (potentially at an alternative location) if any of the bores are decommissioned due to mining or if they become unserviceable for any other reason (e.g. due to bore collapse or failure). Monitoring sites and monitoring purpose are shown in Table 4-1 and bore locations (as well as surface water monitoring points that are discussed in Section 6.0) are presented in Figure 4-1.

All existing bores in the monitoring network were assessed in August/September 2018 for bore integrity, and confirmation of bore depth, and were re-developed prior to commencement of water quality and water level sampling.

The three alluvial monitoring bores that are between the mining operation and the Mackenzie River (JMR4WA, JMR24WA and JMR25WA) have been fitted with dataloggers. Water level data for these bores is discussed in Section 5.2.2.

Table 4-1: Mackenzie North Groundwater Monitoring Bores

Monitoring Bore	Hydrogeological Unit	Easting (GDA94)	Northing (GDA94)	Surface RL (mAHD)	Screened Interval (mbgl)		Bore Purpose and Monitoring Frequency[1]	
					From	To	Water Quality	Water Level
JMR4WA	Alluvium	695949	7427175	123.8	36	42	Compliance	Compliance
JMR22WA	Alluvium	697111	7429809	122.2	14.5	17.5	-	Compliance
JMR23WA	Alluvium	697214	7428283	122.3	17.2	20.2	Interpretation	Compliance
JMR24WA	Alluvium	697303	7432067	120.4	14.8	17.8	-	Compliance
JMR25WA	Alluvium	696363	7427544	122.5	17.9	20.9	Compliance	Compliance
JMR26WA	Alluvium	696550	7425800	123.4	18.2	21.2	-	Interpretation
JP0911T	Alluvium	694540	7425880	124.86	22	28	-	Interpretation
JP0912T	Alluvium	697270	7426150	122.56	36	42	-	Interpretation
JMR4WP2	Permian-Pollux seam	695952	7427176	124	83.5	88	Compliance	Compliance
JMR22WP	Permian-Pollux seam	697115	7429826	122.2	157	163	Interpretation	Compliance
JMR24WP2	Permian-Overburden	697305	7432067	120.5	72.8	78.8	Compliance	Compliance
JN1119E	Permian-Pollux seam	697068	7430176	121.38	140	146	Interpretation	Compliance

1. For bores where monitoring is shown to be required (i.e. for Interpretation or Compliance purposes), the monitoring frequency is quarterly, i.e. every 3 months.

4.2 Changes to Monitoring Bore Network

No new groundwater bores were drilled, and no bores were decommissioned during the reporting period; i.e. there were no changes to the monitoring bore network during the 2021 – 2022 Water Year.

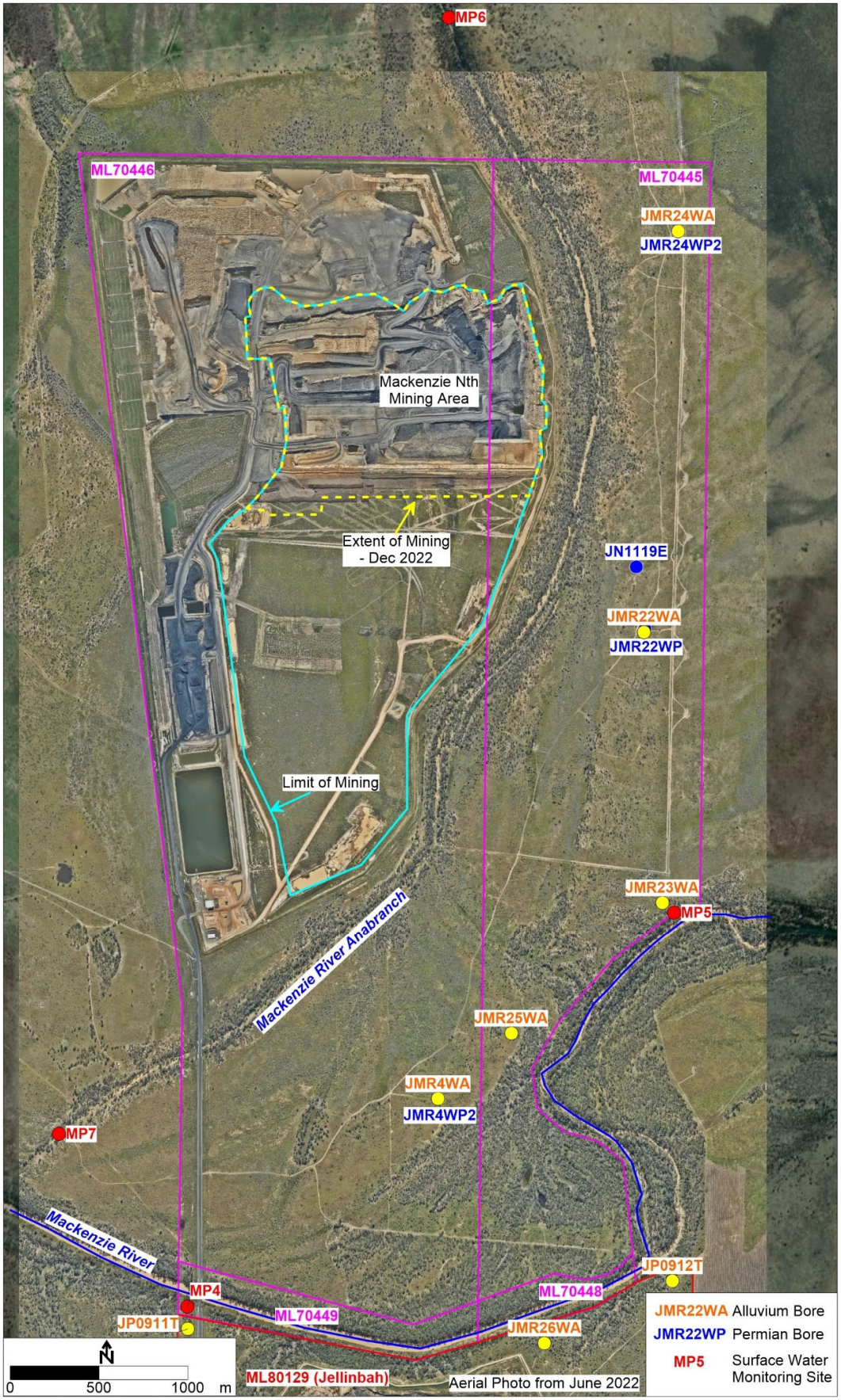

Figure 4-1: Groundwater Bore and Surface Water Monitoring Locations

5.0 GROUNDWATER MONITORING

5.1 Groundwater Quality Monitoring

5.1.1 Monitoring Requirements

Groundwater quality monitoring is undertaken at the bore sites and monitoring frequency shown in Table 4-1 and for the parameters shown below in Table 5-1 and Table 5-2.

Table 5-1: Groundwater Quality Limits (EA Table I2)

Monitoring Bore	Groundwater Quality Characteristic Limit		
	pH (pH units)	EC (µS/cm)	Sulfate (mg/L)
JMR4WA	6.37 - 8.6	6,900	103
JMR4WP2		9,590	60
JMR24WP2		10,490	20
JMR25WA		2,200	16

Table 5-2: Groundwater Contaminant Limits (Adapted from EA Table I3)

Quality Characteristic	Unit	Groundwater limit
Total dissolved solids (TDS)	mg/L	No specified limit - interpretative purposes only
Major anions (Ca, K, Mg, Na)	mg/L	No specified limit - interpretative purposes only
Major anions (Cl^-, OH^-, CO^{2-}, HCO_3^-)	mg/L	No specified limit - interpretative purposes only
Dissolved Metals/Metalloids		
Aluminium	(µg/L)	55
Arsenic	(µg/L)	13
Chromium	(µg/L)	1
Cobalt	(µg/L)	1.4
Copper	(µg/L)	2
Manganese	(µg/L)	1900
Molybdenum	(µg/L)	34
Nickel	(µg/L)	211 (Permian Bores*),
		221 (Alluvium Bores**)
Selenium	(µg/L)	10
Zinc	(µg/L)	154 (Permian Bores*)
	(µg/L)	161 (Alluvium Bores**)
Petroleum Hydrocarbons		
TPH C6-C9	(µg/L)	20
TPH C10-C36	(µg/L)	50

* Alluvium Bores - JMR4WA, JMR23WA, JMR25WA

** Permian Bores – JMR4WP2, JMR22WP, JMR24WP2, JN1119E

5.1.2 Groundwater Quality Data Assessment

Water quality sampling has been undertaken at 6-monthly intervals for the bores and sampling parameters shown in Table 5-1, with the exception of bore JMR23WA where there has been insufficient water for water quality sampling for all sampling events (the water level in JMR23WA is generally just above the base of screens).

All available water quality data (i.e. pH, electrical conductivity, major ions, metals/metalloids, total petroleum hydrocarbons) are provided in the summary table that is included as Attachment B to this report.

5.1.2.1 pH Data

Available field pH data are presented in Appendix A. pH data for the compliance monitoring bores are shown in Figure 5-1, with comparison to the pH groundwater quality limits (EA Table I2 and Table 5-1 of this report) of 6.37 to 8.6.

Also shown in Figure 5-1 is the date at which the groundwater quality limits came into effect (the date the EA changes came into effect on 8 September 2022). As can be seen from Figure 5-1, all data points for the compliance monitoring bores are within the pH limits.

5.1.2.2 Electrical Conductivity (EC) Data

Available field electrical conductivity (EC) data for all site monitoring bores are presented in Appendix A. Available EC data for the compliance monitoring bores are shown in Figure 5-2, with comparison to the EC groundwater quality limits (EA Table I2 and Table 5-1 of this report) shown for each bore. EC data for the compliance monitoring bores is summarised as follows:

- JMR4WA (alluvium) – the field EC range is from 4,197 µS/cm to 7,189 µS/cm, with a mean of 6,137 µS/cm and median of 6,247 µS/cm (14 samples). All available samples (with the exception of the first sample in September 2018) are therefore below the EA compliance limit of 6,900 µS/cm for this bore.
- JMR25WA (alluvium) – the field EC range is from 1,171 µS/cm to 2,358 µS/cm, with a mean of 1,574 µS/cm and median of 1,337 µS/cm (12 samples), with all but one sample below the EA compliance limit of 6,900 µS/cm for this bore. As noted in Section 5.2.2, the water level fell below the base of bore between the June and August 2022 monitoring events and the bore has remained dry since that time.
- JMR4WP2 (Pollux Seam) – the field EC range is from 3,803 µS/cm to 6,190 µS/cm, with a mean of 4,383 µS/cm and median of 3,985 µS/cm (6 samples). All available samples are below the EA compliance limit of 9,590 µS/cm for this bore;
- JMR24WP2 (Pollux Seam) – the field EC range is from 6,912 µS/cm to 8,587 µS/cm in JMR24WP (6 samples), with a mean of 7,544 µS/cm and median of 7,335 µS/cm. A single EC value of 11,491 µS/cm for JMR24WP2 in January 2021 is excluded from the statistical analysis as it appears to be an outlier. Apart from the single value of 11,491 µS/cm, all samples have been below the EA compliance limit of 10,490 µS/cm for this bore.

5.1.2.3 Sulfate Data

Available sulfate data for all site monitoring bores are presented in Appendix A. Available sulfate data for the compliance monitoring bores are shown in Figure 5-2, with comparison to the sulfate groundwater quality limits (EA Table I2 and Table 5-1 of this report) shown for each bore. Sulfate data for the compliance monitoring bores is summarised as follows:

- JMR4WA (alluvium) – the sulfate concentration range is from 66 mg/L to 105 mg/L, with a mean of 90 mg/L and median of 92 mg/L (14 samples). 13 of 14 samples are below the EA sulfate compliance limit of 103 mg/L for this bore.
- JMR25WA (alluvium) – the sulfate concentration range is from 2 mg/L to 17 mg/L, with a mean of 10 mg/L and median of 11 mg/L (12 samples), with all but one sample below the EA compliance limit of 6,900 µS/cm for this bore. Historically, only 1 out of 12 samples has been above the EA sulfate compliance limit of 16 mg/L. As noted in Section 5.2.2, the water level fell below the base of bore between the June and August 2022 monitoring events and the bore has remained dry since that time.
- JMR4WP2 (Pollux Seam) – the sulfate concentration range is from 42 mg/L to 98 mg/L, with a mean of 59 mg/L and median of 52 mg/L (6 samples). As shown in Figure 5-3, all samples except for the first two samples have been below the EA sulfate compliance limit of 60 mg/L for this bore;
- JMR24WP2 (Pollux Seam) – the sulfate concentration range is from <1 mg/L to 6 mg/L, with four of 6 samples recording a sulfate concentration that is below the limit of reporting (i.e. < 1 mg/L). A single value of 404 mg/L from January 2021 is regarded as an outlier (Appendix A) and is not considered

further in the analysis. Therefore, all samples have been below the EA compliance limit of 20 mg/L for this bore.

5.1.2.4 Metal/ Metalloid Data

Dissolved and total metal/metalloid data for all site monitoring bores is contained in Appendix A. Available data is shown for the compliance monitoring bores, for the metal/metalloid parameters shown in Table 5-2, are shown in the figures described below. For each figure the relevant EA contaminant limit (Table 5-2) is included for reference (noting that the EA commencement data for assessment of contaminant limits is 8 September 2022). As a general note for each figure, a concentration that is below the LOR results in no symbol being shown on the figure. Isolated values that are greater than the LOR are shown as single data points, with values that are greater than the LOR for consecutive data points being connected by lines between the data symbols.

It should also be noted that, while the EA contaminant limits are shown in units of µg/L, the figures referenced below, as well as the data contained in Appendix A, is provided in units of mg/L. This relates to the historic and current laboratory data that is available for the site monitoring bores.

With respect to available metal/metalloid data the following observations are made:

- Figure 5-4 – Dissolved Aluminium data – the majority of samples are below the limit of reporting (LOR) for dissolved aluminium, with only bore JN1119E (Pollux Seam) regularly recording dissolved aluminium concentrations that are >LOR. The most recent sample for JN1119E (5 October 2022) was slightly higher than the contaminant limit (0.6 mg/L relative to a contaminant limit of 0.55 mg/L), however consecutive historical samples >LOR have not been recorded for this bore.
- Figure 5-5 - Dissolved Arsenic data – All bores have recorded dissolved arsenic concentration values that are generally below the contaminant limit, with isolated historic values being recorded above the limit.
- Figure 5-6 - Dissolved Chromium data – the majority of samples for all bores are below the LOR, with isolated samples being recorded that are above the contaminant limit (historically, no bore has recorded three consecutive values above the contaminant limit).
- Figure 5-7 - Dissolved Copper data - the majority of samples for all bores are below the LOR, with isolated samples being recorded that are above the contaminant limit (historically, no bore has recorded three consecutive values above the contaminant limit).
- Figure 5-8 - Dissolved Manganese data – all bores record samples that are generally below the contaminant limit, with only isolated occurrences above the contaminant limit of 1.9 mg/L. Bore JMR4WA (alluvium) records the highest manganese concentration, with a range between 1.59 mg/L and 1.93 mg/L (mean of 1.58mg/L and median of 1.64 mg/L).
- Figure 5-9 - Dissolved Molybdenum data. The majority of bores record dissolved molybdenum concentrations that are below the contaminant limit of 0.034 mg/L. The exception is bore JN1119E (Pollux Seam), which records a concentration range of 0.007 to 0.077 mg/L (mean of 0.053 mg/L and median of 0.059 mg/L). The field pH in this bore is regularly >11 and it is possible that the bore has construction issues (relating to grouting). Therefore, the reliability of data from this bore is questioned and the water chemistry of bore JMR22WP (which JN1119E was originally intended to replace) is assessed to be a more reliable indicator of groundwater quality in the area where the bores are located. Bore JMR22WP records a dissolved molybdenum concentration ranging from 0.003 mg/L to 0.036 mg/L, with a mean of 0.012 mg/L and median of 0.008 mg/L. Based on the historical data for JN1119E, it could be expected that three consecutive readings above the contaminant limit could be recorded within the next two monitoring events.

- Figure 5-10 - Dissolved Nickel data – all bores record dissolved nickel concentrations that are below the contaminant limit;
- Figure 5-11 - Dissolved Selenium data – all bores to date have recorded selenium concentrations that are below the LOR for all samples.;
- Figure 5-12 - Dissolved Zinc data - all bores record dissolved zinc concentrations that are below the contaminant limit.

In summary, the only bore that currently presents a concern is JN1119E, which regularly records dissolved molybdenum concentrations that are in excess of the contaminant limit, with the bore likely to exceed the contaminant limit on three consecutive occasions within the next two monitoring events (as the only sample after the 8 September 2022 commencement date for contaminant limits was above the limit (concentration of 0.058 mg/L relative to a limit of 0.034 mg/L). As noted above, this bore also records a high field pH (generally >11) and may have construction issues (it is noted that the high molybdenum concentration at this site extends back to 2019 and is therefore pre-mining activities). As such, the data from this bore may be unreliable for the purposes of groundwater quality assessment and the water quality for bore JMR22WP is likely to be more representative of groundwater quality in the general area of this bore. It is therefore recommended that consideration be given to removing JN1119E as a water quality assessment bore, but retaining the bore for the purpose of water level assessment.

