



ILUKA

Iluka Resources Limited

**Licence L9176
Annual Environmental Report
Cataby Mineral Sands Mine**

Year Ending 31 December 2021

Document control

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A	Draft document for internal review	R McCarron	L Sharp	J Robertson	22.03.2022
0	Final Report for issue	R McCarron	L Sharp	L Sharp	30.03.2022

ACRONYMS AND ABBREVIATIONS

TERM	DEFINITION
AEP	Annual Exceedance Probability
CEO	Chief Executive Officer CEO for the purposes of notification means: Director General Department Administering the Environmental Protection Act 1986
CWD	Clean Water Dam
EC	Electrical Conductivity at 25° C
EP Act	<i>Environmental Protection Act 1986 (WA)</i>
HMC	Heavy Mineral Concentrate
Iluka	Iluka Resources Limited
MUP	Mining Unit Plant
PASS	Potential Acid Sulfate Soil
pHF	Field pH
pHFox	Field pH after oxidation with peroxide
RIWI Act	<i>Rights in Water and Irrigation Act 1914 (WA)</i>
SSP	Surface Screening Plant
SWL	Standing Water Level
TA	Titrateable Acidity
TAlk	Total Alkalinity
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
TSS	Total Suspended Solids
UTL	Upper Threshold Limit
WCP	Wet Concentrator Plant
WHIMS	Wet High Intensity Magnetic Separators

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ATTACHMENTS

Appendix A	2021 Annual Audit Compliance Report
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1 Project Summary

Iluka Resources Limited (Iluka) operates the Cataby Mine located approximately 150 kilometers north of Perth (Figure 1). The project area includes mining tenements M70/194, M70/195, M70/196, M70/517, M70/518, M70/696, M70/760, M70/867, M70/868, M70/869, M70/1018 and M70/1086. Figure 2 provides a site overview. Figure 3 shows the layout of mining pits. Figure 4 depicts the key infrastructure of the Cataby Mine.

Construction and commissioning of the Cataby Mine was completed in accordance with Works Approval W5935. Commissioning was completed on 10th May 2019 and a Commissioning Report, required by condition 5.1.3 of W5935, was submitted to DWER on 21st May 2019. The Cataby Mine was fully operational from May 2019 onwards and throughout this entire reporting period 1 January to 31 December 2021. The current status and production details of the Cataby Mine are summarised in Table 1.

Table 1 Cataby Mine Summary

Aspect	Description
Estimated Life of Mine	10 years
Current status	Operational
Duration of operations to date	34 months
Estimated completion of operations	2028
Total disturbance footprint to date (ha)	1129.32ha
Total approved footprint (ha)	2093.5 ha
Prescribed Premises Category 8 Production for 2021	541, 251 t HMC
Prescribed Premises Category 6 Dewatering Discharge 2021	4,877,413 kL