5.1.2.5 Total Petroleum Hydrocarbon (TPH) Data

Total petroleum hydrocarbon (TPH) data for all site monitoring bores is contained in Appendix A. Available data is shown for the compliance monitoring bores as follows:

- Figure 5-13 shows available data for the TPH C6-C9 fraction, relative to the contaminant limit of 20 µg/L (which is also the limit of reporting for this parameter). Apart from isolated historic values that are above the LOR (and therefore above the contaminant limit), there have been no occurrences of consecutive values above the LOR for this parameter.
- Figure 5-14 shows available data for the TPH C10-C36 fraction, relative to the contaminant limit of 50 µg/L (which is also the limit of reporting for this parameter). It is noted that a number of bores regularly record TPH C10-C36 concentrations where historic data is above the contaminant limit for 3 consecutive samples. This includes:
    - Bore JN1119E (Pollux Seam), which, as noted above, may be a suspect bore in terms of bore construction; and,
    - Bore JMR4WA (alluvium), where the past 5 samples have been above the contaminant limit (though three consecutive samples above the contaminant limit have not been detected since the EA commencement date of 8 September 2022).

The presence of hydrocarbon contamination in groundwater is not suspected as the high concentrations exist from the period that is pre-mining activities. It is recommended that TPH samples be tested via the silica gel cleanup method (for at least the next 12 months of quarterly sampling) to establish whether the hydrocarbons are biogenic (naturally occurring) and therefore not indicative of contamination due to site activities.

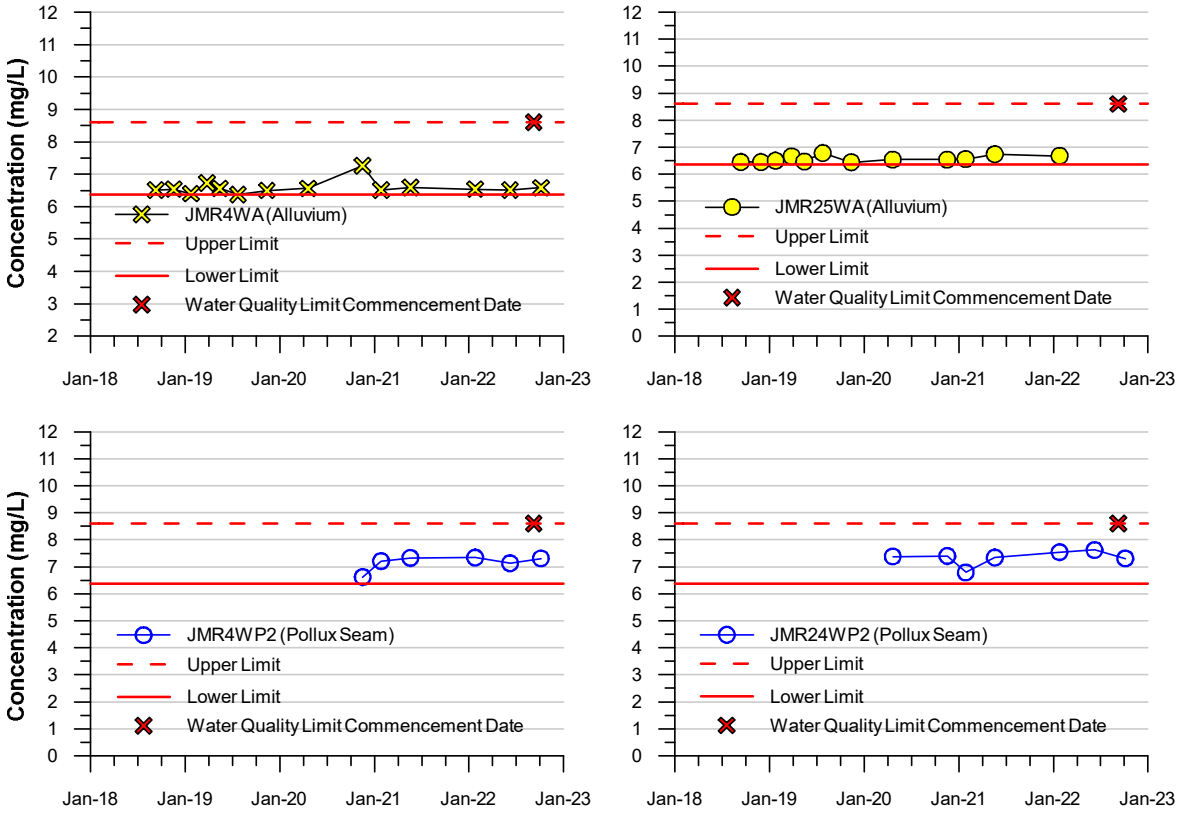

Figure 5-1: pH Data – Compliance Bores

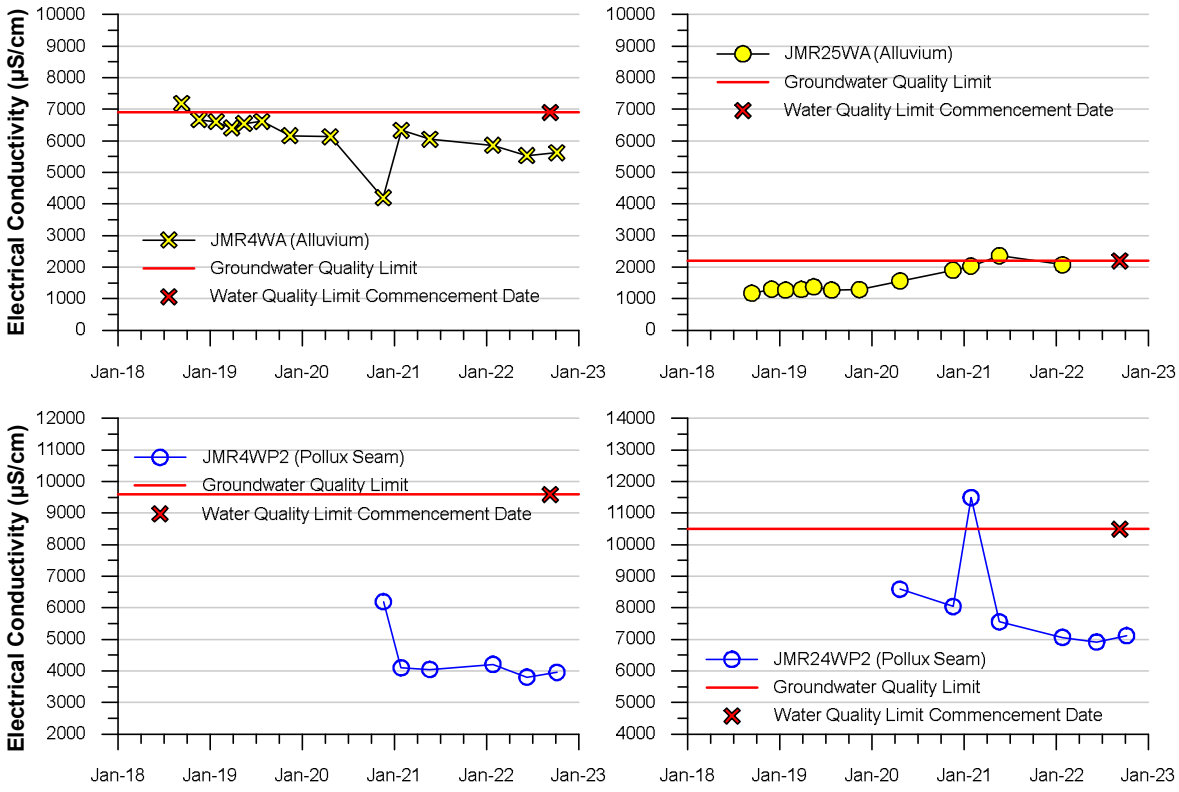

Figure 5-2: EC Data – Compliance Bores

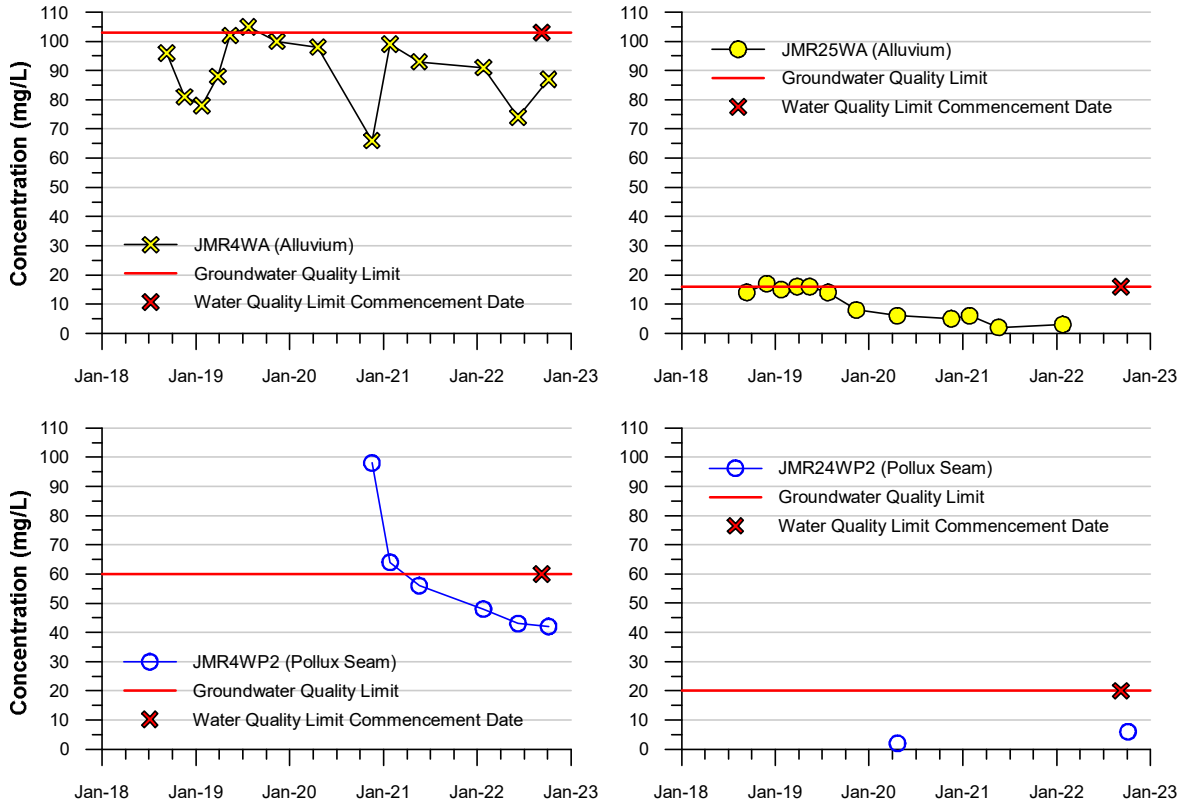

Figure 5-3: Sulfate Data – Compliance Bores

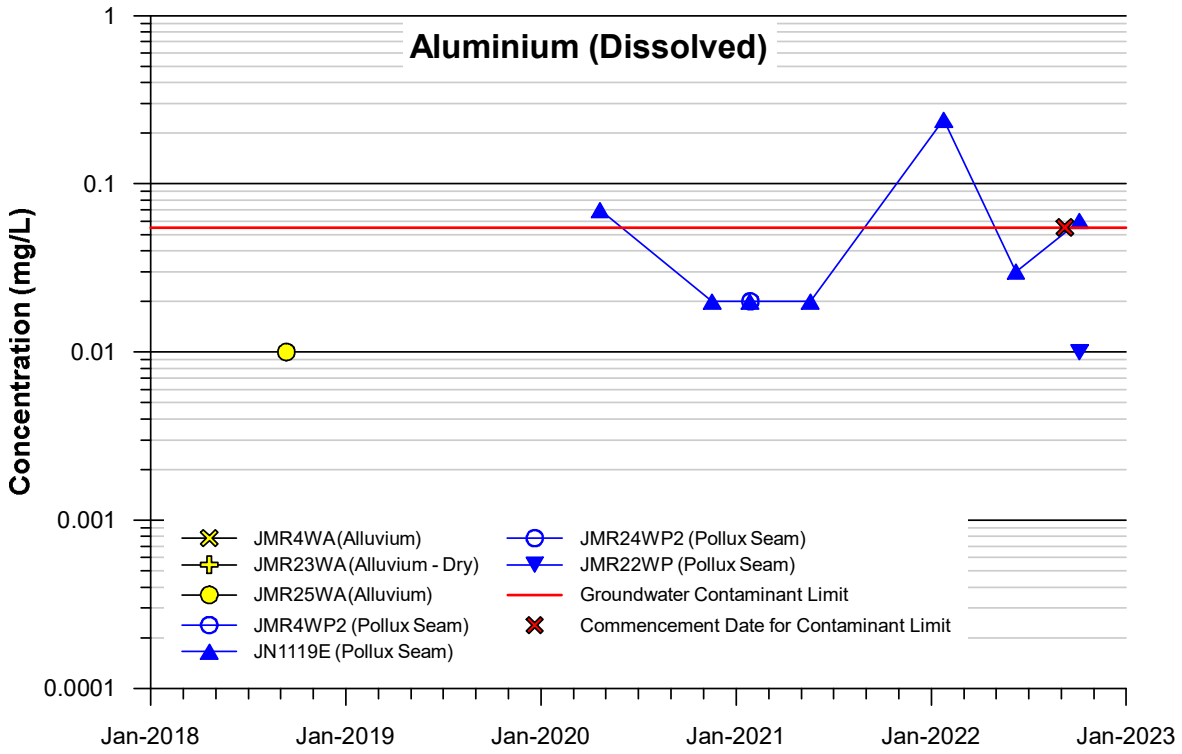

Figure 5-4: Dissolved Aluminium Data – Compliance Bores

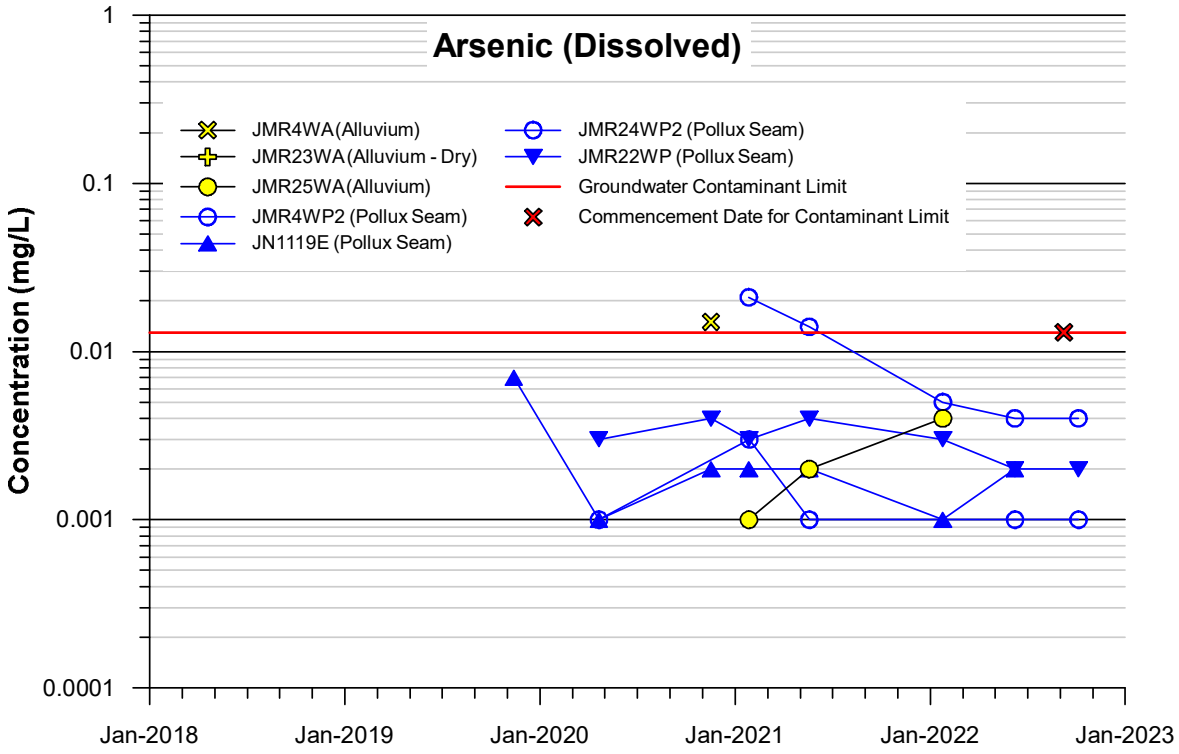

Figure 5-5: Dissolved Arsenic Data – Compliance Bores

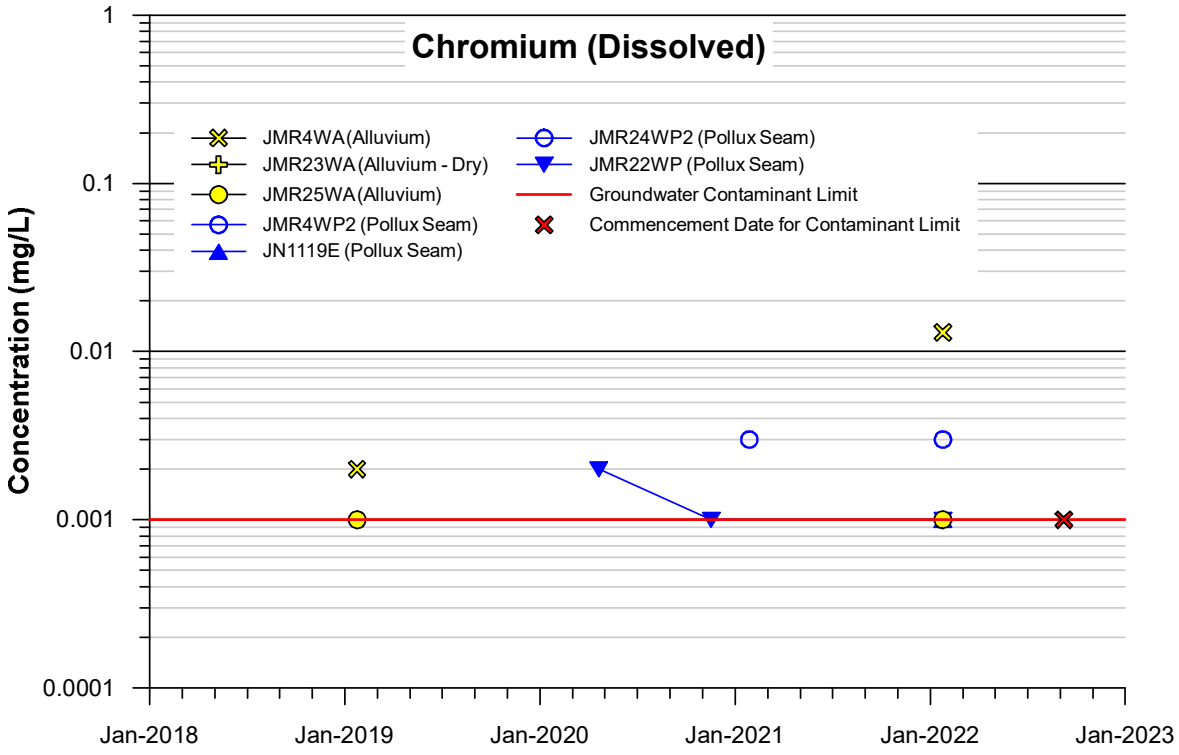

Figure 5-6: Dissolved Chromium Data – Compliance Bores

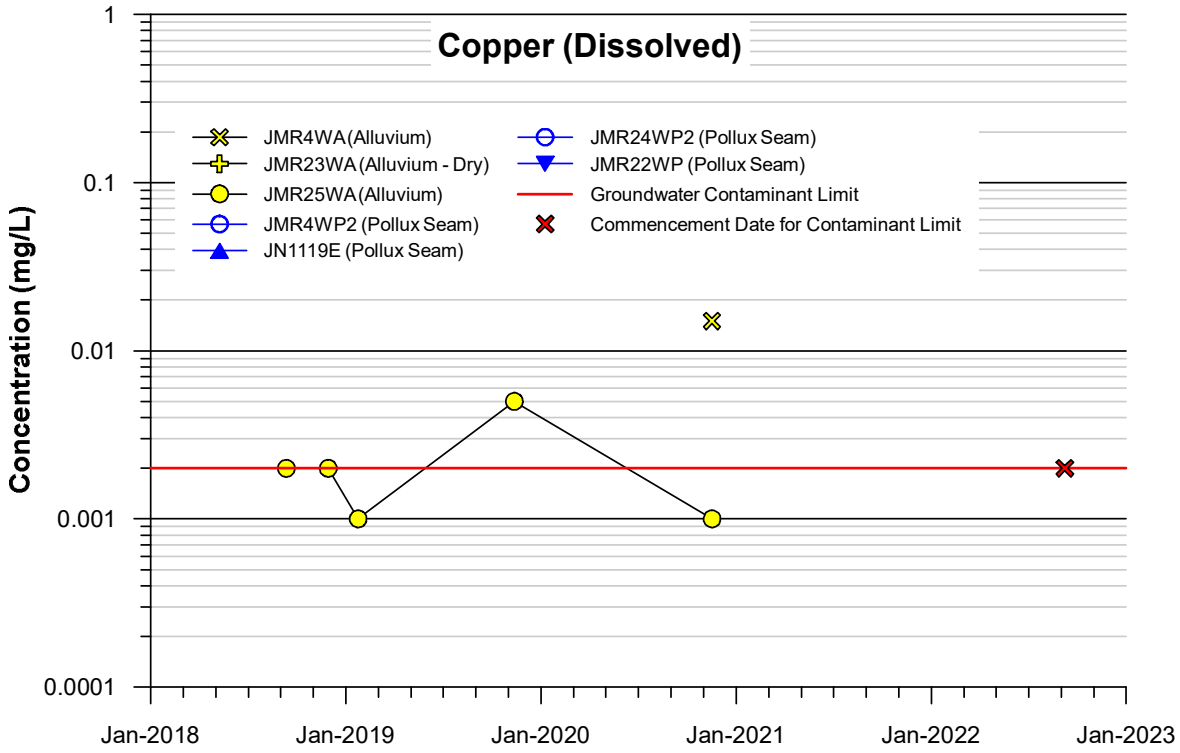

Figure 5-7: Dissolved Copper Data – Compliance Bores

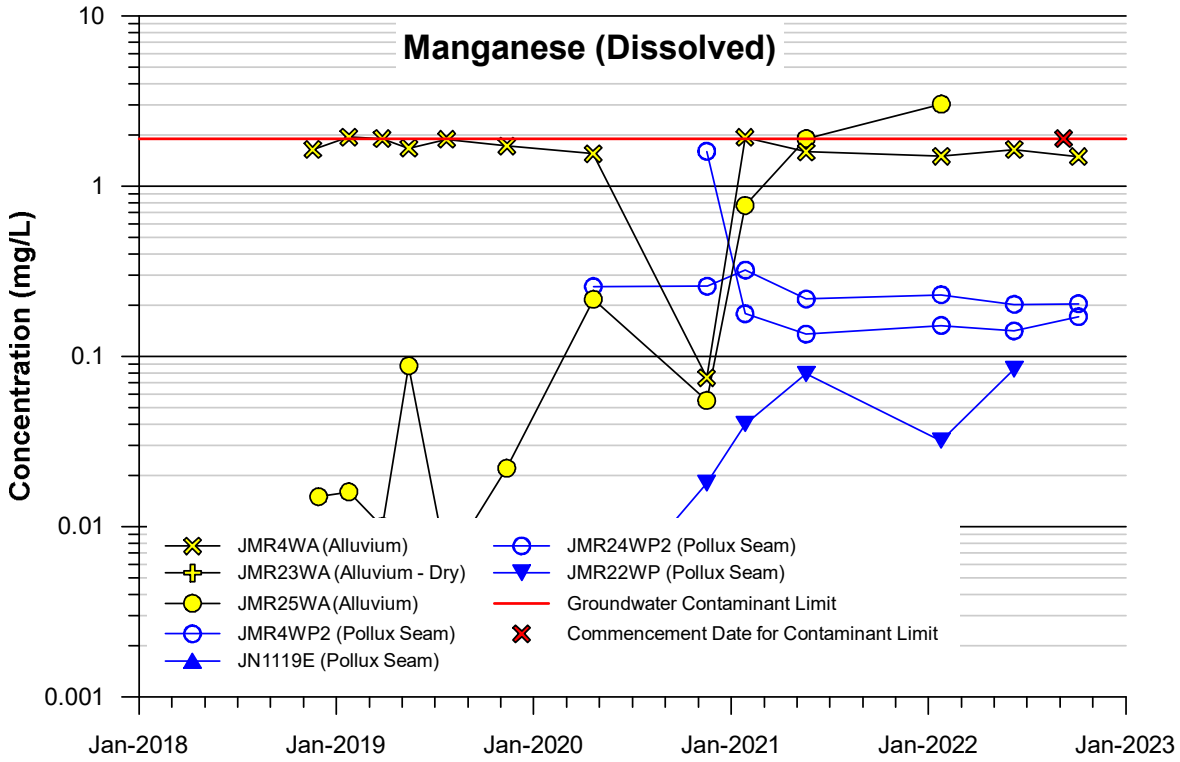

Figure 5-8: Dissolved Manganese Data – Compliance Bores

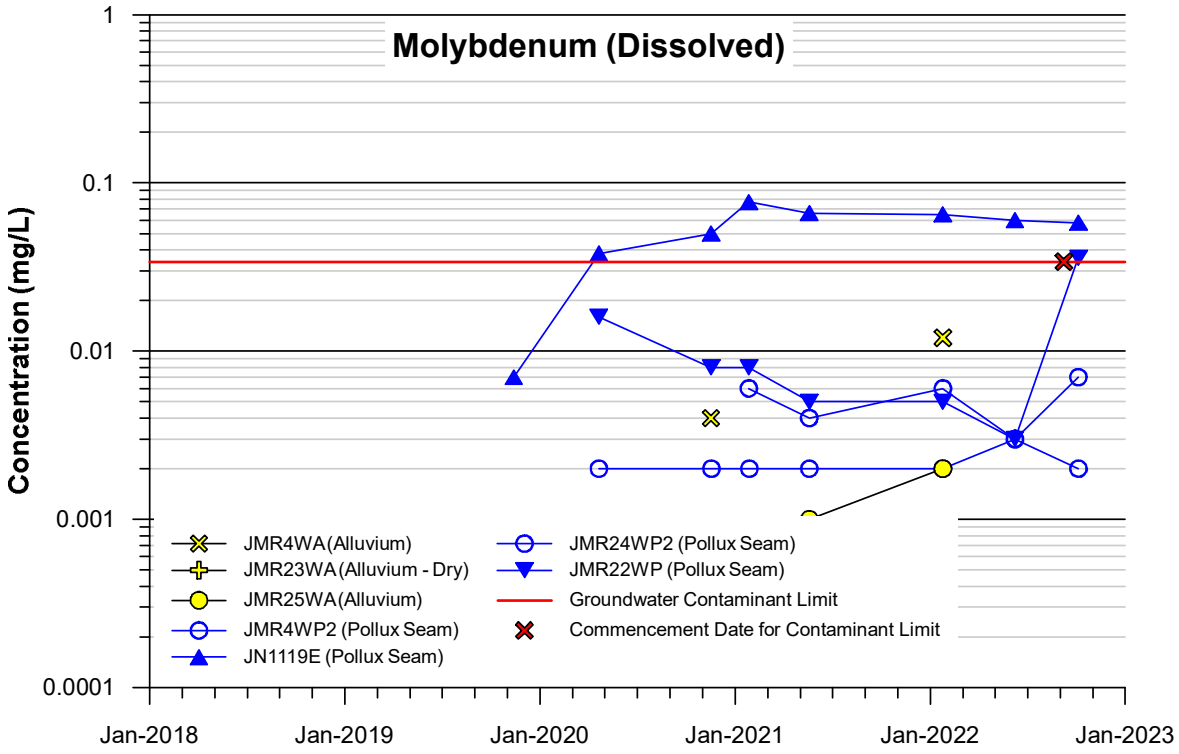

Figure 5-9: Dissolved Molybdenum Data – Compliance Bores

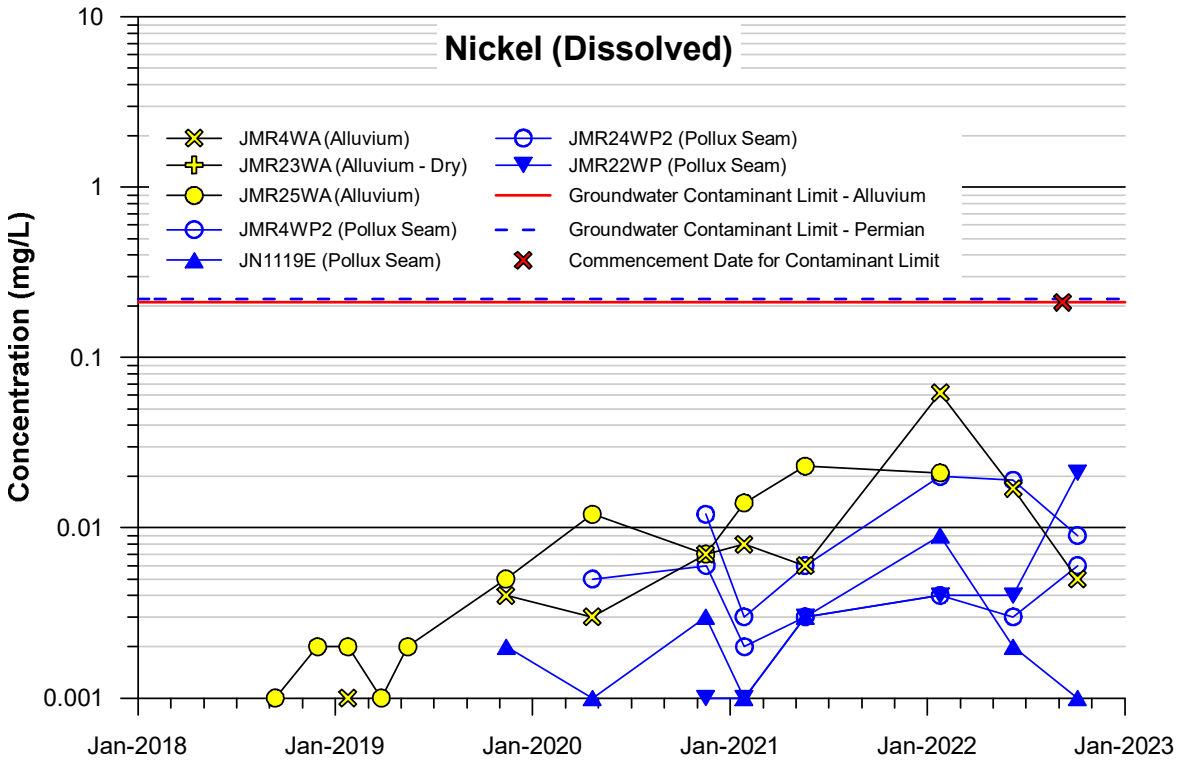

Figure 5-10: Dissolved Nickel Data – Compliance Bores

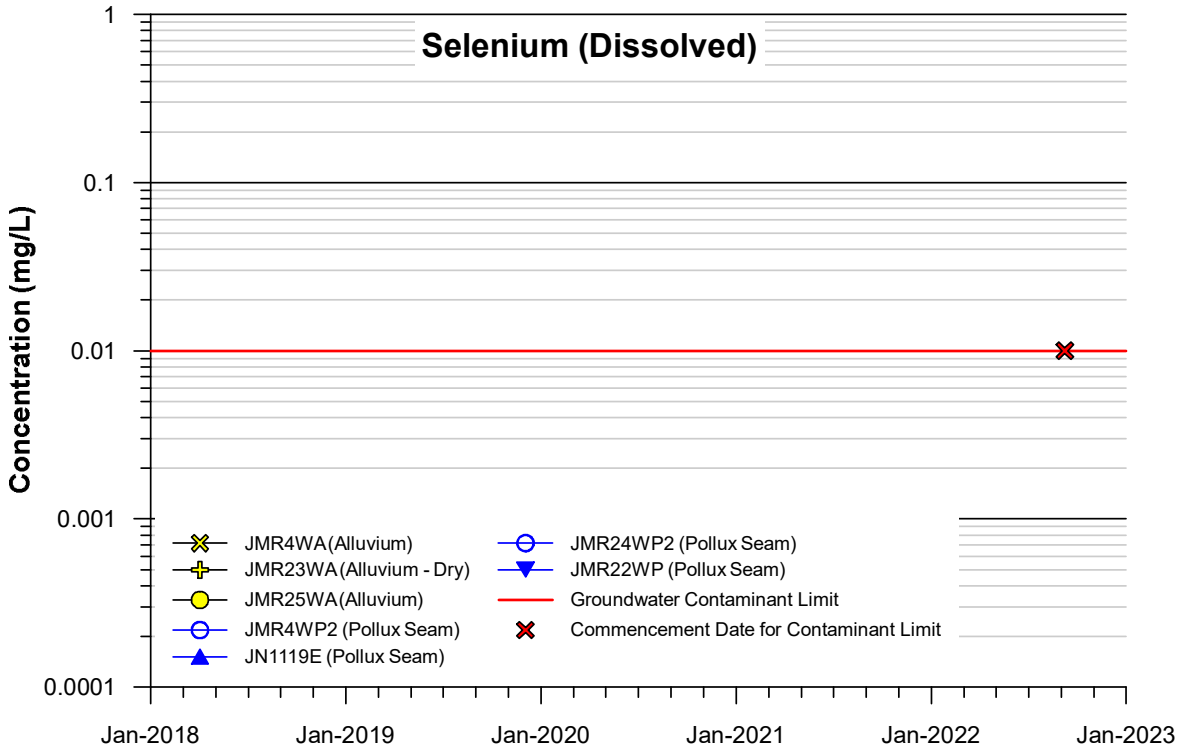

Figure 5-11: Dissolved Selenium Data – Compliance Bores

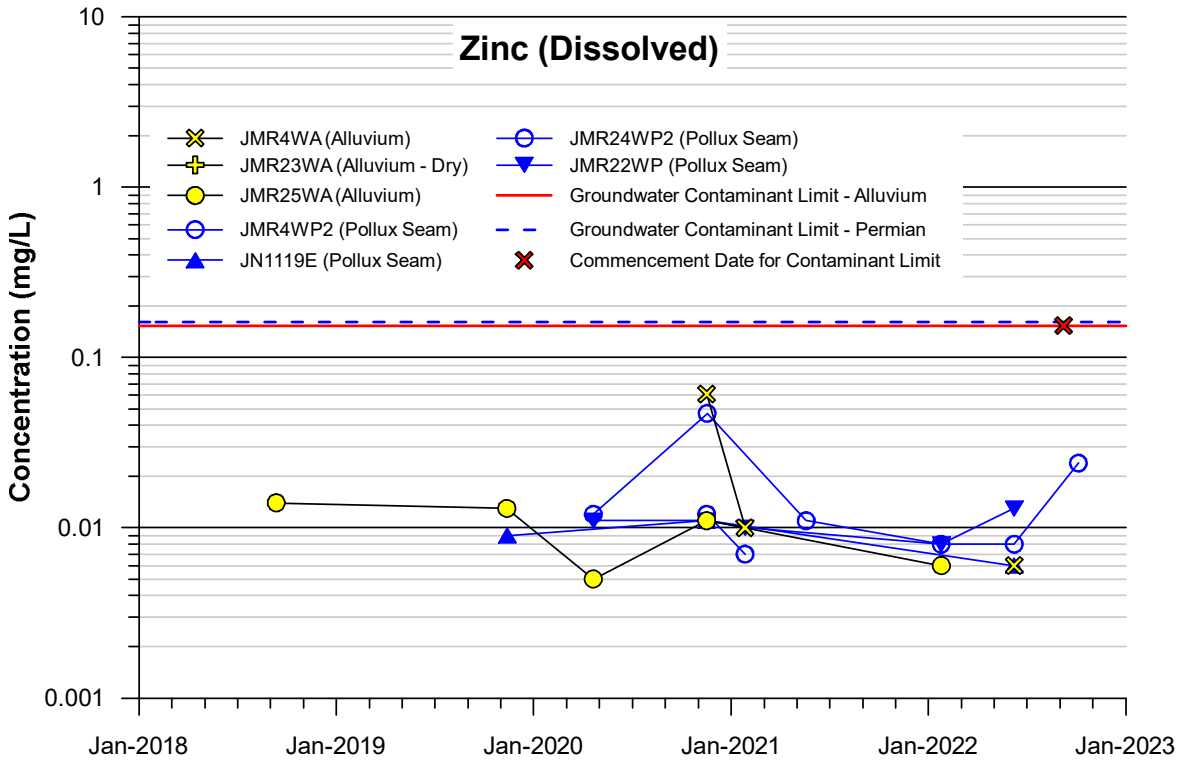

Figure 5-12: Dissolved Zinc Data – Compliance Bores

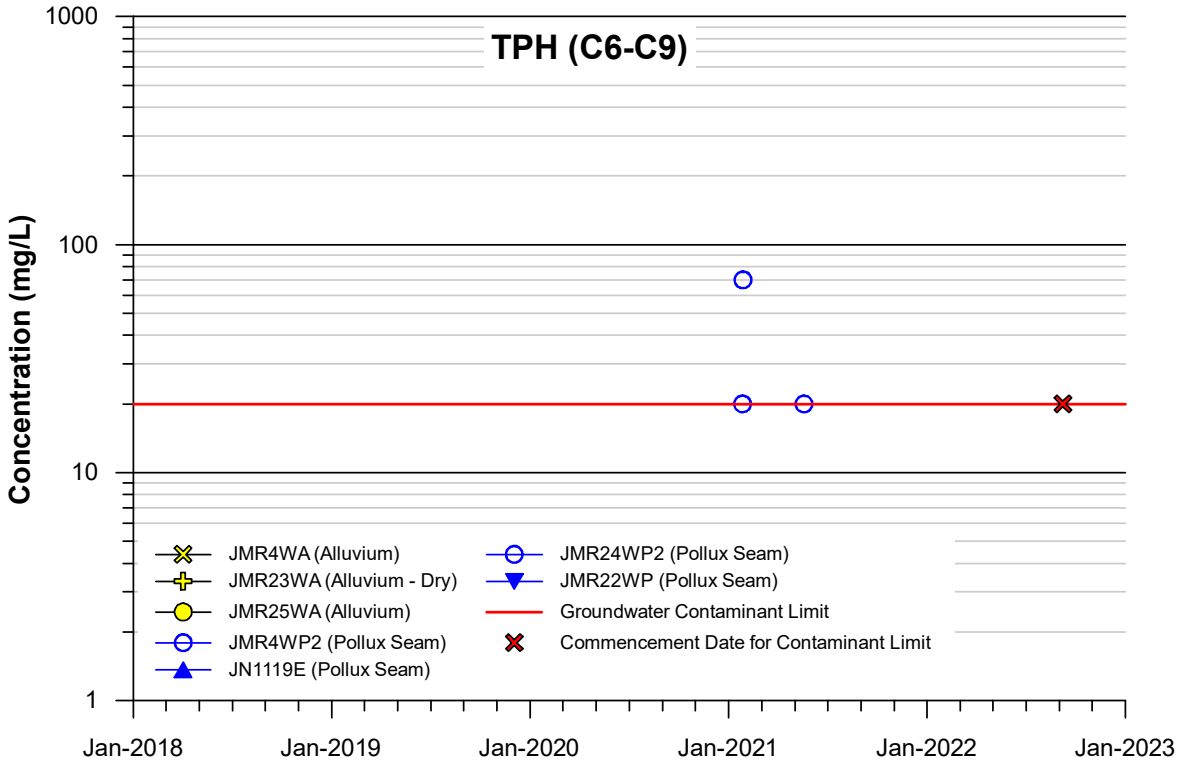

Figure 5-13: TPH Data – C6-C9 Fraction – Compliance Bores

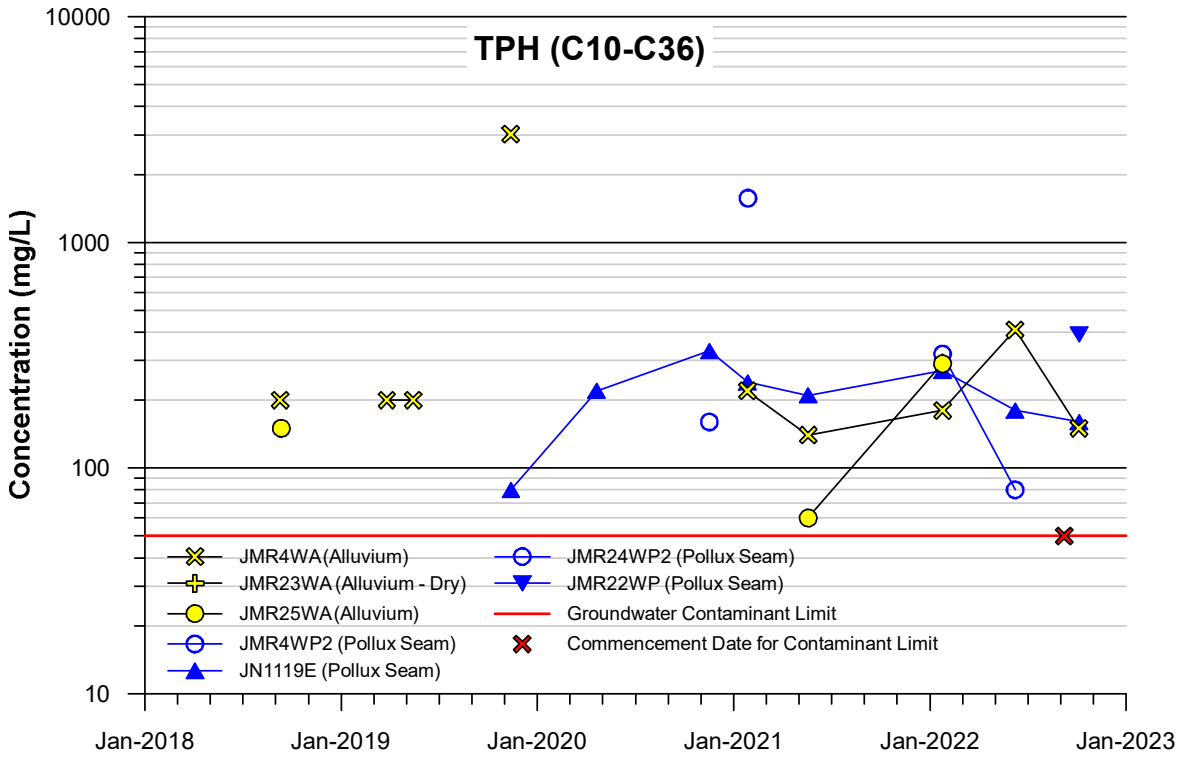

Figure 5-14: TPH Data – C10-C36 Fraction – Compliance Bores

5.2 Groundwater Level Monitoring

5.2.1 Monitoring Requirements

Water level monitoring is undertaken at all sites on a quarterly basis, with data loggers fitted to a number of alluvial monitoring bores that are located adjacent to the Mackenzie River (JMR4WA, JMR24WA and JMR25WA). The logger data from these bores is analysed to establish seasonal variations in water levels, including response to rainfall recharge and response to flow events in the Mackenzie River. Bore JMR24WA has been dry since commencement of monitoring and the logger is installed in the bore only to detect water level impacts from significant recharge events. The groundwater level has never been above the base of the logger (i.e. the bore has always been dry), therefore logger data for JMR24WA is not discussed in this report.

5.2.2 Assessment of Groundwater Level Data

This section presents the following tables and figures:

- Table 5-3 shows the EA groundwater level monitoring locations, the required monitoring frequency and the groundwater drawdown triggers for each bore (based on Table I4 of the EA).
- Table 5-4 shows the observed groundwater level drawdown at October 2022 (most recent 2022 reading) relative to the baseline value for each monitoring site.
- Figure 5-15 shows the hydrographs (groundwater elevation over time) for each monitoring site.
- Figure 5-16 shows datalogger and manual water level data for alluvium bore JMR4WA.
- Figure 5-17 shows datalogger and manual water level data for alluvium bore JMR25WA.
- Figure 5-18 shows ground Elevation contours for the mining area at December 2022.
- Figure 5-19 shows the depth of mining below groundwater, based on subtraction of the December 2022 ground elevation contours (within the mining area) from the Pre-Mining (Dec 2012) Permian groundwater level. Figure 5-19 also shows the October 2022 groundwater elevation for bores that are closest to the mining area.

Available groundwater level data is also included in Appendix B.

Based on review of available groundwater level data, the following observations are made with respect to groundwater level trends and evidence for mining impacts on groundwater levels:

- The majority of bores record a water level reduction between July 2017 and January 2022, with this reduction in water level interpreted to be related to below-average rainfall conditions over this period (Figure 5-15 also includes the rainfall residual mass curve, which indicates below-average rainfall over this period);
- As noted in Section 3.0, above-average rainfall occurred between November 2021 and November 2022 that is interpreted to have caused recharge and subsequently rising groundwater levels (or at least a slowing-down in the rate of water level reduction) at a number of groundwater monitoring sites.
- With respect to bores that monitor the Quaternary and Tertiary alluvium, observations include:
    - JMR4WA –the water level at this site has been in decline since monitoring commenced in October 2015, which is interpreted to be related to climatic conditions. Figure 5-16 shows available data logger data for JMR4WA, which has been collected at 6-hourly intervals since November 2020, as well as daily rainfall data from the Mackenzie North AWS. High rainfall periods in November 2021 and May 2022 correspond with minor increases in water level in the logger data. The logger water level rapidly returns to the pre-rainfall level; however, the reducing water level trend slows down after

November 2021, indicating that the above-average rainfall in the period November 2021 to November 2022 has provided some recharge to the alluvial aquifer at this location.

- JMR25WA – the water level has fallen below the base of bore at this site; the water level was recorded as 2.26 m above base of bore when monitoring commenced in October 2018 and the bore was recorded as being at the base of the bore in June 2022 and dry in August 2022. The water level reduction at this site is interpreted to be related to climatic conditions. JMR25WA has a data logger fitted that records at 6-hourly intervals, with logger data shown in Figure 5-17. The logger was installed approximately 0.5 m above the base of the bore. The water level fell below the base of the logger in ~August 2021 and, as stated above, manual data indicates that the water level was at the base of the bore in June 2022 and that the bore has been dry from August 2022 onwards.
- Compliance monitoring bores JMR22WA, JMR23WA and JMR24WA are currently dry and have been since at least October 2018.