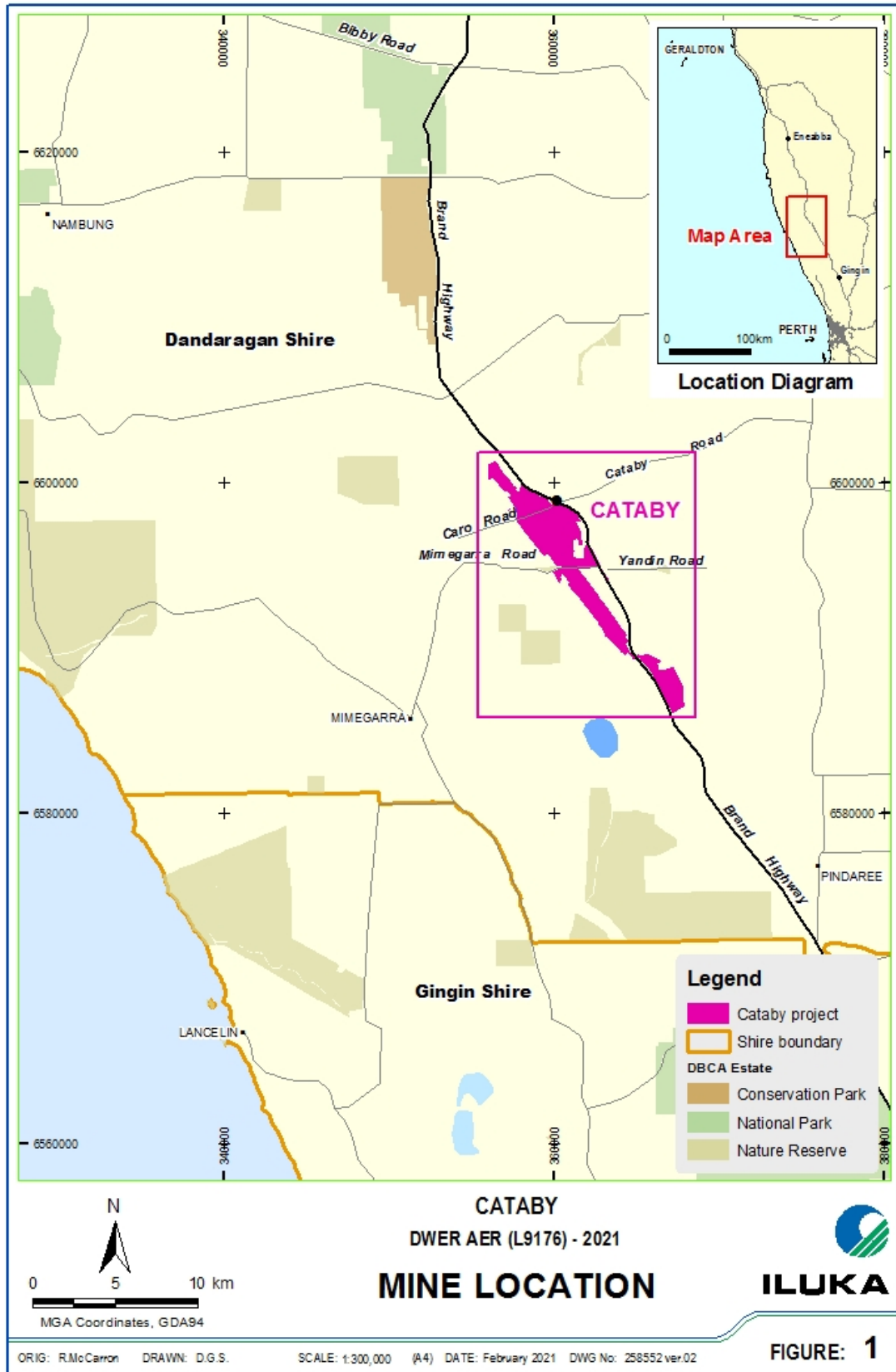


Figure 1 Cataby Mine Location

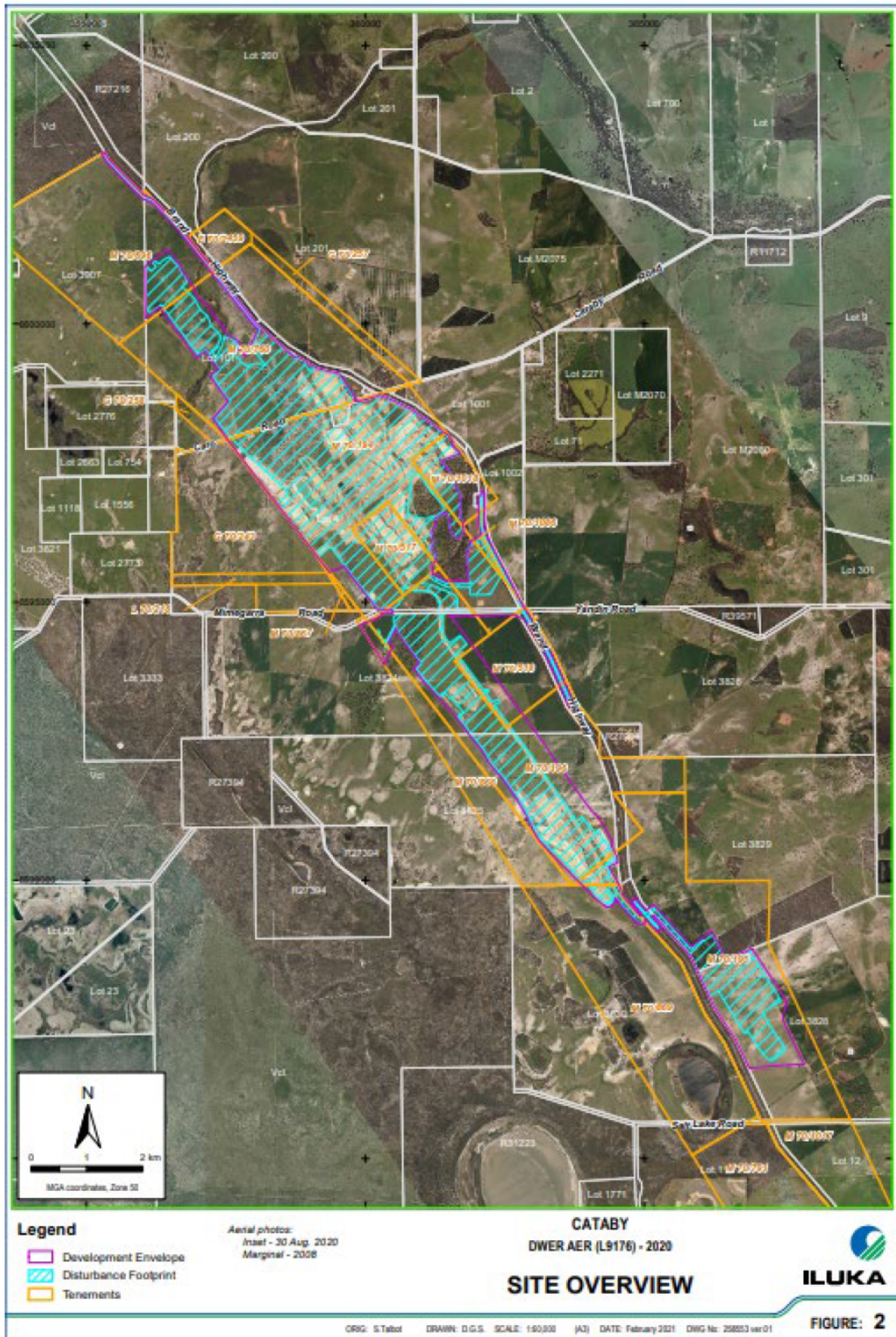


Figure 2 Site Overview

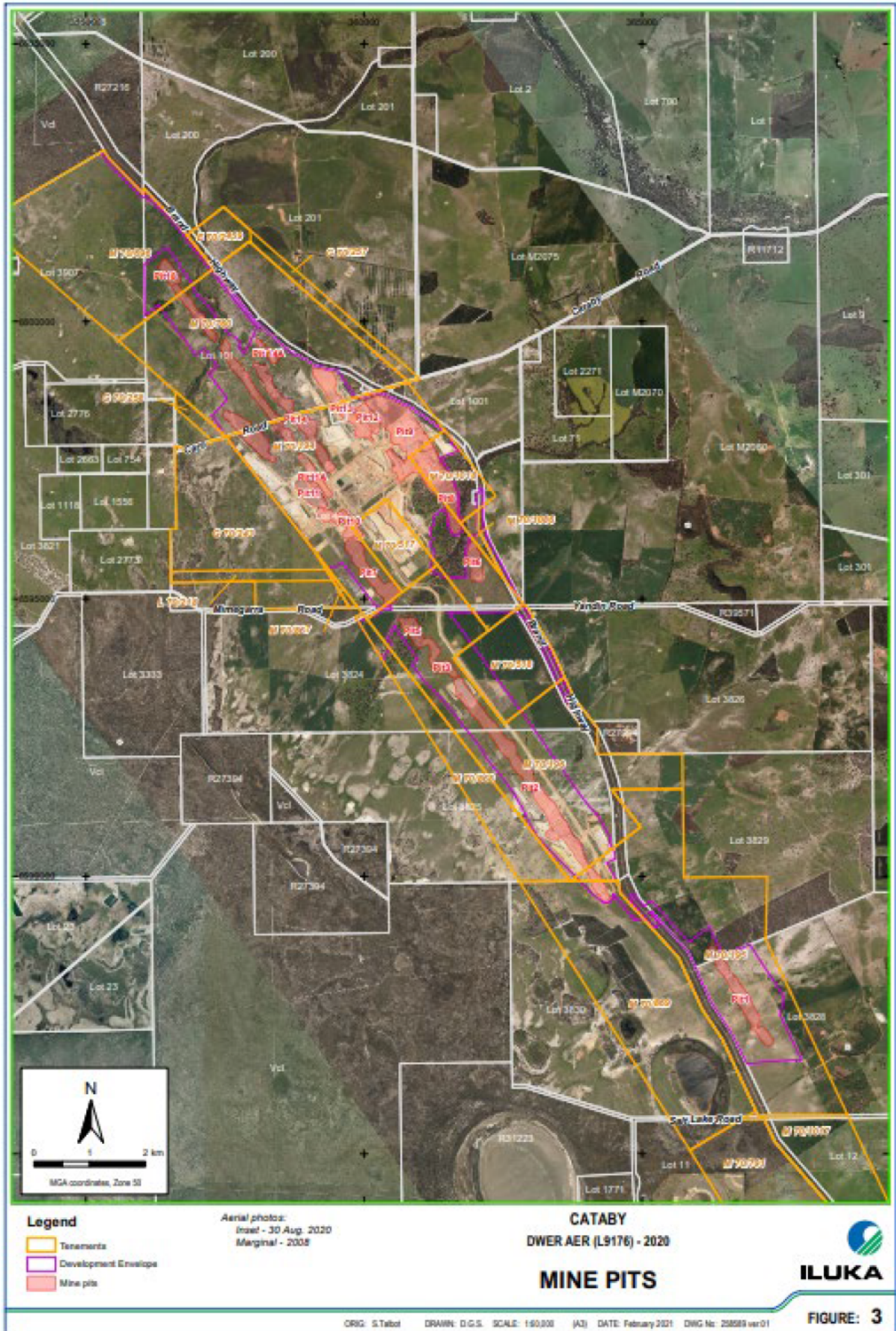


Figure 3 Mine Pits

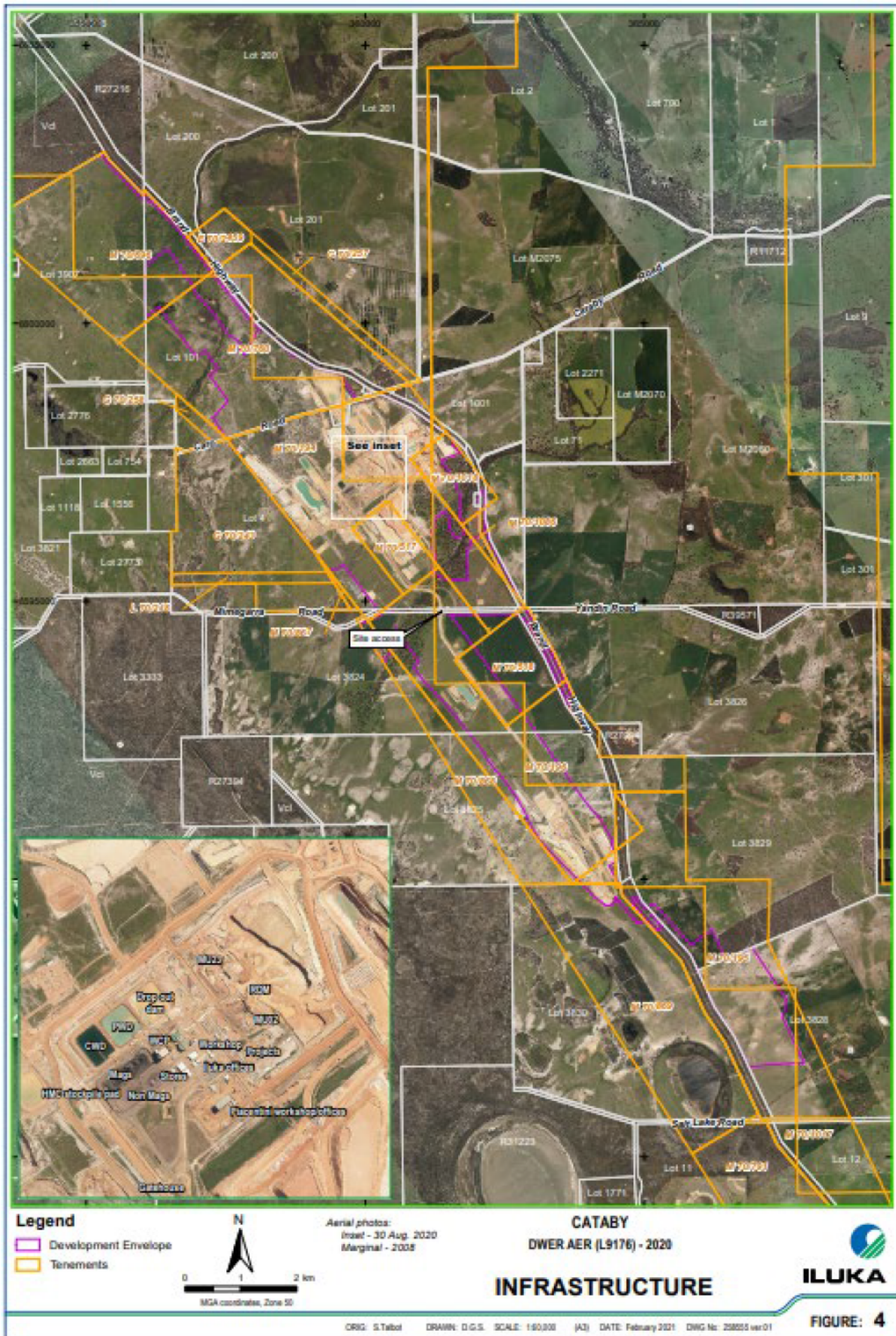


Figure 4 Infrastructure Map

2 Climate

The Cataby area has a Mediterranean climate with hot dry summers and cool wet winters. Data from Bureau of Metrology (BoM) was obtained online on the 08/03/2022 for weather station 9210 located in Lake Nammen. This data was utilised to explore rainfall conditions relevant to the Mine. Annual average rainfall for the Mine area over the last 51 years (commencing in 1971) was interpreted to be approximately 565 mm with 715mm recorded in 2021. Figure 5 below shows an overall declining trend in annual rainfall since monitoring began at BoM station 9210.

Figure 6 shows the 2021 average monthly rainfall compared to the historical average monthly rainfalls from the last 51 years. It appears that there was above average rainfall for months February, May, July and October in 2021. Over an average year both monthly rainfall and evaporation rates are highly seasonal and often inconsistent in both distribution and intensity. Potential evaporation rates generally exceed rainfall in all months except for June to August, with average yearly pan-evaporation of 2,456 mm (Iluka, 2017).