- Bores JP0911T and JP0912T monitor the Tertiary alluvium to the south of the Mackenzie River. Both bores recorded a slight water level rise between March and June 2022 that is interpreted to be related to recharge from the above-average rainfall in May 2022. From Figure 5-15 a slight water level rise is evident in these bores for post-January 2022 data, with the most recent reading (October 2022) recording a slight decline at both sites. At a number of other monitoring sites a reduction in the rate of groundwater level decline is also evident for the period post-August 2021, which is interpreted to indicate groundwater recharge at these sites.

- With respect to bores that monitor the Permian sediments, observations include:
  - JMR24WP2 – this bore recorded a significant rise in water level between the August 2021 and January 2022 monitoring events, which is interpreted to be related to the above-average November rainfall. These bores continued to show a water level rise in monitoring events to June 2022, which is interpreted to be related to additional recharge from the above-average rainfall in May 2022. A return to a declining water level trend is noted for the past two monitoring events. This bore is located in the north of the mining area and the lower groundwater level relative to other bores (as evident in Figure 5-15) is related to the location of the bore relative to the overall groundwater elevation contours for this unit (refer Figure 5-19 for pre-mining Permian groundwater level contours). Based on available water level data for these bores (i.e. October 2022 groundwater level relative to the December 2012 groundwater level), it is interpreted that the Permian groundwater level at this location is not impacted by mining to date;
  - JN1119E - the pit crest had advanced to within ~720 m of this bore by December 2022. The magnitude of water level reduction was greater at this site over the period between January 2021 and October 2022 (-4.56 m) than has been observed at any other Permian site (maximum drawdown recorded in other Permian bores over the same period was -1.27 m in bore JMR22WP). It is therefore interpreted that mining impacts are evident on groundwater levels at the site of JN1119E.
  - JMR4WP2 – this bore was located approximately 3,400 m from the pit crest at December 2022 and recorded a water level reduction of -0.90 m between January 2021 and October 2022. This water level reduction is interpreted to be related to climatic conditions and it is interpreted that there is no evidence to date of groundwater level impacts at this site.
- With respect to evidence of impact of mining activities (and with reference to EA Table I4 and Table 5-4 of this report) it is concluded that:
  - Permian groundwater unit:
    - JN1119E - as noted above, mining impacts are interpreted at the site of Permian monitoring bore JN1119E; however, it is noted that, with respect to the drawdown level trigger threshold, the

observed drawdown of -4.85 m relative to baseline conditions is significantly less than the end of mining drawdown threshold of -100 m at this site.

- Mining impacts are not interpreted to date for other Permian monitoring sites. The observed water level drawdown at October 2022 relative to the baseline level, as well as the remaining drawdown at each site until the drawdown level trigger threshold is reached, are shown in Table 5-4.

- Alluvium groundwater unit:
  - Groundwater level data for bores in the Quaternary alluvium that are closest to the mining area, at October 2022. It is noted that both bores shown in Figure 6-2, (JMR22WA and JMR24WA) are dry; these bores were also dry in December 2012 (AGE 2013) and have been dry for every monitoring event since that time. It is also noted that alluvial bore JMR18WA, which was located within the current mining area and has now been destroyed, was also dry in December 2012. It is therefore concluded that the Quaternary alluvium is dry in the current area of mining;

- Other observations with respect to mining impacts on groundwater are as follows:
  - Figure 5-18 shows the extent of mining and ground elevation contours within the mining area at December 2022; this figure shows that the deepest area of mining at December 2022 (eastern side of the pit) was at ~25 mAHD compared to a ground elevation at the adjacent pit crest of ~120 mAHD, i.e. the deepest point of mining was approximately 95 mbgl.
  - Figure 5-19 shows the depth of mining at December 2022 below the pre-mining groundwater level. Figure 5-19 shows the following information:
    - Groundwater level contours for the Permian groundwater unit, based on water level data available for December 2012 in AGE (2013);
    - Groundwater level data for bores in the Quaternary alluvium that are closest to the mining area, at October 2022. It is noted that both bores shown in Figure 6-2, (JMR22WA and JMR24WA) are dry; these bores were also dry in December 2012 (AGE 2013) and have been dry for every monitoring event since that time. It is also noted that alluvial bore JMR18WA, which was located within the current mining area and has now been destroyed, was also dry in December 2012. It is therefore concluded that the Quaternary alluvium is dry in the current area of mining;
    - Groundwater level data for Permian bores close to the mining area, at October 2022. It is noted that the water levels at October 2022 are similar or slightly higher than the water level contours from December 2012; therefore, it is concluded that the extent of groundwater impacts due to mining is limit. Notwithstanding this observation, it is concluded (as discussed above) that mining impacts are evident in the water level data for bore JN1119E;
    - Contours showing the depth and extent of mining at December 2022 below the Permian groundwater level contours for December 2012. These contours are taken to represent the approximate depth of mining below the groundwater level, which was in the order of 55 m in the deepest areas of mining. Based on discussions with mine personnel, there have been no observations of groundwater inflow to the mine at this stage. It is therefore concluded that, at the current depth of mining, the rate of groundwater inflow would be less than the rate of evaporation and that this would give the impression of a dry pit.