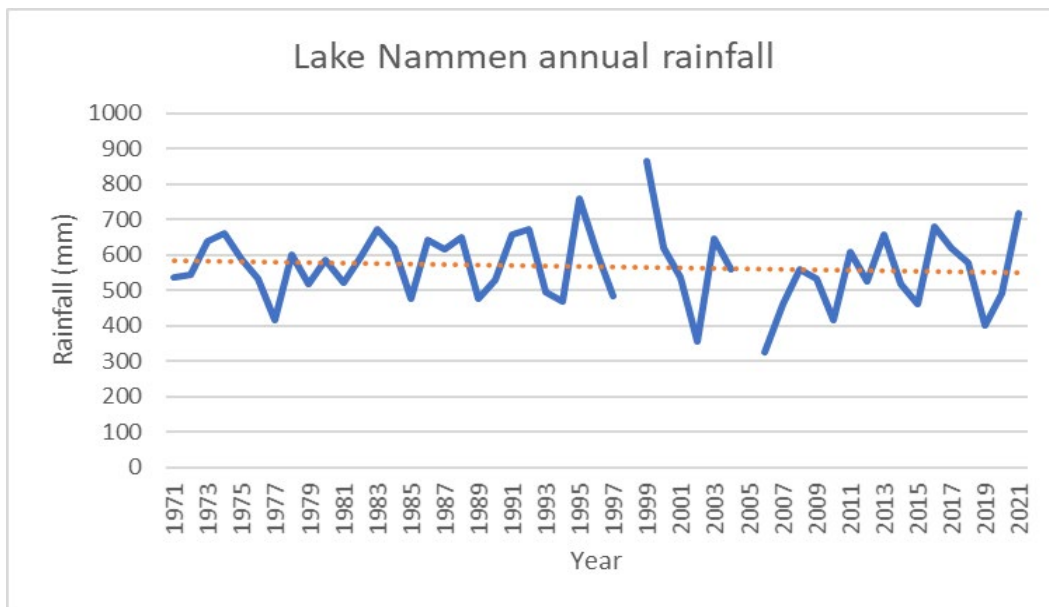


Figure 5 2021 Annual Rainfall Recorded at BoM Weather Station 9210

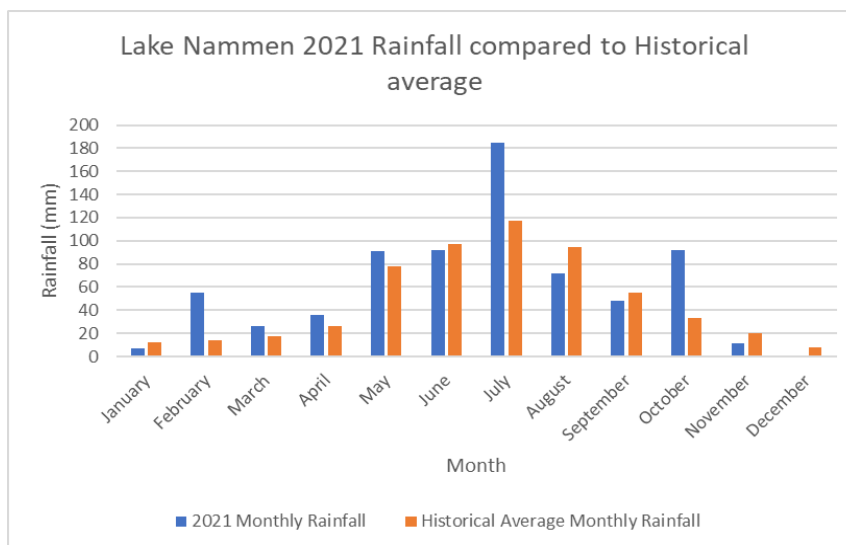


Figure 6 2021 Monthly Rainfall Comparison to Average Monthly Rainfall at BoM Weather Station 9210

3 Process Monitoring

3.1 Mining and Mineral Processing

Volumes of overburden removal, ore processing and tailings disposal during the 2021 reporting period are presented in Table 2.

Table 2 Monitoring of mining and mineral processing (condition 12 of L9176)

Process description	Parameter	Units	Frequency	Volume (tonnes)			
Overburden removal	Amount of overburden removed	Wet tonnes	Annual	13,356,751			
Processing of ore	Amount of ore processed through the WCP			13,818,371			
	Amount of HMC produced			541,251			
Disposal of tailings	Amount and location of sand tailings and clay slimes disposed on the Premises		Quarterly	Q1	Q2	Q3	Q4
				2,128,595	2,039,396	2,147,302	2,400,415

3.2 Dewatering Quality

Dewatering occurred at Pits 2, 7, 8, 9, 10 and 11 during the reporting period (Figure 3 and Figure 4). A total of 4,877,413 kL was abstracted during the 2021 period. Groundwater abstraction is conducted as per GWL175697 with annual reports covering the same monitoring period as this licence (L1976), hence, both reports are complimentary in regards to groundwater data presented.

3.2.1 pH

Weekly pH values for dewatering water (measured at the Clean Water Dam inflow point) during the 2021 reporting period are shown in Figure 7. Field pH values are reported and pH lab results confirmed by an accredited laboratory. The range of values recorded at the CWD in 2021 was 5.52 pH to 6.62 pH.

Monitoring data was assessed against background pH from monitoring wells located hydraulically up-gradient of the mine site (therefore not impacted by operations). As groundwater in the area flows in a west to south westerly direction, monitoring wells IMCPW01 is used as a background reference point due to its location to the east and north-east of the mining area. Monitoring well IMCPW01 trends were similar with a pH above 6.0. The CWD recorded the majority of readings between 6 to 7pH with some (6 in total) anomalous readings between 5.14-6.0pH.

Iluka has conducted several acid sulfate soil (ASS) investigations for the Cataby project, as described in the Iluka Soil Management Plan (2018). These findings are incorporated into a geological block model for the Cataby mine to quantify the volumes of Acid Sulfate Soil (ASS) present and their spatial distribution in relation to mining. The block model predicted six pits (2, 8, 13, 14, 15 & 16) to contain Potential ASS (PASS). Pits 2 and 8 were active mine pits during the reporting period. Dewatering trigger criteria and corresponding actions are required under licence condition 10 (Table 8 of L9176) and

detail acid sulfate soil controls in relation to dewatering, specifying that dewatering water is to be managed to ensure a pH ≥ 5.5 and Talk > TA. The 2021 values measured from the CWD remained above 5.5pH and all samples for TALK were greater than TA

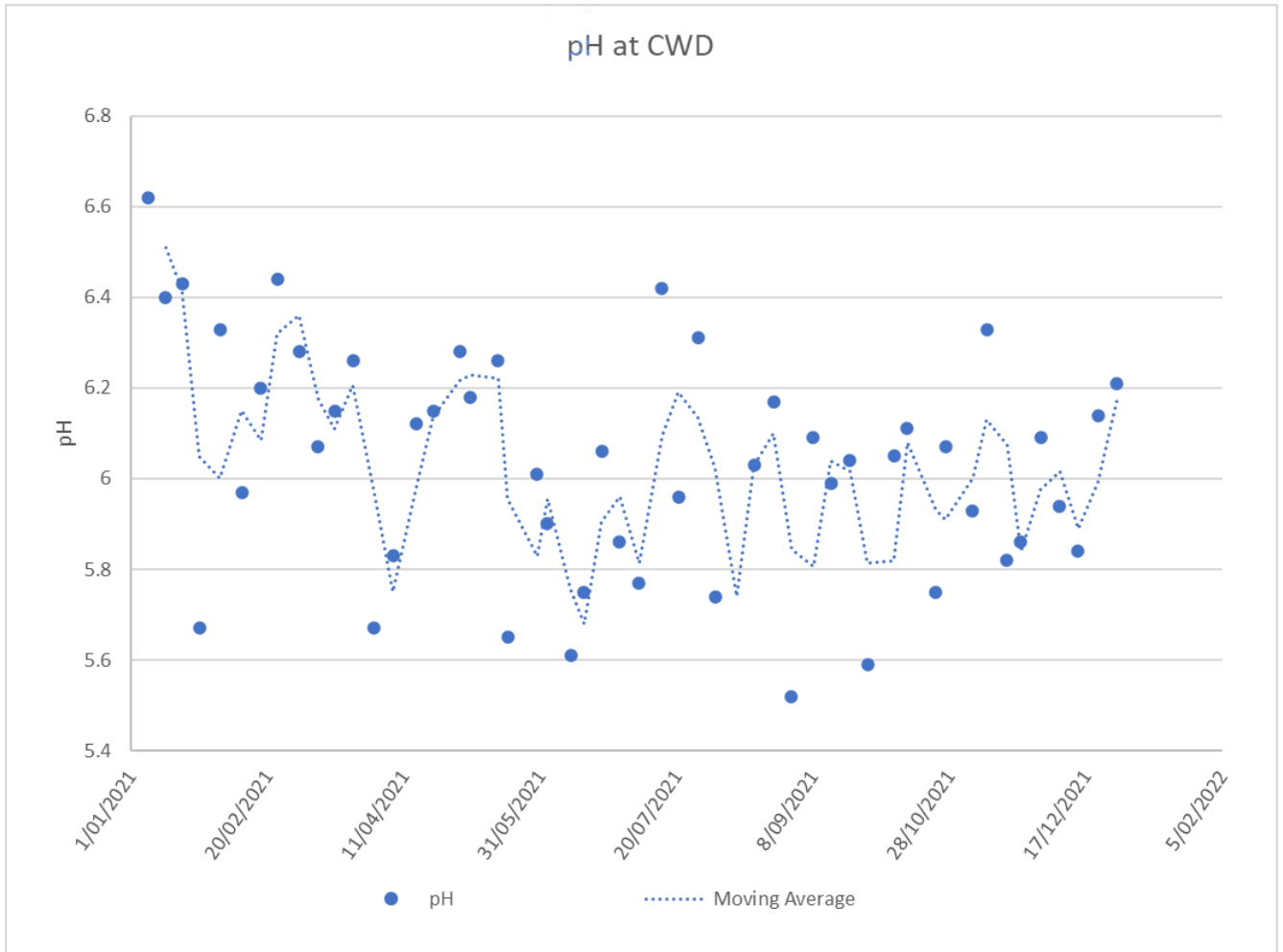


Figure 7 Weekly dewatering water pH (Table 10 of L9176)

3.2.2 Electrical Conductivity (EC)

Weekly EC values for dewatering water (measured at the Clean Water Dam inflow point) during the 2021 reporting period are shown in Figure 8. The data provided is determined by a NATA accredited laboratory. The average EC during the reporting period was 1,772 $\mu\text{S}/\text{cm}$, ranging from 1200 $\mu\text{S}/\text{cm}$ to 2,300 $\mu\text{S}/\text{cm}$. The average EC during the 2020 reporting period was 1,489 $\mu\text{S}/\text{cm}$, also ranging from 1200 $\mu\text{S}/\text{cm}$ to 2,300 $\mu\text{S}/\text{cm}$.

The CWD received groundwater abstracted across a wider geographical range for the reporting period in 2021 and the variability in salinity levels across the mining area it is not unexpected. EC readings have increased slightly in comparison to the previous reporting period. The average remains relatively low at 1772 $\mu\text{S}/\text{cm}$.

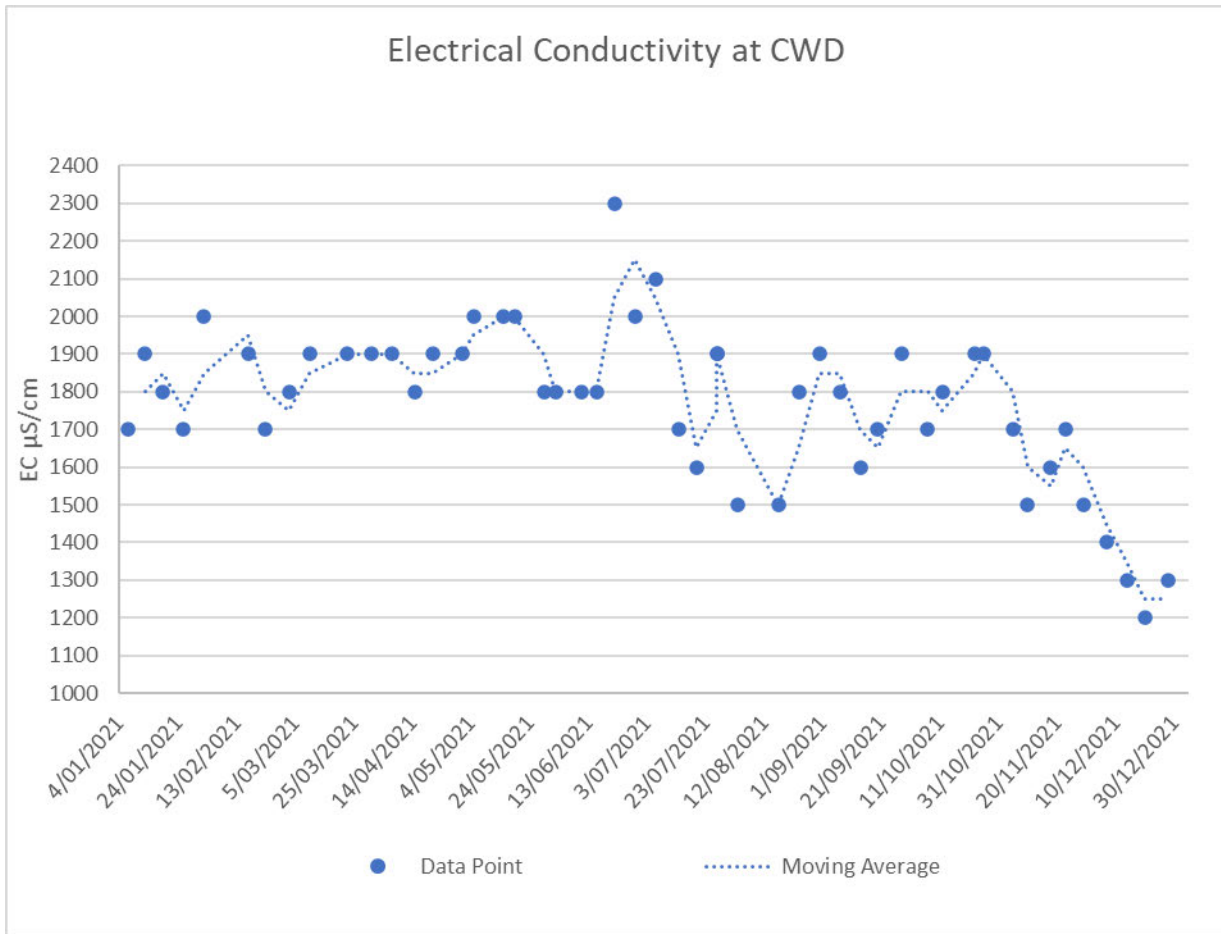


Figure 8 Weekly dewatering water Electrical Conductivity (Table 10 of L9176)

3.2.3 Titratable Acidity (TA)

Weekly TA values for dewatering water (measured at the Clean Water Dam inflow point) during the 2021 reporting period are shown in Figure 9. The data provided is laboratory determined by a NATA accredited laboratory.

With limited pre-mining baseline data available for TA the data will continue to evolve to build the dataset required to set groundwater triggers for pH and titratable acidity (TA) based upon the (to be determined) upper threshold limit (UTL) of background water quality in the area. Licence condition 10 (Table 8 of L9176) requires dewatering water to be managed to ensure TAlk > TA. As all recorded values met this criteria during the 2021 reporting period there were no management actions required as per the dewatering trigger values provided in Table 9 of L1976.

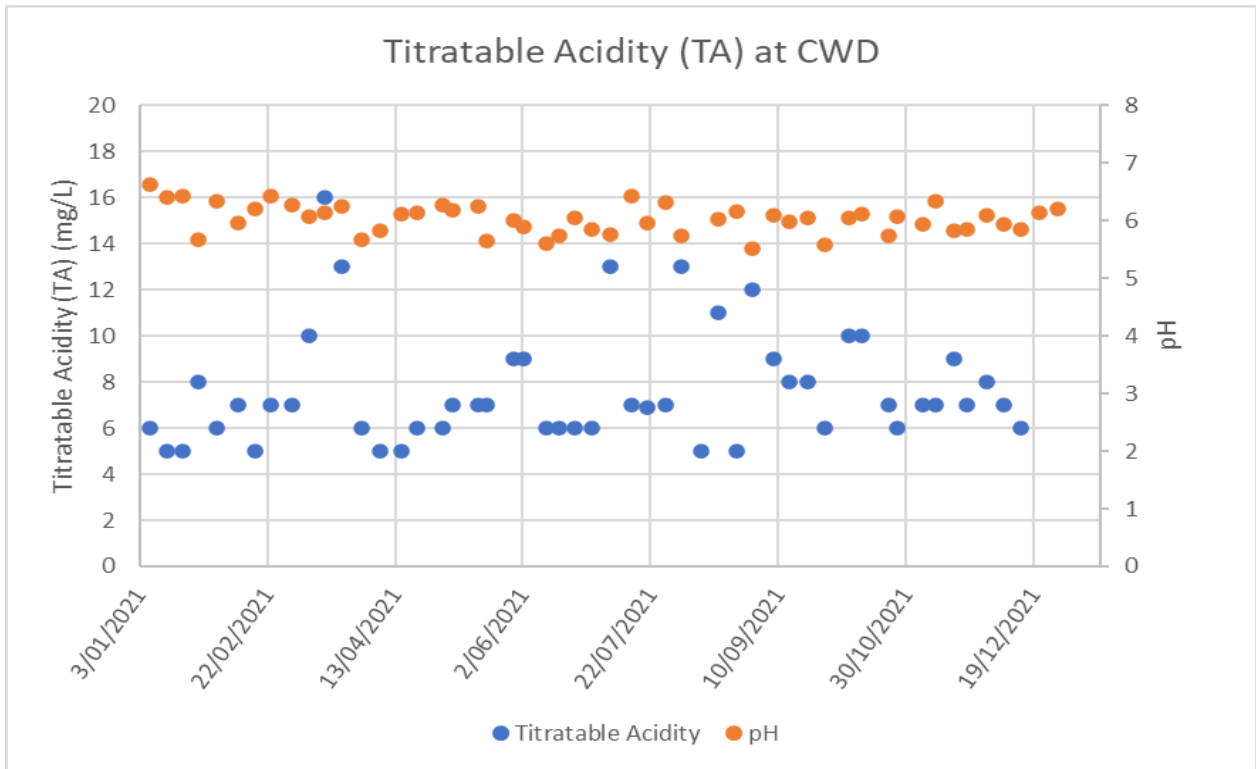


Figure 9 Weekly dewatering water Titratable Acidity (Table 10 of L9176)

3.2.4 Total Alkalinity (TAlk)

Weekly TAlk values for dewatering water (measured at the Clean Water Dam inflow point) during the 2021 reporting period are shown in Figure 10. The data provided is laboratory determined by a NATA accredited laboratory.

Iluka has conducted several acid sulfate soil (ASS) investigations for the Cataby Project prior to mining. Investigations found The inherently acidic nature of these soils is typical for surficial soils on the Swan Coastal Plain and reflects their poor buffering capacity.

Soils tested for Acid Neutralising Capacity (ANC) all returned results of less than 10 kg H₂SO₄/t; and inorganic carbon results of less than 5 kg H₂SO₄/t, confirming a generally low buffering capacity. Results at some sites indicated the sporadic presence of highly alkaline materials (pH > 9) possibly due to high proportions of calcium carbonate of marine origin. These were evident in both aeolian sediments in the surface zone and shallow marine sediments in the deeper Yoganup Formation.

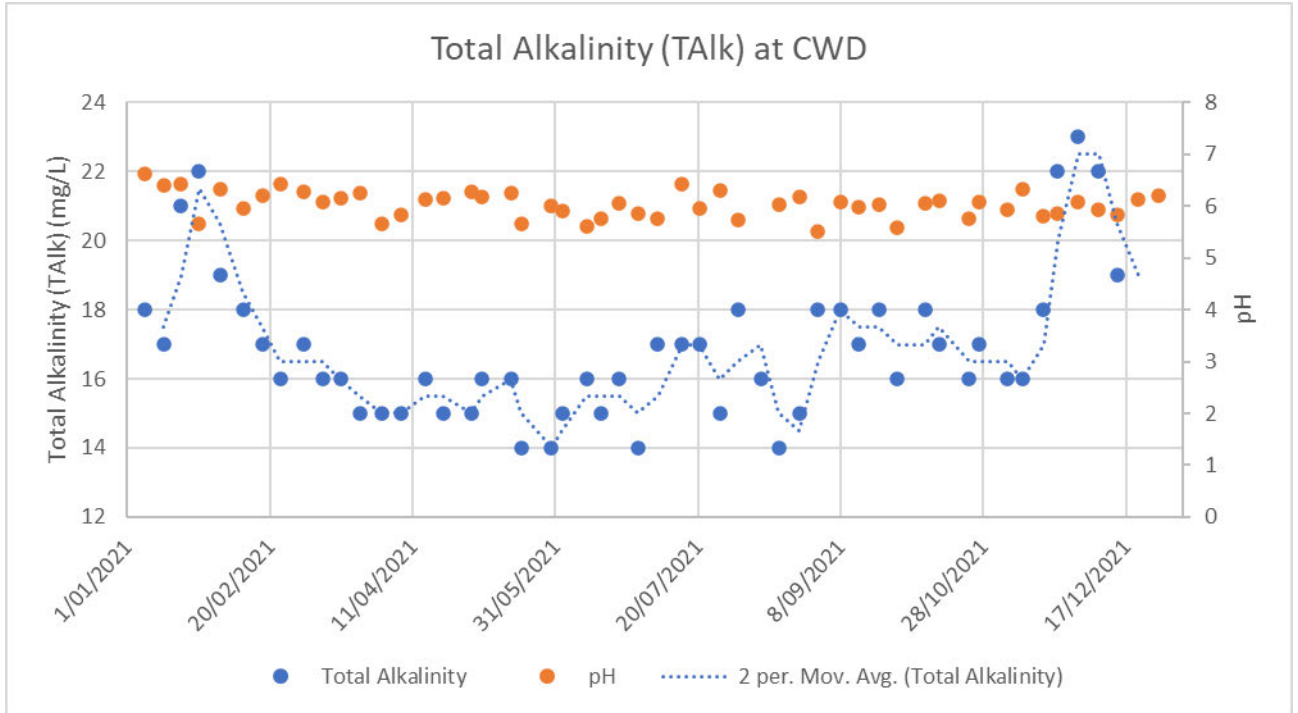


Figure 10 Weekly dewatering water Total Alkalinity (Table 10 of L9176)

3.2.5 Comparison of TA, TALK and pH

TA, TALK and pH values for dewatering water (measured at the Clean Water Dam inflow point) during the 2021 reporting period are shown in Figure 11.