Table 5-3: Groundwater Level Monitoring Locations, Frequency and Triggers (Table I4 of EA)

Monitoring Bore	Hydrogeological Unit	Location (decimal degrees, GDA2020)		Surface RL (mAHD)	Screened Interval (mbgl)		Monitoring Frequency[1]	Baseline water level (mAHD)[3]	Level Trigger Threshold – End of mining drawdown[2] (m)
		Latitude	Longitude		From	To			
Interpretation Bores									
JP0911T	Alluvium	-23.264898	148.901783	124.86	22	28	Q	99.48	N/A
JP0912T	Alluvium	-23.262135	148.928424	122.56	36	42	Q	100.89	N/A
JMR26WA	Alluvium	-23.265381	148.921434	123.40	18.2	21.2	Q	Dry	N/A
Compliance Bores									
JMR4WP2	Permian-Pollux seam	-23.253030	148.915413	124.00	83.5	88	Q	103.20	18
JMR24WP2	Permian-Overburden	-23.208712	148.927998	120.50	72.8	78.8	Q	77.81	55
JMR4WA	Alluvium	-23.253039	148.915384	123.80	36	42	Q	103.25	10 to 20
JMR25WA	Alluvium	-23.249658	148.919381	122.50	17.9	20.9	Q	102.43	5 to 10
JMR22WP	Permian	-23.228966	148.926433	122.2	157	163	Q	101.24	90
JMR22WA	Alluvium	-23.229120	148.926396	122.2	14.5	17.5	Q	Dry	N/A
JN1119E	Permian	-23.225812	148.925928	121.38	140	146	Q	100.79	100
JMR24WA	Alluvium	-23.208712	148.927979	120.40	14.8	17.8	Q	Dry	N/A
JMR23WA	Alluvium	-23.242885	148.927600	122.30	17.2	20.2	Q	Dry	N/A

1. Q-quarterly monitoring (every 3 months).
2. Trigger level thresholds sourced from 'Australasian Groundwater & Environmental Consultants Pty Ltd, report on Mackenzie North groundwater assessment, June 2013' (AGE 2013).
3. Baseline water levels are underpinned by data gathered prior to July 2020 (as mining of coal in the Mackenzie North Pit commenced in August 2020).

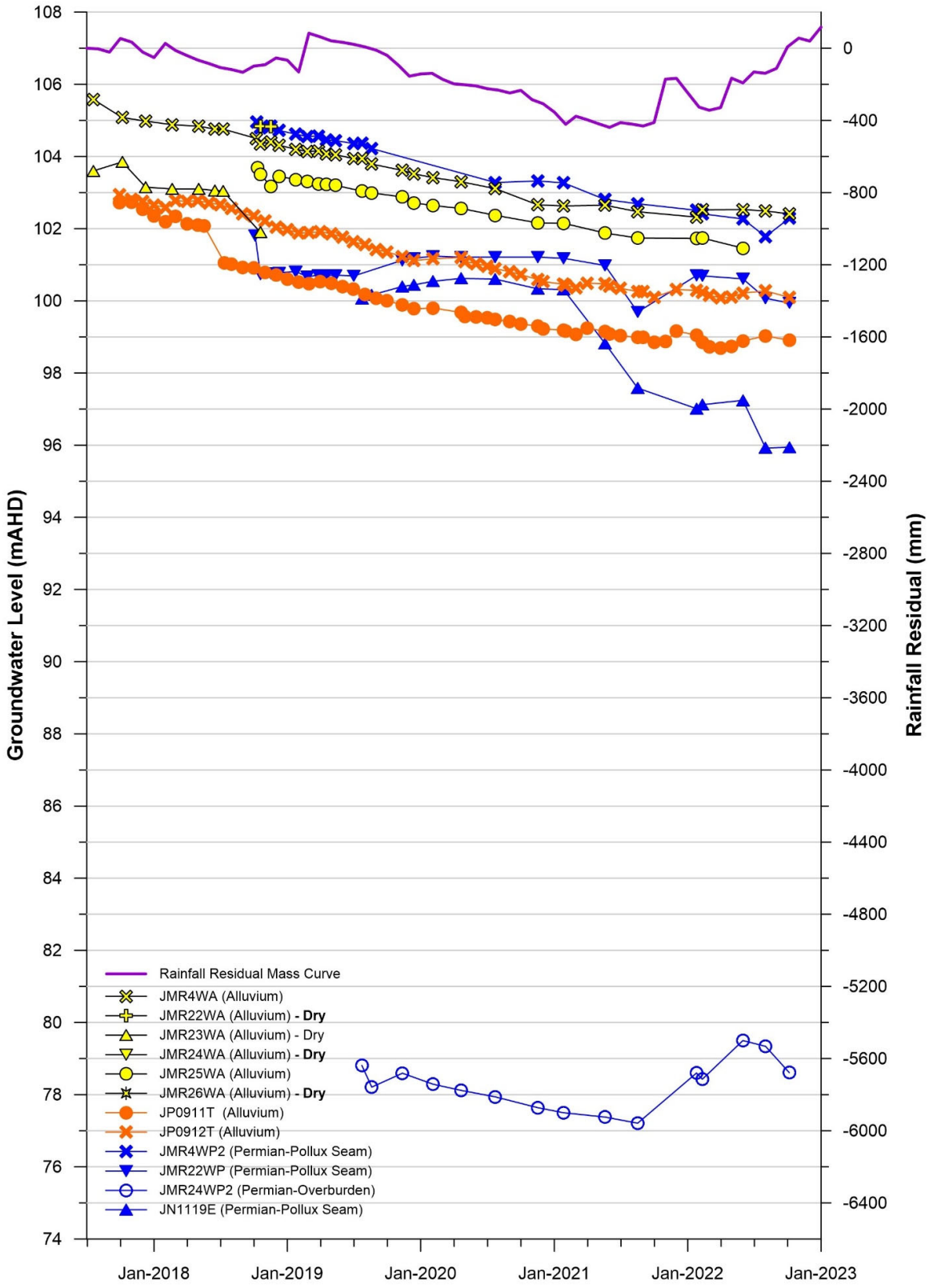

Figure 5-15: Water Level Hydrographs for Groundwater Monitoring Bores

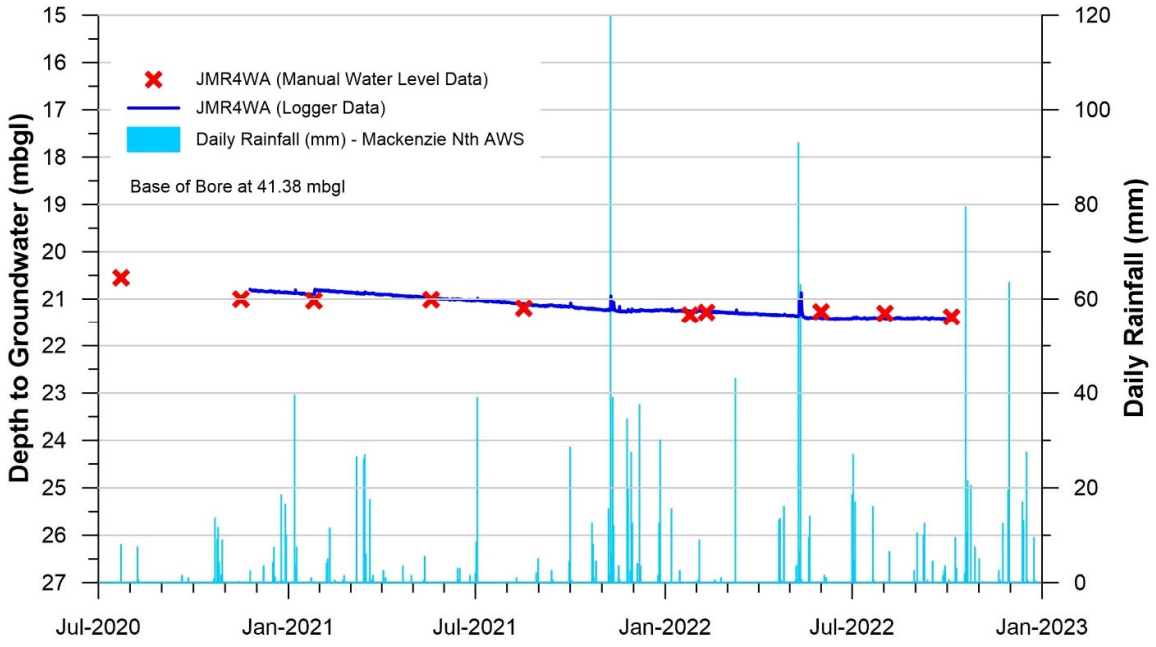

Figure 5-16: Datalogger and Manual Water Level Data – Bore JMR4WA

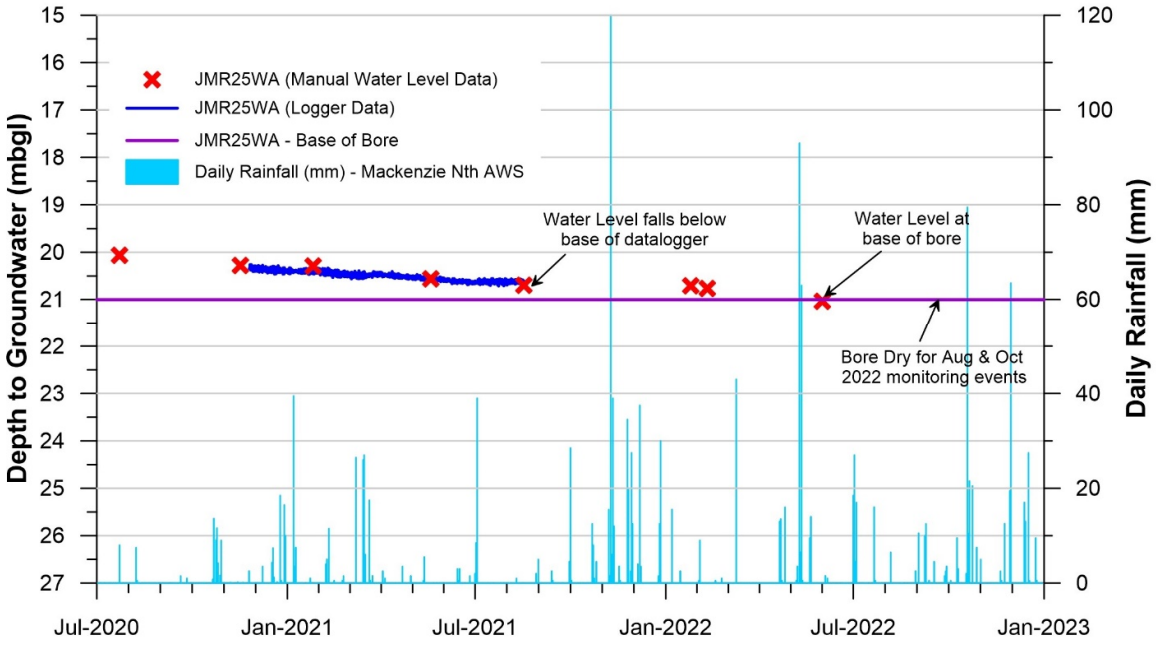

Figure 5-17: Datalogger and Manual Water Level Data – Bore JMR25WA

Table 5-4: Observed Groundwater Level Drawdown Relative to Baseline

Date	Unit	Baseline Waterlevel (mAHD)[1]	Trigger Level Threshold - End of Mining Drawdown (m)[1]	Water Level (mAHD) Oct-2022	Observed Drawdown (m)[2]	Remaining Drawdown (m) until Trigger Threshold
JMR4WA	Alluvium	103.25	10 to 20	102.41	-0.84	9.16 to 19.16
JMR4WP2	Permian	103.2	18	102.29	-0.91	17.09
JMR22WA	Alluvium	Dry	N/A	Dry	N/A	N/A
JMR22WP	Permian	101.24	90	99.94	-1.30	88.7
JN1119E	Permian	100.79	100	95.94	-4.85	95.15
JMR23WA	Alluvium	Dry	N/A	Dry	N/A	N/A
JMR24WA	Alluvium	Dry	N/A	Dry	N/A	N/A
JMR24WP2	Permian	77.81	55	78.61	0.80	55.8
JMR25WA	Alluvium	102.43	5 to 10	Dry	N/A	Dry
JMR26WA	Alluvium	Dry	N/A	Dry	N/A	N/A
JP0911T	Alluvium	99.48	N/A	98.91	-0.57	N/A
JP0912T	Alluvium	100.89	N/A	100.10	-0.80	N/A

1. From Table I3 of EA (Refer also Table 5-3 of this report)
2. Difference in water level between baseline water level and October 2022 observed water level – a negative value indicates water level drawdown relative to baseline value

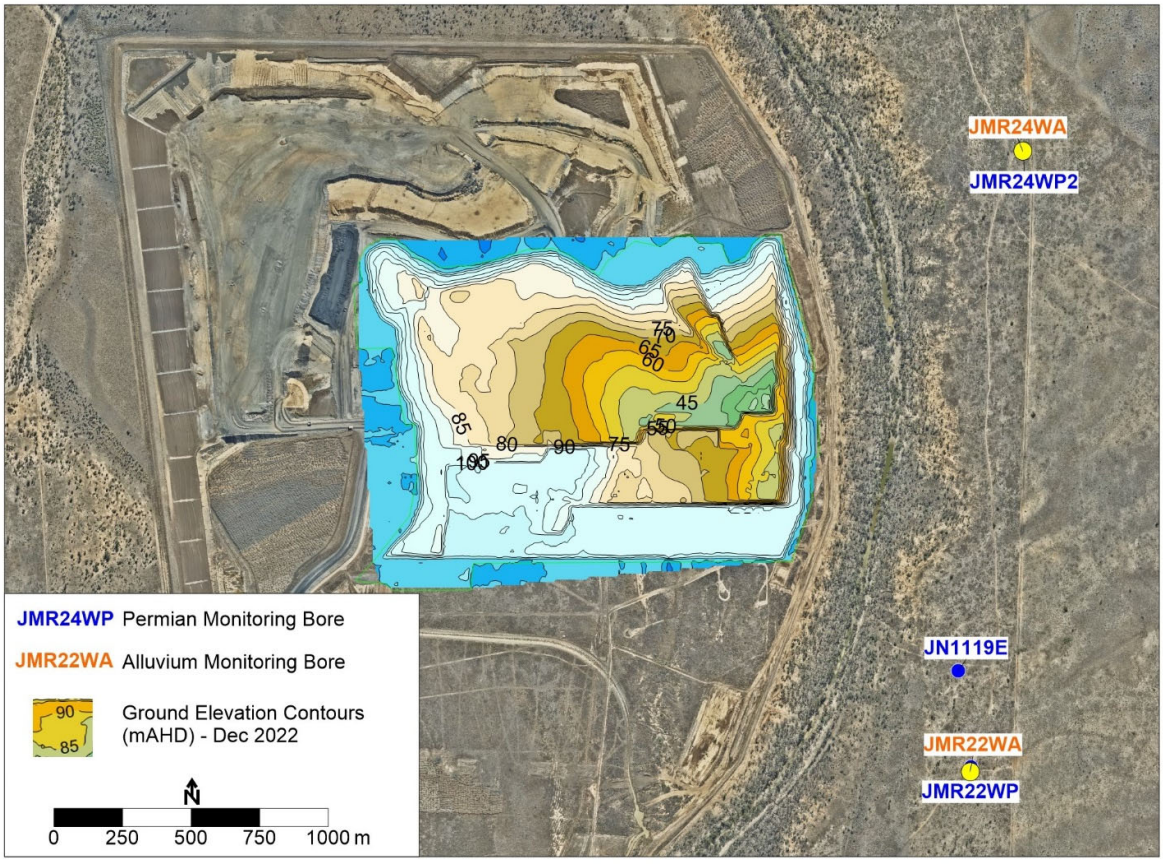

Figure 5-18: Ground Elevation Contours – Mining Area – December 2022

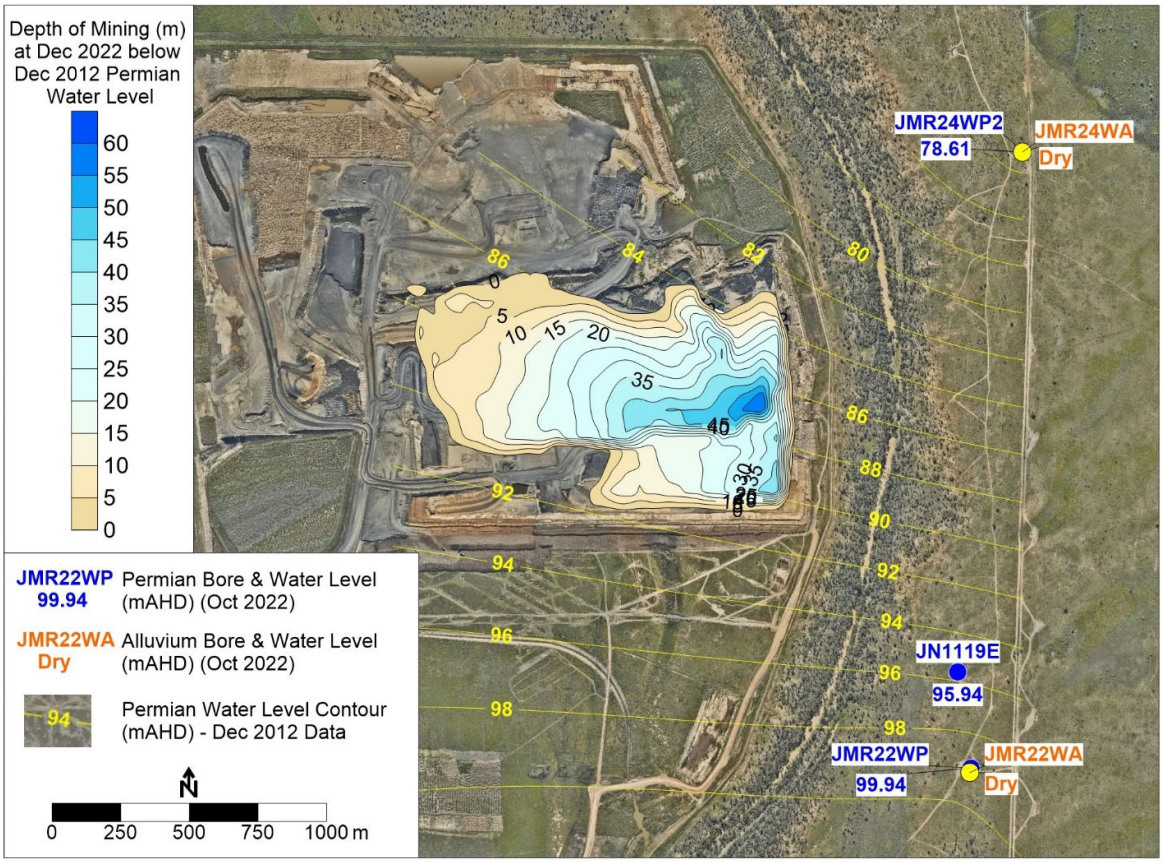

Figure 5-19: Oct 2022 Water Level Relative to Pre-Mining (Dec 2012) Water Level

6.0 ASSESSMENT OF SURFACE WATER DATA

Condition I17 of the EA requires that the AGMR include a comparison of groundwater monitoring results with receiving environment surface water quality monitoring results, to determine any interaction or impact from groundwater on surface water. Following review of available groundwater surface water monitoring data the following observations are made

- Within the impacted zone for groundwater drawdown impacts, groundwater flow will be towards the pit and impacts away from the mining area could not be expected to occur via the deep (i.e. Permian) groundwater system which, in any case, occurs at a depth of > 20 mbgl and is therefore disconnected from the surface water system.
- Where groundwater is observed in alluvium bores (generally in bores that are close to the Mackenzie River), the depth to groundwater is also in the order of 20 mbgl. In all alluvium monitoring bores that are close to the current mining area, the alluvium is dry and has been since commencement of monitoring (e.g. at the time of the AGE 2013 groundwater assessment[3])
- The locations of surface water monitoring points are shown in Figure 4-1. Based on the overall direction of groundwater flow from south to north (in the case of the Permian coal measures – refer Figure 5-19) and the disconnected nature of groundwater in the alluvial sediments(as the alluvium is dry over much of the mining area – refer Section 5.2.2), the most likely indicator of current surface water/ groundwater impacts related to mining would be at surface water monitoring point MP6, which is located on the Mackenzie River Anabranch to the north (and downgradient of) the mining area.
    - The most reliable general indicator of water quality impacts is assessed to be electrical conductivity (EC). Summary EC statistics for groundwater units (alluvium and Permian), including minimum, maximum, mean and median EC values and sample count, as well as the most recent sample value and sample date (for alluvium, one sample is available for October 2022 from bore JMR4WA; for the Permian Groundwater unit, the sample range is for samples from bores JMR4WP2, JMR22WP, JMR24WP2 and JN1119E).

In summary, the significant discrepancy in EC values between surface water and groundwater monitoring sites, as well as the low groundwater level (generally >20 mbgl) in groundwater bores, is interpreted to indicate that there is currently no interaction between groundwater and surface water at the surface water monitoring locations.

- Table 6-1 (below) shows the following:
    - Summary EC statistics for surface water sites (minimum, maximum, mean and median EC values and sample count) as well as the most recent sample value and sample date.
    - Summary EC statistics for groundwater units (alluvium and Permian), including minimum, maximum, mean and median EC values and sample count, as well as the most recent sample value and sample date (for alluvium, one sample is available for October 2022 from bore JMR4WA; for the Permian Groundwater unit, the sample range is for samples from bores JMR4WP2, JMR22WP, JMR24WP2 and JN1119E).

In summary, the significant discrepancy in EC values between surface water and groundwater monitoring sites, as well as the low groundwater level (generally >20 mbgl) in groundwater bores, is interpreted to

[3] AGE (2013) Mackenzie North Groundwater Assessment. Report prepared for Australasian Resource Consultants Pty Ltd (AARC) by Australasian Groundwater and Environmental Consultants (AGE). Project No. G1512, May 2013.

indicate that there is currently no interaction between groundwater and surface water at the surface water monitoring locations.

Table 6-1: Electrical Conductivity (EC) at Surface Water & Groundwater Sampling Points

Monitoring Location		Min	Max	Mean	Median	Sample Count	Most Recent Value	Sample Date
Surface Water Sites	MP4	167	482	279	261	9	167	Jun 2022
	MP5	185	328	248	240	4	328	Jun 2022
	MP6	185	283			2	283	Apr 2022
	MP7	273	458			2	458	Apr 2022
Groundwater Sites	Alluvium	1171	7189	4031	4863	29	5960	Oct 2022
	Permian	1074	18096	9907	8921	57	3952 – 14657	Oct 2022

7.0 SUMMARY AND CONCLUSIONS

Following review of available data the following summary and conclusions are made:

- Monitoring of groundwater level and groundwater quality is occurring at 12 monitoring sites, at a frequency and for parameters that are in accordance with the requirements of the Project's Environmental Authority number EPML00516813.
- During the 12-month period covered by this report, no new groundwater monitoring bores have been installed and no bores have been decommissioned.
- Groundwater level observations are discussed in Section 5.2 and observations of note include:
  - The majority of bores record a water level reduction between July 2017 and January 2022, with this reduction in water level interpreted to be related to below-average rainfall conditions over this period (Figure 5-15 also includes the rainfall residual mass curve, which indicates below-average rainfall over this period);
  - As noted in Section 3.0, above-average rainfall occurred between November 2021 and November 2022 that is interpreted to have caused recharge and subsequently rising groundwater levels (or at least a slowing-down in the rate of water level reduction) at a number of groundwater monitoring sites.
  - With respect to bores that monitor the Quaternary and Tertiary alluvium, observations include:
    - JMR4WA –the water level at this site has been in decline since monitoring commenced in October 2015, which is interpreted to be related to climatic conditions. However, the reducing water level trend slows down after November 2021, indicating that the above-average rainfall in the period November 2021 to November 2022 has provided some recharge to the alluvial aquifer at this location.
    - JMR25WA – the water level has fallen below the base of bore at this site; the water level was recorded as 2.26 m above base of bore when monitoring commenced in October 2018 and the bore was recorded as being at the base of the bore in June 2022 and dry in August 2022. The water level reduction at this site is interpreted to be related to climatic conditions.
    - Compliance monitoring bores JMR22WA, JMR23WA and JMR24WA are currently dry and have been since at least October 2018.
    - Bores JP0911T and JP0912T monitor the Tertiary alluvium to the south of the Mackenzie River. Both bores recorded a slight water level rise between March and June 2022 that is interpreted to be related to recharge from the above-average rainfall in May 2022.
  - With respect to bores that monitor the Permian sediments, observations include:

- JN1119E - the pit crest had advanced to within ~720 m of this bore by December 2022. The magnitude of water level reduction was greater at this site over the period between January 2021 and October 2022 (-4.56 m) than has been observed at any other Permian site (maximum drawdown recorded in other Permian bores over the same period was -1.27 m in bore JMR22WP). It is therefore interpreted that mining impacts are evident on groundwater levels at the site of JN1119E. It is also concluded that, with respect to the drawdown level trigger threshold, the observed drawdown of -4.85 m relative to baseline conditions is significantly less than the end of mining drawdown threshold of -100 m at this site.
- At other Permian monitoring bore sites (JMR22WP, JMR24WP2, JMR4WP2) no mining impacts are currently interpreted.

- Groundwater quality observations are discussed in Section 5.2.1, which includes presentation of available groundwater quality data relative to the EA groundwater quality limits (for pH, EC and sulfate) and groundwater contaminant limits (for dissolved metals/metalloids and TPH). Observations of note include:
  - Dissolved Molybdenum data:
    - The majority of bores record dissolved molybdenum concentrations that are below the contaminant limit of 0.034 mg/L. The exception is bore JN1119E (Pollux Seam), which records a concentration range of 0.007 to 0.077 mg/L (mean of 0.053 mg/L and median of 0.059 mg/L). Based on the historical data for JN1119E, it could be expected that three consecutive readings above the contaminant limit could be recorded within the next two monitoring events. Bore JN1119E also records a high field pH (generally >11) and may have construction issues (it is noted that the high molybdenum concentration at this site extends back to 2019 and is therefore pre-mining activities). As such, the data from this bore may be unreliable for the purposes of groundwater quality assessment and the water quality for bore JMR22WP is likely to be more representative of groundwater quality in the general area of this bore.
    - **Recommendation** - it is therefore recommended that consideration be given to removing JN1119E as a water quality assessment bore, but retaining the bore for the purpose of water level assessment.
  - TPH C10-C36 Data:
    - A number of bores regularly record TPH C10-C36 concentrations where historic data is above the contaminant limit for 3 consecutive samples. This includes:
      - Bore JN1119E (Pollux Seam), which, as noted above, may be a suspect bore in terms of bore construction; and,
      - Bore JMR4WA (alluvium), where the past 5 samples have been above the contaminant limit (though three consecutive samples above the contaminant limit have not been detected since the EA commencement date of 8 September 2022).
    - The presence of hydrocarbon contamination in groundwater is not suspected as the high concentrations exist from the period that is pre-mining activities.
    - **Recommendation** - it is recommended that TPH samples be tested via the silica gel cleanup method (for at least the next 12 months of quarterly sampling) to establish whether the hydrocarbons are biogenic (naturally occurring) and therefore not indicative of contamination due to site activities.

- Section 6.0 presents a comparison of groundwater monitoring results with receiving environment surface water quality monitoring results, to determine any interaction or impact from groundwater on surface water. It is concluded that:
    - the significant discrepancy in EC values between surface water and groundwater monitoring sites, as well as the low groundwater level (generally >20 mbgl) in groundwater bores, is interpreted to indicate that there is currently no interaction between groundwater and surface water at the surface water monitoring locations.

ATTACHMENT A

Water Quality Monitoring Data

Mackenzie North Groundwater Quality Monitoring

pH, EC, TDS, Major Ions, Hydrocarbon Data

Bore ID	Sample Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
		Field	Lab	Field	Lab	Total Dissolved Solids (TDS)	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Hydroxide Alkalinity	Carbonate Alkalinity	Bicarbonate Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
		pH	pH	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
JMR24WP	12-Nov-2019	7.56	8.14	9490	9570	6530	224	131	1590	8	3270	8	<1	<1	222	222	<20	<50	<100	<50	<50
JMR24WP	20-Apr-2020	7.53	7.97	7950	8250	5190	202	152	1220	8	2670	<1	<1	<1	198	198	<20	<50	<100	<50	<50
JMR24WP	16-Nov-2020	7.61	7.98	8269	7860	5570	203	147	1300	9	2800	4	<1	<1	215	215	<20	<50	<100	<50	<50
JMR24WP	26-Jan-2021	7.33	7.98	8308	8020	5210	191	144	1200	7	2850	12	<1	<1	204	204	<20	<50	<100	<50	<50
JMR24WP	19-May-2021	7.32	7.94	7966	7810	4510	180	124	1170	7	2740	2	<1	<1	203	203	<20	<50	<100	<50	<50
JMR24WP	24-Jan-2022	7.58	8.04	7752	7790	5140	189	137	1300	8	2720	1	<1	<1	212	212	<20	<50	<100	<50	<50
JMR24WP	08-Jun-2022	7.6	8.09	7670	7830	5260	181	132	1300	8	2680	1	<1	<1	204	204	<20	<50	<100	<50	<50
JMR24WP	05-Oct-2022	7.24	7.77	7875	8230	4630	168	126	1290	7	2630	2	<1	<1	221	221	<20	<50	<100	<50	<50
JMR24WP2	20-Apr-2020	7.38	7.96	8587	8870	5500	182	125	1420	8	2910	2	<1	<1	204	204	<20	<50	<100	<50	<50
JMR24WP2	17-Nov-2020	7.4	7.86	8036	7730	5190	172	111	1370	7	2750	<1	<1	<1	214	214	<20	<50	<100	<50	<50
JMR24WP2	27-Jan-2021	6.79	7.8	11491	11200	6420	281	171	1910	8	3430	404	<1	<1	992	992	70	<50	960	610	1570
JMR24WP2	19-May-2021	7.34	7.96	7553	7400	4250	139	90	1150	7	2550	<1	<1	<1	233	233	<20	<50	<100	<50	<50
JMR24WP2	24-Jan-2022	7.54	8.07	7059	7110	4550	144	97	1290	7	2350	<1	<1	<1	282	282	<20	50	150	120	320
JMR24WP2	08-Jun-2022	7.62	8.2	6912	7060	4460	134	93	1270	6	2260	<1	<1	<1	266	266	<20	<50	<100	80	80
JMR24WP2	05-Oct-2022	7.31	7.89	7116	7460	4410	120	90	1280	6	2280	6	<1	<1	298	298	<20	<50	<100	<50	<50
JMR25WA	11-Sep-2018	6.45	7.01	1171	1190	905	67	43	66	5	282	14	<1	<1	161	161	<20	<50	100	50	150
JMR25WA	29-Nov-2018	6.45	6.93	1299	1200	738	81	44	80	5	298	17	<1	<1	153	153	<20	<50	<100	<50	<50
JMR25WA	24-Jan-2019	6.5	6.99	1273	1200	1010	82	44	83	5	302	15	<1	<1	171	171	<20	<50	<100	<50	<50
JMR25WA	27-Mar-2019	6.66	7.51	1292	1260	909	93	49	97	6	297	16	<1	<1	163	163	<20	<50	<100	<50	<50
JMR25WA	15-May-2019	6.47	7.14	1374	1220	919	96	50	96	5	334	16	<1	<1	166	166	<20	<50	<100	<50	<50
JMR25WA	25-Jul-2019	6.78	7.03	1272	1280	815	82	43	87	5	316	14	<1	<1	184	184	<20	<50	<100	<50	<50
JMR25WA	12-Nov-2019	6.44	7.32	1285	1280	942	90	45	99	5	327	8	<1	<1	189	189	<20	<50	<100	<50	<50
JMR25WA	20-Apr-2020	6.54	7.44	1561	1560	1040	99	60	122	3	401	6	<1	<1	197	197	<20	<50	<100	<50	<50
JMR25WA	16-Nov-2020	6.54	7.16	1904	1870	1430	120	74	159	4	522	5	<1	<1	242	242	<20	<50	<100	<50	<50
JMR25WA	26-Jan-2021	6.56	7.55	2029	1920	1460	113	74	153	2	545	6	<1	<1	235	235	<20	<50	<100	<50	<50
JMR25WA	19-May-2021	6.74	7.71	2358	2220	1510	124	77	178	2	656	2	<1	<1	276	276	<20	<50	<100	60	60
JMR25WA	24-Jan-2022	6.68	7.48	2072	2070	1670	130	80	183	5	590	3	<1	<1	270	270	<20	<50	170	120	290
JMR4WA	09-Sep-2018	6.51	7.05	7189	6570	3610	271	275	783	8	1620	96	<1	<1	838	838	<20	60	140	<50	200
JMR4WA	18-Nov-2018	6.54	6.97	6665	6450	3980	290	253	793	8	1440	81	<1	<1	834	834	<20	<50	<100	<50	<50
JMR4WA	24-Jan-2019	6.4	7.13	6604	6360	4280	299	253	784	8	1670	78	<1	<1	843	843	<20	<50	<100	<50	<50
JMR4WA	27-Mar-2019	6.73	7.68	6407	6400	3990	294	254	795	8	1510	88	<1	<1	832	832	<20	70	130	<50	200
JMR4WA	15-May-2019	6.56	7.07	6547	6070	4440	302	247	757	8	1720	102	<1	<1	794	794	<20	70	130	<50	200
JMR4WA	24-Jul-2019	6.37	7.03	6614	6550	4170	286	233	727	8	1660	105	<1	<1	882	882	<20	<50	<100	<50	<50
JMR4WA	12-Nov-2019	6.5	7.51	6161	6230	4310	287	228	716	7	1660	100	<1	<1	763	763	<20	<50	2170	850	3020
JMR4WA	20-Apr-2020	6.56	7.36	6133	6320	3800	244	236	683	8	1660	98	<1	<1	704	704	<20	<50	<100	<50	<50
JMR4WA	16-Nov-2020	7.26	7.88	4197	4040	2270	77	68	743	4	1100	66	<1	<1	475	475	<20	<50	<100	<50	<50
JMR4WA	26-Jan-2021	6.51	7.65	6333	6110	4240	260	240	676	7	1680	99	<1	<1	679	679	<20	<50	220	<50	220
JMR4WA	19-May-2021	6.59	7.55	6053	5890	3840	227	196	577	7	1640	93	<1	<1	668	668	<20	<50	140	<50	140
JMR4WA	24-Jan-2022	6.54	7.42	5856	5820	4020	235	214	622	7	1590	91	<1	<1	677	677	<20	50	130	<50	180
JMR4WA	08-Jun-2022	6.51	7.69	5529	5710	3850	231	229	659	8	1550	74	<1	<1	617	617	<20	<50	360	50	410
JMR4WA	05-Oct-2022	6.58	7.26	5627	5960	3990	219	213	644	7	1500	87	<1	<1	646	646	<20	<50	150	<50	150
JMR4WP	09-Sep-2018	7.07	7.65	7450	6870	4050	140	110	1070	5	1860	38	<1	<1	458	458	<20	<50	<100	<50	<50
JMR4WP	18-Nov-2018	7.08	7.44	8921	8600	5010	252	143	1490	7	2710	22	<1	<1	428	428	<20	<50	<100	<50	<50
JMR4WP	24-Jan-2019	6.91	7.54	9883	9500	5620	263	153	1570	6	3160	22	<1	<1	432	432	<20	<50	<100	<50	<50
JMR4WP	27-Mar-2019	7.29	8.01	9096	9070	5620	280	146	1610	7	2830	18	<1	<1	428	428	<20	<50	<100	<50	<50
JMR4WP	15-May-2019	7.06	7.68	9235	8620	5650	345	149	1650	7	3060	22	<1	<1	419	419	<20	<50	<100	<50	<50
JMR4WP	25-Jul-2019	6.9	7.59	8725	8760	5250	254	128	1380	6	2800	18	<1	<1	480	480	<20	<50	<100	<50	<50
JMR4WP	16-Nov-2020	6.62	7.28	6190	5920	4270	267	241	710	8	1640	98	<1	<1	696	696	<20	<50	160	<50	160
JMR4WP	26-Jan-2021	7.21	8.13	4099	3980	2170	62	65	695	4	1060	64	<1	<1	473	473	20	<50	<100	<50	<50
JMR4WP	19-May-2021	7.33	8.11	4046	3930	2170	61	53	621	4	1070	56	<1	<1	476	476	20	<50	<100	<50	<50
JMR4WP	24-Jan-2022	7.34	8.05	4207	4220	2330	63	56	670	4	1140	48	<1	<1	503	503	<20	<50	<100	<50	<50
JMR4WP	08-Jun-2022	7.13	8.14	3803	3930	2170	68	66	723	4	1040	43	<1	<1	457	457	<20	<50	<100	<50	<50
JMR4WP	05-Oct-2022	7.31	7.89	3952	3990	2180	66	57	733	5	1010	42	<1	<1	486	486	<20	<50	<100	<50	<50
JN1119E	13-Nov-2019	8.6	8.35	17353	18000	11400	98	99	3550	10	6300	3	<1	5	119	124	<20	<50	<100	80	80
JN1119E	20-Apr-2020	11.97	11.6	13343	13100	7670	90	<1	2550	17	3860	11	396	113	<1	509	<20	50	170	<50	220
JN1119E	16-Nov-2020	11.88	11.6	13958	12800	6880	81	<1	2680	18	4060	10	468	109	<1	578	<20	50	280	<50	330
JN1119E	26-Jan-2021	11.97	11.4	12691	11400	5310	7	<1	2240	12	3520	16	349	308	<1	657	<20	<50	240	<50	240
JN1119E	19-May-2021	11.98	11.6	11974	11100	6360	<1	<1	2240	12	3290	16	433	294	<1	727	<20	<50	210	<50	210
JN1119E	24-Jan-2022	12.08	12	11791	11300	6340	22	<1	2250	12	2870	18	712	253	<1	964	<20	70	200	<50	270