Licence condition 10 (Table 8 of L9176) requires dewatering water to be managed to ensure pH ≥ 5.5 and TALK > TA. As all recorded values met this criteria during the 2021 reporting period there were no management actions required as per the dewatering trigger values provided in Table 9 of L1976.

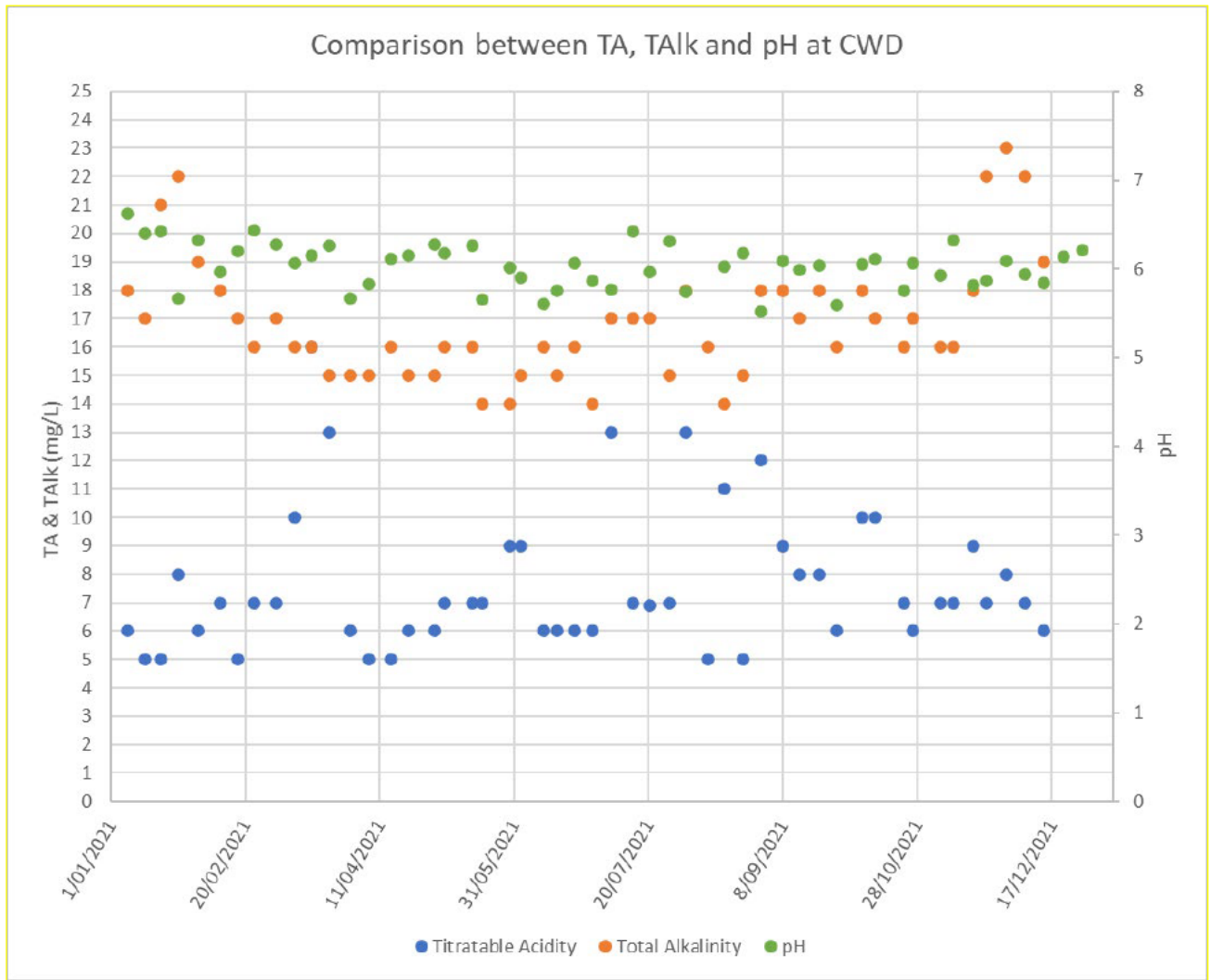


Figure 11 Comparison between TA, Talk and pH at the CWD

4 Environmental Monitoring

4.1 Ambient Air Quality

The licence requirement for ambient air quality is determined during the period 1 October to 31 May and as such the data is presented for the 2021 period (1 Jan-31 May: 1 Oct-31 Dec) as per previous reporting. The AQ1 and AQ2 (identified by Iluka as ‘Liberty Roadhouse’ and ‘Wally’s Bore’, respectively) are the two key monitoring stations which were established in March 2017. AQ1 is positioned at the northern roadhouse, Liberty and is considered a high risk receptor, while AQ2 is located at Wally’s Bore and is used for background monitoring (Figure 15).

4.1.1 Total Suspended Particles (TSP)

Condition 16 of Licence L9176 requires monitoring of TSP at least once every 6 days during the 1 October to 31 May period at locations AQ1 and AQ2. TSP is measured using High Volume Air Samplers (HVAS). The HVAS are calibrated every two months as per AS/NZS 3580.9.3 and is conducted by a NATA accredited external contractor. The 24-hour average TSP limit stipulated in the licence is 260µg/m³.

Meteorological monitoring is also undertaken at a site-based Automated Weather Station (AWS) located at Wally’s Bore, an area with minimal mining influence. Trends show winter winds from the north-east in the mornings, changing to westerlies in the afternoon. Spring and summer winds are

from the east in the morning, shifting to south-westerlies in the afternoon and Autumn winds from the north-east in the morning, changing to south-westerlies in the afternoon. Daily production meetings utilise the AWS and the Sentinex system for site based forecast/actual wind speed and direction data to provide predictive dust generation modelling and thereby informing management actions in real time.

TSP results show two exceedances of the 260µg/m³ limit in the first half of the year. These exceedances are attributed to construction work being undertaken at the Liberty fuel station directly adjacent the monitoring station (Figure 12). The exceedances coincide with earthmoving associated with the construction work.

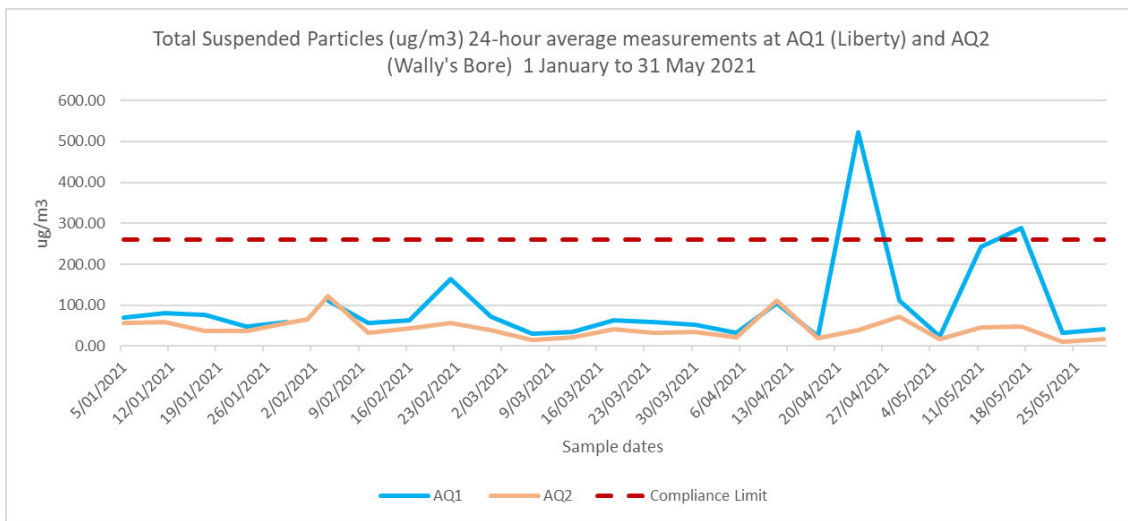


Figure 12 Total Suspended Particles (µg/m³) at AQ1 and AQ2 – 1 January to 31 May 2021.

TSP results for the second period of the year (October 1st to December 31st) showed no exceedances for the period (Figure 13). Multiple sampling events failed to reach a total of 24 hours sampling time at sites AQ2 due a fault with the sampling equipment. Trouble shooting with the equipment supplier and field technician has determined it is likely to a faulty temperature sensor which has prevented the sampler to complete a 24 hour run when programmed. Due to National supply shortages of the required part, a replacement part did not arrive in the 2021 reporting season.

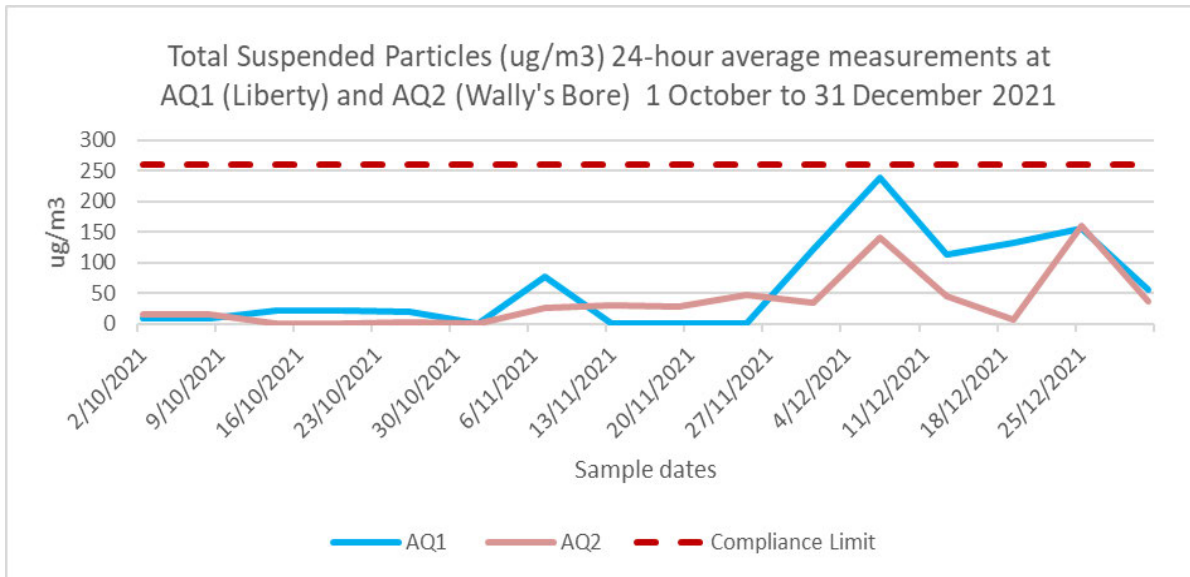


Figure 13 Total Suspended Particles (µg/m³) at AQ1 and AQ2 – 1 October to 31 December 2021.

The following dust suppression activities were applied during the reporting period:

- Use of water trucks for in-pit dust suppression, open areas and haul roads;
- Use of dust suppressant applications including Gluon and Clay fines (slimes);
- Minimising open areas cleared of vegetation and topsoil;
- Vehicle speed limits are enforced to control the dust generated during haulage;
- Roads are graded and maintained

4.1.2 Particulate Matter (PM₁₀)

The 24-hour average PM₁₀ upper limit stipulated in the licence is 50µg/m³ based on a minimum 14 days continuous logging with 15 minute sample averages (including availability ≥90% of the measurement interval on a monthly basis). The licence requires a minimum of 2 samples (14 days) to be taken at least 4 weeks apart within the 2021 monitoring period (1 January-31 May:1 October-31 December).

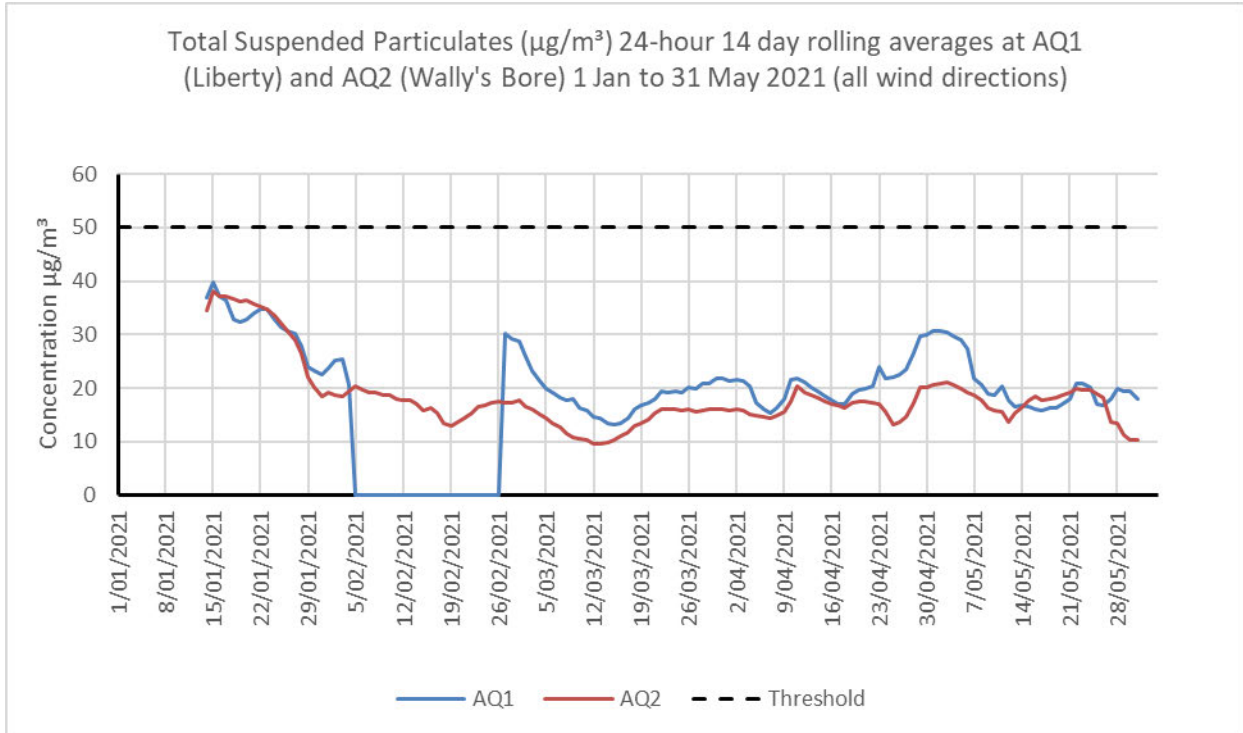


Figure 14a AQ1 & AQ2 - 24-hour average PM_{10} (14 day rolling average) from 1 January to 31 May 2021

For the period of 1st January to 31st May 2021, licence compliance requirements were met at AQ2, however, AQ1 experienced a data taker failure at the end of January. Due to parts shortages and delivery delays, the problem was not rectified until late February as detailed above in Figure 14a.

AQ2 achieved sampling compliance during all other months of 2021. Full maintenance records are available if further information is required.

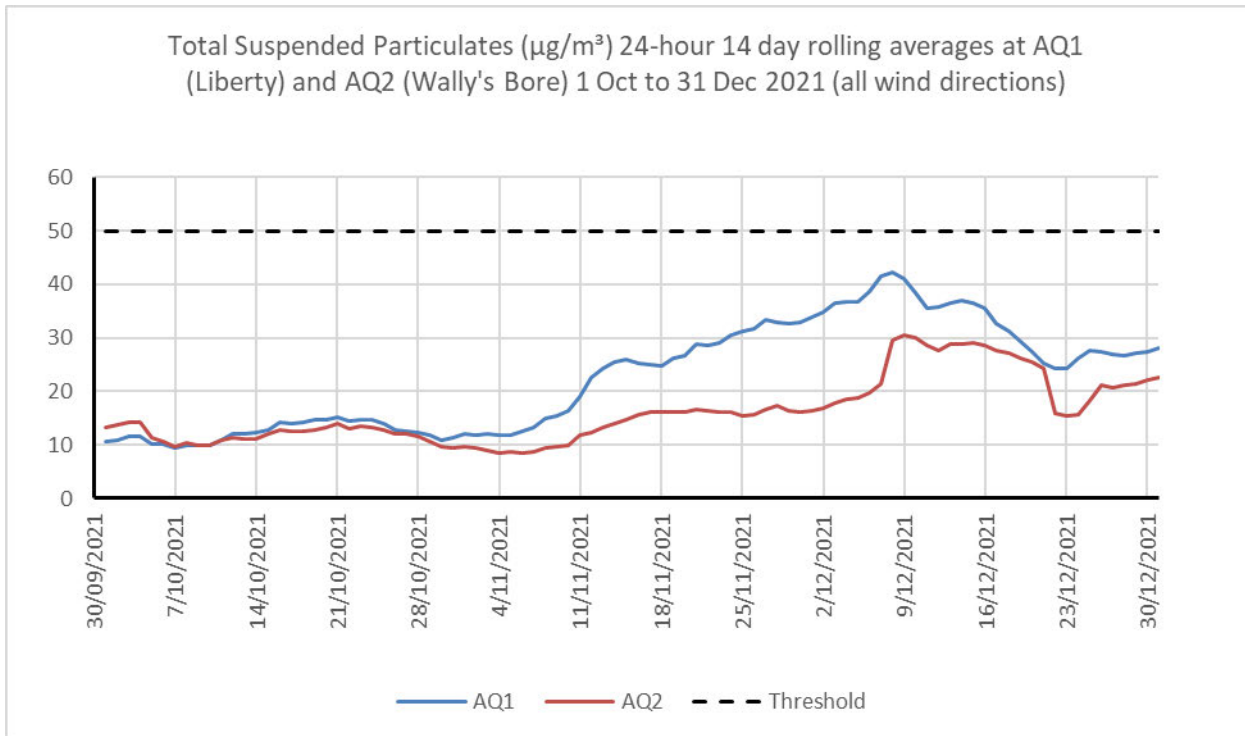


Figure 14b AQ1 & AQ2 - 24-hour average PM10 (14 day rolling average) from 1 October to 31 December 2021