Mackenzie North Groundwater Quality Monitoring

pH, EC, TDS, Major Ions, Hydrocarbon Data

Bore ID	Sample Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
		Field	Lab	Field	Lab	Total Dissolved Solids (TDS)	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Hydroxide Alkalinity	Carbonate Alkalinity	Bicarbonate Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
		pH	pH	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
JN1119E	08-Jun-2022	12.01	11.6	10851	10300	5770	5	<1	2300	11	3100	14	379	394	<1	773	<20	50	130	<50	180
JN1119E	05-Oct-2022	12.03	11.8	12838	12700	5910	15	<1	2470	11	3140	12	733	340	<1	1070	<20	50	110	<50	160

Mackenzie North Groundwater Quality Monitoring

Dissolved Metals/Metalloids Data

Bore ID	Sample Date	Dissolved Metals																	
		Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Vanadium	Zinc	Boron	Iron
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
JMR24WP	12-Nov-2019	<0.01	0.002	<0.0001	0.004	<0.001	<0.001	<0.001	0.193	<0.0001	0.008	0.02	<0.01	<0.001	<0.001	<0.01	0.01	0.51	<0.05
JMR24WP	20-Apr-2020	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.196	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.014	0.49	<0.05
JMR24WP	16-Nov-2020	<0.01	0.002	<0.0001	0.002	<0.001	0.003	<0.001	0.214	<0.0001	0.004	0.017	<0.01	<0.001	<0.001	<0.01	0.019	0.36	<0.05
JMR24WP	26-Jan-2021	<0.01	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	0.22	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.017	0.46	<0.05
JMR24WP	19-May-2021	<0.01	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	0.218	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.017	0.46	<0.05
JMR24WP	24-Jan-2022	<0.01	0.002	<0.0001	0.016	<0.001	0.002	<0.001	0.248	<0.0001	0.016	0.072	<0.01	<0.001	<0.001	<0.01	0.014	0.51	<0.05
JMR24WP	08-Jun-2022	<0.01	0.002	<0.0001	<0.001	<0.001	0.002	<0.001	0.2	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.016	0.61	<0.05
JMR24WP	05-Oct-2022	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.219	<0.0001	0.002	0.008	<0.01	<0.001	<0.001	<0.01	0.03	0.55	<0.05
JMR24WP2	20-Apr-2020	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.257	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.012	0.43	0.2
JMR24WP2	17-Nov-2020	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.258	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.047	0.39	0.21
JMR24WP2	27-Jan-2021	0.02	0.003	<0.0001	0.003	<0.001	<0.001	<0.001	0.321	<0.0001	0.002	0.002	<0.01	<0.001	0.002	<0.01	<0.005	1.26	0.06
JMR24WP2	19-May-2021	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.217	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.011	0.5	0.16
JMR24WP2	24-Jan-2022		<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.23	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.008	0.6	<0.05
JMR24WP2	08-Jun-2022	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.202	<0.0001	0.003	0.003	<0.01	<0.001	<0.001	<0.01	0.008	0.64	<0.05
JMR24WP2	05-Oct-2022	<0.01	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.204	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.024	0.59	0.45
JMR25WA	11-Sep-2018	0.01	<0.001	<0.0001	<0.001		0.002	<0.001		<0.0001		0.001	<0.01				0.014		<0.05
JMR25WA	29-Nov-2018	<0.01	<0.001	<0.0001	<0.001	-	0.002	<0.001	0.015	<0.0001	<0.001	0.002	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	<0.05
JMR25WA	24-Jan-2019	<0.01	<0.001	<0.0001	0.001	<0.001	0.001	<0.001	0.016	<0.0001	<0.001	0.002	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	<0.05
JMR25WA	27-Mar-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.01	<0.0001	<0.001	0.001	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	<0.05
JMR25WA	15-May-2019	<0.01	<0.001	<0.0001	<0.001	0.001	<0.001	<0.001	0.088	<0.0001	<0.001	0.002	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	<0.05
JMR25WA	25-Jul-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.006	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	<0.05
JMR25WA	12-Nov-2019	<0.01	<0.001	0.0002	<0.001	<0.001	0.005	<0.001	0.022	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.013	<0.05	<0.05
JMR25WA	20-Apr-2020	<0.01	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	0.216	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.005	<0.05	<0.05
JMR25WA	16-Nov-2020	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.055	<0.0001	<0.001	0.007	<0.01	<0.001	0.001	<0.01	0.011	<0.05	<0.05
JMR25WA	26-Jan-2021	<0.01	0.001	<0.0001	<0.001	0.006	<0.001	<0.001	0.769	<0.0001	<0.001	0.014	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	0.09
JMR25WA	19-May-2021	<0.01	0.002	<0.0001	<0.001	0.01	<0.001	<0.001	1.9	<0.0001	0.001	0.023	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	0.34
JMR25WA	24-Jan-2022	<0.01	0.004	<0.0001	0.001	0.012	<0.001	<0.001	3.03	<0.0001	0.002	0.021	<0.01	<0.001	0.001	<0.01	0.006	0.07	4.43
JMR4WA	09-Sep-2018	<0.01	<0.001	<0.0001	<0.001		<0.001	<0.001		<0.0001		<0.001	<0.01				<0.005		5.61
JMR4WA	18-Nov-2018	<0.01	<0.001	<0.0001	<0.001	-	<0.001	<0.001	1.64	<0.0001	<0.001	<0.001	<0.01	<0.001	0.001	<0.01	<0.005	0.13	5.9
JMR4WA	24-Jan-2019	<0.01	<0.001	<0.0001	0.002	<0.001	<0.001	<0.001	1.94	<0.0001	<0.001	0.001	<0.01	<0.001	0.001	<0.01	<0.005	<0.05	6.69
JMR4WA	27-Mar-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.9	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	0.05	6.49
JMR4WA	15-May-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.67	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	6.45
JMR4WA	24-Jul-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.88	<0.0001	<0.001	<0.001	<0.01	<0.001	0.001	<0.01	<0.005	0.06	6.92
JMR4WA	12-Nov-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.72	<0.0001	<0.001	0.004	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	5.54
JMR4WA	20-Apr-2020	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.55	<0.0001	<0.001	0.003	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	4.59
JMR4WA	16-Nov-2020	<0.01	0.015	<0.0001	<0.001	<0.001	0.015	<0.001	0.075	<0.0001	0.004	0.007	<0.01	<0.001	0.002	<0.01	0.061	0.16	<0.05
JMR4WA	26-Jan-2021	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.93	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.01	0.05	5.11
JMR4WA	19-May-2021	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.59	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	4.57
JMR4WA	24-Jan-2022	<0.01	<0.001	<0.0001	0.013	<0.001	<0.001	<0.001	1.5	<0.0001	0.012	0.062	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	4.64
JMR4WA	08-Jun-2022	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.64	<0.0001	<0.001	0.017	<0.01	<0.001	0.002	<0.01	0.006	0.09	3.9
JMR4WA	05-Oct-2022	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.49	<0.0001	<0.001	0.005	<0.01	<0.001	0.001	<0.01	<0.005	<0.05	5.36
JMR4WP	09-Sep-2018	<0.01	<0.001	<0.0001	<0.001		<0.001	<0.001		<0.0001		0.001	<0.01				<0.005		0.14
JMR4WP	18-Nov-2018	<0.01	<0.001	<0.0001	<0.001	-	<0.001	<0.001	0.096	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.016	0.25	0.21
JMR4WP	24-Jan-2019	<0.01	<0.001	<0.0001	0.001	<0.001	<0.001	<0.001	0.104	<0.0001	<0.001	0.001	<0.01	<0.001	<0.001	<0.01	0.006	0.18	0.13
JMR4WP	27-Mar-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.11	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.009	0.19	0.13
JMR4WP	15-May-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	0.111	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.012	0.17	0.1
JMR4WP	25-Jul-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.107	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.007	0.21	0.07
JMR4WP	16-Nov-2020	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.6	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.012	<0.05	4.17
JMR4WP	26-Jan-2021	<0.01	0.021	<0.0001	<0.001	0.001	<0.001	<0.001	0.178	<0.0001	0.006	0.003	<0.01	<0.001	0.001	<0.01	0.007	0.16	0.5
JMR4WP	19-May-2021	<0.01	0.014	<0.0001	<0.001	<0.001	<0.001	<0.001	0.135	<0.0001	0.004	0.006	<0.01	<0.001	<0.001	<0.01	<0.005	0.14	<0.05
JMR4WP	24-Jan-2022	<0.01	0.005	<0.0001	0.003	<0.001	<0.001	<0.001	0.152	<0.0001	0.006	0.02	<0.01	<0.001	<0.001	<0.01	<0.005	<0.05	0.15
JMR4WP	08-Jun-2022	<0.01	0.004	<0.0001	<0.001	<0.001	<0.001	<0.001	0.141	<0.0001	0.003	0.019	<0.01	<0.001	<0.001	<0.01	<0.005	0.23	0.07
JMR4WP	05-Oct-2022	<0.01	0.004	<0.0001	<0.001	<0.001	<0.001	<0.001	0.171	<0.0001	0.007	0.009	<0.01	<0.001	<0.001	<0.01	<0.005	0.18	<0.05
JN1119E	13-Nov-2019	<0.01	0.007	<0.0001	<0.001	<0.001	<0.001	<0.001	0.01	<0.0001	0.007	0.002	<0.01	<0.001	<0.001	<0.01	0.009	0.52	<0.05

Mackenzie North Groundwater Quality Monitoring

Dissolved Metals/Metalloids Data

Bore ID	Sample Date	Dissolved Metals																
		Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Vanadium	Zinc	Boron	Iron
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
JN1119E	20-Apr-2020	0.07	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	0.038	0.001	<0.01	<0.001	<0.001	<0.01	<0.005	0.21	<0.05
JN1119E	16-Nov-2020	0.02	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	0.05	0.003	<0.01	<0.001	<0.001	<0.01	0.011	0.18	<0.05
JN1119E	26-Jan-2021	0.02	0.002	0.0002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0003	0.077	0.001	<0.01	<0.001	<0.001	<0.01	<0.005	0.18	<0.05
JN1119E	19-May-2021	0.02	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0001	0.066	0.003	<0.01	<0.001	<0.001	<0.01	<0.005	0.14	<0.05
JN1119E	24-Jan-2022	0.24	0.001	<0.0001	0.001	<0.001	<0.001	<0.001	<0.001	0.0002	0.065	0.009	<0.01	<0.001	<0.001	<0.01	<0.005	0.16	<0.05
JN1119E	08-Jun-2022	0.03	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0001	0.06	0.002	<0.01	<0.001	<0.001	<0.01	0.006	0.22	<0.05
JN1119E	05-Oct-2022	0.06	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	0.058	0.001	<0.01	<0.001	<0.001	<0.01	<0.005	0.21	<0.05