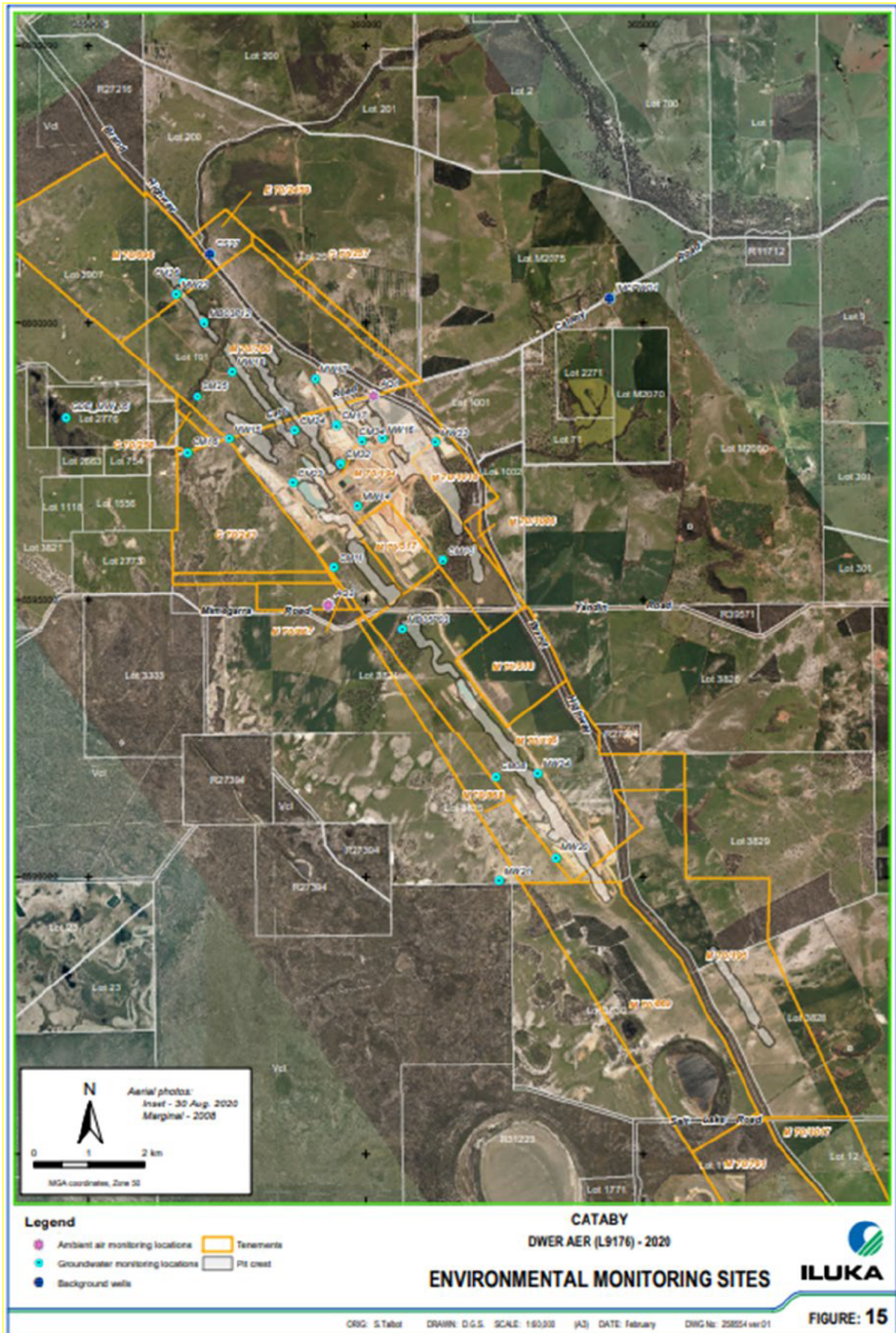


Figure 15 Environmental Monitoring Sites

4.2 Ambient Groundwater Quality

Ambient groundwater monitoring is required under condition 18 (Table 13 of L9176) as detailed in the following section.

4.2.1 Standing Water Level – Monthly

The data for monthly groundwater standing water levels (SWL) is summarised in Table 3 with reference to baseline and recent monitoring values. All “MW” monitoring points were established at commissioning of the operation and therefore do not have a reference baseline.

A review of the mean and variance data indicates that 2021 groundwater levels show a rise in sixteen of the monitoring sites compared to 2020 results) within the range of decline 100-500mm across most locations with some exceptions. This excludes CM23 bores which were unable to be sampled for most of the year due to restricted access stemming from geotechnical stability concerns in the area. 9 bores showed a drop in in groundwater levels due to their proximity to actively dewatered mining pits (Pits 2, 10 and 11). Trends are illustrated and described with reference to Figures 16 to 18.

Table 3 Summary of monthly groundwater SWL data (mTOC)

Monitoring point	Historical			Current Reporting Period		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	21.9 - 25.8	22.5 – 23.0	23.11	23.54	0.11	23.55
CM10S	No data	No data available	DRY	DRY	n/a	-
CM11 S	21.3 – 22.8	No data	23.59	25.28	0.41	25.24
CM11 M	21.0 – 22.1	21.1 – 21.9*	23.40	25.07	0.43	25.05
CM16S	1.06 – 2.7	1.6 – 2.6*	3.03	2.92	0.6	3.20
CM17S	9.1 – 10.9	9.3 – 10.2 (16)	9.88	9.38	1.37	10.41
CM23 S*	2.8 – 4.5	2.8 – 4.5 (16)	12.70	11.88	n/a	-
CM23 M*	2.6 – 4.5	2.7 – 4.4*	14.06	11.75	n/a	-
CM24 S	1.3 – 3.2	No data	4.28	4.27	0.94	4.46
CM24 M	1.66 – 3.2	No data	4.43	4.39	0.93	4.62
CM25S	1.7 – 4.4	2.8 – 3.2*	3.11	3.01	0.76	3.12
CM26 S	7.7 – 10.5	8.1 – 10.0 (28)	9.89	9.77	0.48	9.80
CM26 M	7.6 – 10.4	9.0 – 10.0 *)	9.77	9.67	0.44	9.72
CM32S	13.5 – 15.7	13.01 – 14.21 (16)	16.79	17.49	0.61	17.59
CM34S	15.9 – 17.7	15.5 – 16.2 (15)	15.58	15.85	0.86	16.10
GDE_MW_05S	No data	5.9 – 6.6	6.78	6.78	0.49	6.92
MB03P12 S	6.9 – 8.1	6.2 – 7.1	7.26	7.08	0.45	7.31
MB03P12 M	7.1 – 10.7	6.4 – 7.2*	7.34	7.03	0.58	7.29
MB05P03S	7.08 – 27.3	10.3 – 11.3*	27.95	28.61	0.64	28.77

Monitoring point	Historical			Current Reporting Period		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
MW_14S	No Data	22.2 – 23.2**	26.32	29.20	0.76	29.21
MW_15S	No Data	1.6 – 2.4**	3.72	3.65	0.48	3.83
MW_16S	No Data	21.44 – 21.95**	21.99	22.15	0.50	22.37
MW_17S	No Data	13.7 – 14.24**	13.81	13.38	0.68	13.63
MW_18S	No Data	2.3 – 2.8**	3.61	3.41	0.41	3.57
MW_20S	No Data	18.9 – 20.1**	21.30	22.03	0.16	22.02
MW_21S	No Data	6.2 – 6.8**	7.29	7.40	0.42	7.64
MW_22S	No Data	34.4 – 35.6**	36.96	36.70	0.08	36.71
MW_23S	No Data	8.6 – 9.5**	9.69	9.60	0.43	9.53
MW_24S	No Data	28.5 – 28.7**	29.32	30.04	0.21	30.03

* CM23 was unable to be sampled from January 2021 due to site access restriction. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access within a certain distance to the pit wall is closed.

Figure 16 shows the influence of dewatering at Pit 2 (in-pit abstraction only) on MW24S, MW20S/D, MW21S and CM08S. The overall trend in SWL's shows no significant decreases in water level were observed in the surrounding bores during / following groundwater abstraction and does not respond sharply to abstraction rates or rainfall replenishment. Figure 17 shows Pit 10 SWL dynamics.

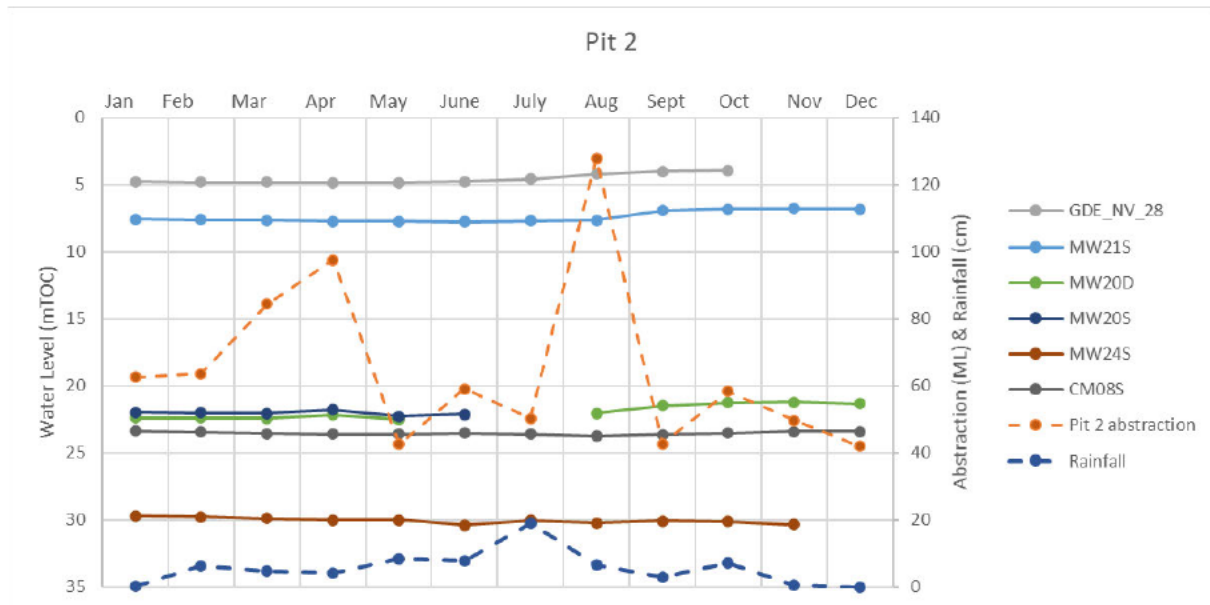


Figure 16 Abstraction Pit 2 – Standing Water Levels (SWL)