Mackenzie North Groundwater Quality Monitoring

Total Metals/Metalloids Data

Bore ID	Sample Date	Total Metals																	
		Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Vanadium	Zinc	Boron	Iron
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
JMR24WP	12-Nov-2019	0.32	0.003	<0.0001	0.007	<0.001	0.003	<0.001	0.199	<0.0001	0.004	0.007	<0.01	<0.001	<0.001	<0.01	0.052	0.49	0.46
JMR24WP	20-Apr-2020	1.38	0.002	<0.0001	0.006	0.001	0.009	0.003	0.23	<0.0001	0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.028	0.45	2.42
JMR24WP	16-Nov-2020	0.44	0.002	<0.0001	0.002	0.001	0.003	0.001	0.219	<0.0001	0.003	0.009	<0.01	<0.001	<0.001	<0.01	0.015		0.61
JMR24WP	26-Jan-2021	0.09	0.002	<0.0001	<0.001	<0.001	0.003	<0.001	0.222	<0.0001	0.003	0.007	<0.01	<0.001	<0.001	<0.01	0.022		0.37
JMR24WP	19-May-2021	0.04	0.002	<0.0001	<0.001	<0.001	0.002	<0.001	0.216	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.025	0.44	0.35
JMR24WP	24-Jan-2022	0.88	0.004	<0.0001	0.009	0.002	0.014	0.005	0.305	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.059	0.5	3.66
JMR24WP	08-Jun-2022	0.33	0.004	<0.0001	0.003	<0.001	0.019	0.003	0.235	<0.0001	0.002	0.007	<0.01	<0.001	<0.001	<0.01	0.047	0.57	2.32
JMR24WP	05-Oct-2022	0.19	0.001	<0.0001	0.002	<0.001	0.003	<0.001	0.216	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.037	0.51	0.69
JMR24WP2	20-Apr-2020	0.44	0.002	<0.0001	0.007	<0.001	0.003	<0.001	0.282	<0.0001	0.004	0.009	<0.01	<0.001	<0.001	<0.01	0.074	0.5	0.84
JMR24WP2	17-Nov-2020	0.16	0.001	<0.0001	0.004	<0.001	0.007	<0.001	0.271	<0.0001	0.003	0.009	<0.01	<0.001	<0.001	<0.01	0.071		0.54
JMR24WP2	27-Jan-2021	6.07	0.012	0.0001	0.033	0.004	0.018	0.007	0.366	<0.0001	0.003	0.026	<0.01	<0.001	0.003	0.02	0.462		8.42
JMR24WP2	19-May-2021	0.06	0.001	<0.0001	0.002	<0.001	0.002	<0.001	0.222	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.031	0.45	0.36
JMR24WP2	24-Jan-2022	0.75	0.001	<0.0001	0.005	<0.001	0.006	<0.001	0.246	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.036	0.6	0.86
JMR24WP2	08-Jun-2022	0.1	0.001	<0.0001	0.001	<0.001	0.004	<0.001	0.215	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.03	0.68	0.51
JMR24WP2	05-Oct-2022	0.06	<0.001	<0.0001	0.001	<0.001	0.002	<0.001	0.188	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.037	0.58	0.58
JMR25WA	11-Sep-2018	89.3	0.028	0.0003	0.202		0.209	0.046		0.0002		0.241	<0.01				0.302		152
JMR25WA	29-Nov-2018	14.7	0.009	<0.0001	0.028	-	0.057	0.01	1.38	<0.0001	<0.001	0.04	<0.01	<0.001	0.002	0.06	0.055	<0.05	27.4
JMR25WA	24-Jan-2019	15.2	0.008	<0.0001	0.025	0.022	0.035	0.008	0.942	<0.0001	<0.001	0.034	<0.01	<0.001	0.001	0.06	0.048	<0.05	25
JMR25WA	27-Mar-2019	11.4	0.014	<0.0001	0.018	0.022	0.04	0.01	0.924	<0.0001	<0.001	0.052	<0.01	<0.001	0.002	0.05	0.043	<0.05	20.7
JMR25WA	15-May-2019	13.5	0.008	<0.0001	0.024	0.021	0.024	0.007	0.929	<0.0001	<0.001	0.026	<0.01	<0.001	0.001	0.05	0.04	<0.05	21.4
JMR25WA	25-Jul-2019	7.42	0.007	<0.0001	0.013	0.016	0.019	0.006	0.64	<0.0001	<0.001	0.02	<0.01	<0.001	<0.001	0.03	0.036	0.1	13.5
JMR25WA	12-Nov-2019	13	0.005	<0.0001	0.019	0.016	0.051	0.005	0.668	<0.0001	<0.001	0.026	<0.01	<0.001	0.001	0.04	0.042	<0.05	19.1
JMR25WA	20-Apr-2020	23.5	0.009	0.0002	0.046	0.035	0.053	0.044	1.16	<0.0001	<0.001	0.058	<0.01	<0.001	0.002	0.09	0.07	<0.05	41.9
JMR25WA	16-Nov-2020	5.16	0.002	<0.0001	0.011	0.006	0.016	0.003	0.17	<0.0001	<0.001	0.017	<0.01	<0.001	0.002	0.02	0.037		8.1
JMR25WA	26-Jan-2021	36.4	0.01	0.0002	0.084	0.049	0.149	0.031	1.9	0.0004	<0.001	0.102	<0.01	<0.001	0.005	0.15	0.146		70.6
JMR25WA	19-May-2021	49.4	0.019	0.0007	0.132	0.144	0.496	0.114	8.42	0.0009	<0.001	0.276	<0.01	<0.001	0.018	0.33	0.314	<0.05	95.1
JMR25WA	24-Jan-2022	465	0.075	0.0047	1.01	0.629	2.56	2.01	23	0.0024	<0.005	1.27	<0.05	<0.005	0.105	2.11	2.22	0.11	562
JMR4WA	09-Sep-2018	0.03	<0.001	0.0001	<0.001		<0.001	<0.001		<0.0001		<0.001	<0.01				<0.005		5.41
JMR4WA	18-Nov-2018	<0.01	<0.001	<0.0001	<0.001	-	<0.001	<0.001	1.76	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	0.06	6.01
JMR4WA	24-Jan-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.83	<0.0001	<0.001	<0.001	<0.01	<0.001	0.001	<0.01	<0.005	<0.05	6.69
JMR4WA	27-Mar-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.84	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	0.05	6.78
JMR4WA	15-May-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.73	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	<0.05	6.07
JMR4WA	24-Jul-2019	0.02	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.85	<0.0001	<0.001	<0.001	<0.01	<0.001	0.002	<0.01	<0.005	0.1	7.28
JMR4WA	12-Nov-2019	0.03	<0.001	0.0002	<0.001	<0.001	<0.001	<0.001	1.81	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.006	0.06	6.27
JMR4WA	20-Apr-2020	0.02	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.93	<0.0001	<0.001	0.004	<0.01	<0.001	0.003	<0.01	<0.005	<0.05	5.67
JMR4WA	16-Nov-2020	0.02	0.014	<0.0001	<0.001	<0.001	0.014	<0.001	0.077	<0.0001	0.005	0.007	<0.01	<0.001	0.002	<0.01	0.053		<0.05
JMR4WA	26-Jan-2021	0.05	<0.001	0.0001	<0.001	<0.001	0.003	<0.001	1.85	<0.0001	<0.001	0.01	<0.01	<0.001	0.003	<0.01	0.019		5.67
JMR4WA	19-May-2021	0.01	<0.001	0.0001	<0.001	<0.001	0.002	<0.001	1.62	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.01	<0.05	4.76
JMR4WA	24-Jan-2022	0.02	<0.001	<0.0001	0.002	<0.001	<0.001	<0.001	1.75	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.006	<0.05	5.94
JMR4WA	08-Jun-2022	0.05	<0.001	<0.0001	<0.001	<0.001	0.004	<0.001	1.7	<0.0001	<0.001	0.018	<0.01	<0.001	0.002	<0.01	0.013	0.09	4.54
JMR4WA	05-Oct-2022	0.03	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.36	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.005	<0.05	5.11
JMR4WP	09-Sep-2018	0.02	<0.001	<0.0001	<0.001		<0.001	<0.001		<0.0001		0.002	<0.01				<0.005		0.18
JMR4WP	18-Nov-2018	0.01	<0.001	<0.0001	<0.001	-	<0.001	<0.001	0.091	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.007	0.2	0.2
JMR4WP	24-Jan-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.095	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.01	0.18	0.14
JMR4WP	27-Mar-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.107	<0.0001	0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.008	0.21	0.13
JMR4WP	15-May-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.103	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	0.006	0.18	0.11
JMR4WP	25-Jul-2019	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.12	<0.0001	0.002	<0.001	<0.01	<0.001	<0.001	<0.01	0.009	0.29	0.08
JMR4WP	16-Nov-2020	0.04	<0.001	0.0001	<0.001	<0.001	0.004	<0.001	1.6	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.013		4.71
JMR4WP	26-Jan-2021	0.08	0.023	<0.0001	<0.001	0.001	0.002	<0.001	0.184	<0.0001	0.006	0.005	<0.01	<0.001	0.001	<0.01	0.016		0.74
JMR4WP	19-May-2021	0.1	0.014	<0.0001	0.001	<0.001	0.002	<0.001	0.149	<0.0001	0.005	0.008	<0.01	<0.001	<0.001	<0.01	0.026	0.15	0.24
JMR4WP	24-Jan-2022	0.01	0.006	<0.0001	0.003	<0.001	<0.001	<0.001	0.185	<0.0001	0.004	0.004	<0.01	<0.001	<0.001	<0.01	0.015	0.21	0.23
JMR4WP	08-Jun-2022	0.1	0.005	<0.0001	<0.001	<0.001	0.002	<0.001	0.142	<0.0001	0.003	0.021	<0.01	<0.001	<0.001	<0.01	0.019	0.22	0.35
JMR4WP	05-Oct-2022	0.06	0.003	<0.0001	0.003	<0.001	0.002	<0.001	0.157	<0.0001	0.007	0.01	<0.01	<0.001	<0.001	<0.01	0.027	0.18	0.17

Mackenzie North Groundwater Quality Monitoring

Total Metals/Metalloids Data

Bore ID	Sample Date	Total Metals																
		Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Vanadium	Zinc	Boron	Iron
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
JN1119E	13-Nov-2019	11.6	0.012	<0.0001	0.013	0.008	0.025	0.013	0.203	<0.0001	0.006	0.016	<0.01	<0.001	0.003	0.02	0.062	0.51	12.7
JN1119E	20-Apr-2020	1.29	0.002	<0.0001	0.006	<0.001	0.002	0.002	0.023	<0.0001	0.07	0.003	<0.01	<0.001	<0.001	<0.01	0.01	0.22	1.13
JN1119E	16-Nov-2020	0.04	0.002	<0.0001	<0.001	<0.001	0.002	<0.001	0.001	0.0009	0.069	0.002	<0.01	<0.001	<0.001	<0.01	<0.005		0.21
JN1119E	26-Jan-2021	0.1	0.002	0.0002	0.002	<0.001	0.001	<0.001	0.009	0.0005	0.082	0.004	<0.01	<0.001	<0.001	<0.01	<0.005		0.19
JN1119E	19-May-2021	0.06	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	0.0003	0.08	0.002	<0.01	<0.001	<0.001	<0.01	<0.005	0.14	0.06
JN1119E	24-Jan-2022	0.83	0.002	<0.0001	0.002	<0.001	0.001	<0.001	0.001	0.0002	0.084	0.004	<0.01	<0.001	<0.001	<0.01	<0.005	0.16	0.06
JN1119E	08-Jun-2022	0.06	0.002	<0.0001	<0.001	<0.001	0.002	<0.001	<0.001	0.0003	0.075	0.003	<0.01	<0.001	<0.001	<0.01	<0.005	0.14	0.06
JN1119E	05-Oct-2022	0.25	0.001	<0.0001	0.003	<0.001	<0.001	<0.001	0.002	<0.0001	0.057	0.003	<0.01	<0.001	<0.001	<0.01	<0.005	0.15	0.11

ATTACHMENT B

Water Level Monitoring Data

Mackenzie North Groundwater Level Monitoring
Standing Water Level (SWL) - metres below top of casing (mTOC)

Date	JMR4WA	JMR4WP	JMR22WA	JMR22WP	JN1119E	JMR23WA	JMR24WA	JMR24WP	JMR24WP2	JMR25WA	JMR26WA	JP0911T	JP0912T
12-Oct-2015	18.45					20.00							
17-May-2017	18.50					19.30							
19-Jul-2017	18.70					19.40							
28-Sep-2017												22.81	20.30
06-Oct-2017	19.20					19.15							
01-Nov-2017												22.80	20.43
01-Dec-2017												23.00	20.48
09-Dec-2017	19.30					19.85							
01-Jan-2018												23.19	20.59
01-Feb-2018												23.35	20.65
20-Feb-2018	19.40					19.90							
01-Mar-2018												23.19	20.46
01-Apr-2018												23.40	20.48
01-May-2018												23.44	20.47
03-May-2018	19.44					19.90							
18-May-2018												23.46	
01-Jun-2018													20.53
16-Jun-2018	19.52					19.94							
01-Jul-2018													20.58
09-Jul-2018	19.52					19.96							
13-Jul-2018												24.48	
01-Aug-2018												24.52	20.68
01-Sep-2018												24.61	20.83
01-Oct-2018												24.62	20.88
05-Oct-2018				21.04									
08-Oct-2018	19.78												
09-Oct-2018		19.75						35.90					
11-Oct-2018						19.64			22.20	19.35			
19-Oct-2018	19.93	19.91	17.96	22.11		21.10	Dry	36.74		19.53			
01-Nov-2018											Dry	24.75	21.02
17-Nov-2018	19.88	19.87	17.97	22.09		21.18	Dry	36.73	2.85	19.87			
01-Dec-2018											Dry	24.82	21.19
10-Dec-2018	19.97	19.99	Dry	22.07		21.18	Dry	36.71	1.72	19.59			
01-Jan-2019											Dry	24.93	21.26
24-Jan-2019	20.08	20.09	Dry	22.04		21.18	Dry	36.69		19.68			
01-Feb-2019											Dry	25.02	21.36
25-Feb-2019	20.14	20.16	Dry	22.18		21.18	Dry	37.02		19.73			
01-Mar-2019											Dry	25.06	21.35
27-Mar-2019	20.13	20.14	Dry	22.14		21.18	Dry	36.98		19.80			
01-Apr-2019											Dry	25.00	21.32
18-Apr-2019	20.21	20.25	Dry	22.15		21.19	Dry	37.06		19.81			
01-May-2019											Dry	25.05	21.38
13-May-2019	20.23	20.27	Dry	22.14		21.19	Dry	37.06		19.84			
01-Jun-2019											Dry	25.14	21.48
01-Jul-2019											Dry	25.21	21.60

Mackenzie North Groundwater Level Monitoring
Standing Water Level (SWL) - metres below top of casing (mTOC)

Date	JMR4WA	JMR4WP	JMR22WA	JMR22WP	JN1119E	JMR23WA	JMR24WA	JMR24WP	JMR24WP2	JMR25WA	JMR26WA	JP0911T	JP0912T
02-Jul-2019	20.34	20.35	Dry	22.16		21.19	Dry		41.66				
24-Jul-2019	20.34	20.34	Dry		21.97	21.19	Dry		42.65	20.00	Dry		
01-Aug-2019											Dry	25.36	21.69
20-Aug-2019	20.49	20.49	Dry		21.87	21.19	Dry		43.25	20.05			
01-Sep-2019											Dry	25.46	21.82
01-Oct-2019											Dry	25.53	21.89
12-Nov-2019	20.67	NM	Dry	21.73	21.63	Dry	Dry	44.07	42.87	20.16	Dry	25.65	22.01
13-Dec-2019	20.76	NM	Dry	21.68	21.59	Dry	Dry	44.23		20.33	Dry	25.76	22.12
04-Feb-2020	20.87	NM	Dry	21.61	21.49	21.20	Dry	44.44	43.17	20.40	Dry	25.81	22.08
20-Apr-2020	20.98	NM	Dry	21.64	21.41	Dry	Dry	44.68	43.34	20.48	Dry	25.74	22.08
01-May-2020											Dry	25.74	22.04
01-Jun-2020											Dry	25.86	22.04
01-Jul-2020											Dry	25.97	22.15
23-Jul-2020	21.17	21.43	No access	21.64	21.43	No access	No access	44.95	43.52	20.67	Dry	25.99	22.21
01-Sep-2020											Dry	26.01	22.28
01-Oct-2020											Dry	26.06	22.35
16-Nov-2020	21.62	21.39	Dry	21.64	21.7	Dry	Dry	44.72	43.82	20.88	Dry	26.11	22.44
01-Dec-2020											Dry	26.18	22.52
26-Jan-2021	21.65	21.44	Dry	21.67	21.72	Dry	Dry	44.78	43.96	20.89	Dry	26.24	22.65
01-Feb-2021											Dry	26.31	22.71
01-Mar-2021											Dry	26.36	22.78
01-Apr-2021											Dry	26.38	22.81
19-May-2021	21.63	21.9	Dry.	21.87	23.21	Dry.	Dry.	45.45	44.08	21.16	Dry	26.46	22.88
01-Jun-2021											Dry	26.46	22.84
01-Jul-2021											Dry	26.51	22.89
17-Aug-2021	21.81	22.02	Dry	23.16	24.45	Dry	Dry	45.56	44.25	21.3	Dry	26.55	22.98
01-Sep-2021											Dry	26.55	22.99
01-Oct-2021											Dry	26.68	23.14
01-Nov-2021											Dry	26.66	
01-Dec-2021											Dry	26.38	22.92
25-Jan-2022	21.96	22.2	Dry	22.15	25.02	Dry	Dry	39.74	42.86	21.31	Dry	26.48	22.95
10-Feb-2022	21.90	22.22	Dry	22.19	25.10	Dry	Dry	39.53	42.90	21.36	Dry	26.69	23.01
01-Mar-2022											Dry	26.81	23.09
01-Apr-2022											Dry	26.85	23.16
01-May-2022											Dry	26.80	23.14
01-Jun-2022	21.89	22.36	Dry	22.27	24.98	21.04	Dry	38.4	41.83	21.64	Dry	26.65	23.03
02-Aug-2022	21.93	22.85	Dry	22.81	26.3	Dry	Dry	39.03	41.99	Dry	Dry	26.51	22.97
06-Oct-2022	22.01	22.34	Dry	22.94	26.28	Dry	Dry	42.67	42.72	Dry	Dry	26.63	23.15

* JN1119E is a replacement bore for JMR22WP for water quality sampling. Water level data is collected from both bores.
** JMR24WP2 is a replacement bore for JMR24WP for water quality sampling. Water level data is collected from both bores.
No access - road to bore closed due to rain and no safe access