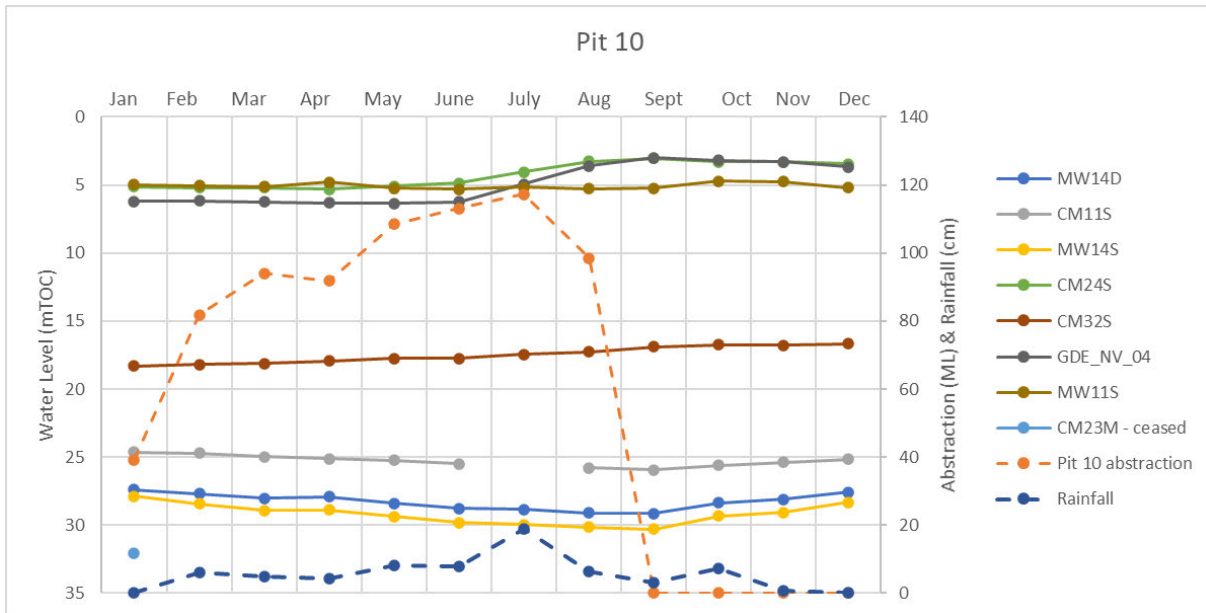


Figure 17 Abstraction Pit 10 – Standing Water Levels (SWL)

Pit 10 dewatering ceased in September 2021 and it is expected that groundwater levels will recover over time as dewatering rates reduce, as demonstrated in Figure 17 which shows the effect of a reduction in dewatering at Pit 11 and ceasing of dewatering in Pit 10 has resulted in MW14S/D, CM24S and CM11S recovering slightly in the immediate vicinity of Pit 10 (Figure 17).

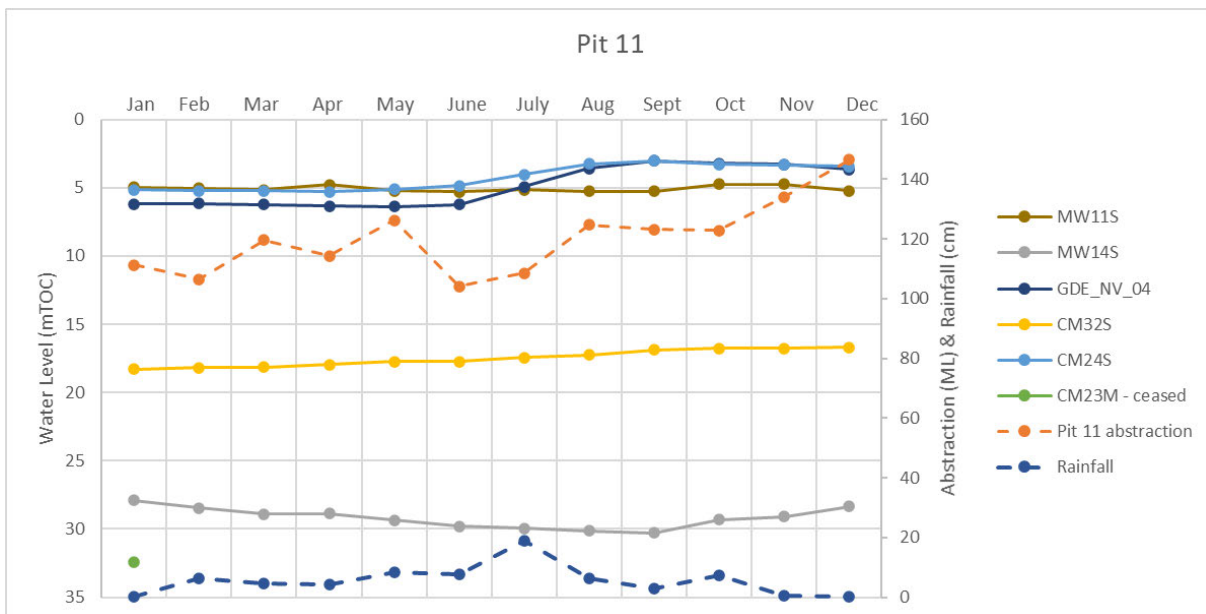


Figure 18 Abstraction Pit 11 – Standing Water Levels (SWL)

4.2.2 pH – Monthly

Field pH is recorded monthly at all monitoring locations and confirmatory laboratory testing is also conducted. The mean and variance data is shown in Table 4 with reference to available background levels or more recent measurements. There are no statistically significant changes in pH levels during the period. Background pH values vary considerably across the operation from low 5's to low 10's and these general levels are reflected in the 2021 data..

Table 4 Summary of monthly groundwater pH (field) data

Monitoring point	Historical (pH)			Current Reporting Period (pH)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	5.2 – 6.3 (19)	5.3 – 5.7 (7)	6	5.85	0.399	5.93
CM10S	No data available	No data available	DRY	DRY	DRY	DRY
CM11 S	5.3 – 5.9 (4)	No data	5.33	5.23	0.295	5.24
CM11 M	5.3 – 5.8 (8)	5.6 – 6.7 (5)	5.28	5.22	0.169	5.28
CM16S	4.9 – 5.9 (16)	5.1 – 5.3 (5)	5.28	5.36	0.261	5.36
CM17S	5.2 – 5.7 (11)	5.0 – 5.8 (7)	5.32	5.21	0.208	5.18
CM23 S*	5.4 – 7.2 (5)	5.6 – 6.2 (8)	5.78	N/A	N/A	N/A
CM23 M*	No data	5.1 – 5.3 (4)	5.24	N/A	N/A	N/A
CM24 S	No data	No data	4.82	4.86	0.231	4.81
CM24 M	No data	No data	5.4	5.35	0.429	5.35
CM25S	5.6 – 6.6 (22)	6.0 – 6.3 (4)	6.11	6.17	0.429	6.09
CM26 S	5.4 – 5.8 (7)	5.6 – 6.1 (7)	5.69	5.93	0.849	5.67
CM26 M	5.4 – 5.5 (6)*	5.4– 5.5 (4)	5.41	5.41	0.295	5.46
CM32S	5.1 – 6.5 (6)	5.3 – 5.9 (6)	5.44	5.30	0.449	5.23
CM34S	5.2 – 6.5 (5)	5.0 – 5.8 (8)	5.31	5.13	0.304	5.17
GDE_MW_05S	No data	6.8 – 7.3 (3)	6	5.85	0.351	5.79
MB03P12 S	No data	5.7 – 6.9 (7)	5.78	5.85	0.730	5.65
MB03P12 M	No data	5.7 – 6.0 (4)	5.86	5.77	0.245	5.77
MB05P03S	No data	No data	5.17	5.29	0.265	5.30
MW_14S	Not constructed	6.0 – 7.6 (6)	5.42	5.23	0.204	5.24
MW_15S	Not constructed	6.1 – 7.6 (8)	6.03	5.92	0.223	6.01
MW_16S	Not constructed	6.2 – 9.4 (5)	5.31	5.26	0.286	5.29
MW_17S	Not constructed	5.5 – 7.0 (6)	5.3	5.39	0.195	5.39
MW_18S	Not constructed	5.7 – 6.5 (5)	5.84	5.72	0.314	5.62
MW_20S	Not constructed	6.8 – 8.7 (6)	6.64	6.51	0.580	6.72

Monitoring point	Historical (pH)			Current Reporting Period (pH)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
MW_21S	Not constructed	7.0 – 7.9 (7)	6.68	6.39	0.407	6.55
MW_22S	Not constructed	7.7 – 9.3 (6)	6.47	5.80	0.255	5.83
MW_23S	Not constructed	11.2 – 11.5 (3)	10.18	8.99	1.907	10.03
MW_24S	Not constructed	7.1 – 7.3 (4)	6.42	5.70	0.340	5.66

* CM23 was unable to be sampled from January 2021 due to site access restriction. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access within a certain distance to the pit wall is closed.

4.2.3 Electrical Conductivity – Monthly

Electrical Conductivity (EC) is recorded monthly at all monitoring locations with results provided through NATA accredited laboratory testing. The mean and variance data is shown in Table 5 with reference to available background levels or more recent measurements. Background EC values are generally low with the exception of CM25S (in the vicinity of the lower extent of Minyulo Brook) and CM11S (located within 1km north of Native Dog Swamp and west of Pit 7) where background EC levels range higher historically towards 10,000 $\mu\text{S}/\text{cm}$ as reflected in the current reporting period. CM11S showed a reduction in mean compared to 2021, starting at approximately 9500 $\mu\text{S}/\text{cm}$ and reducing to approximately 4000 $\mu\text{S}/\text{cm}$ in June and stabilizing at that level for the remainder of the monitoring year. Other than CM11S there are no statistically significant changes in EC levels during the period.

Table 5 Summary of monthly groundwater Electrical Conductivity (EC) data

Monitoring point	Historical ($\mu\text{S}/\text{cm}$)			Current Reporting Period ($\mu\text{S}/\text{cm}$)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	220 – 3210	395- 1160	619	511	190	435
CM10S	No data	No data	DRY	DRY	DRY	DRY
CM11 S	1500 – 2742	No data	9892	5742	2657	4150
CM11 M	1067 – 2579	1548 – 2474*	2350	3000	613	2650
CM16S	450-1287	665 – 797 *	733	760	59	770
CM17S	676- 1540	453 – 668*	1220	1502	352	1500
CM23 S*	398 – 820*	266 – 434	420	N/A	N/A	N/A
CM23 M*	1377 – 2600*	1260 – 1460 *	1525	N/A	N/A	N/A
CM24 S	490 – 580 *	No data	199	280	135	215
CM24 M	1000 – 1417*	No data	1108	996	50	990
CM25S	608 – 9097	6577 – 9170*	8408	8092	701	8100

Monitoring point	Historical (µS/cm)			Current Reporting Period (µS/cm)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM26 S	1290 – 2497	1114- 2572	1943	1754	181	1700
CM26 M	2080 - 3462	2715 - 3355	3067	3038	87	3000
CM32S	426 – 1442	441 – 862	434	444	50	450
CM34S	343 – 818	258 – 452	407	387	44	390
GDE_MW_05S	No data	1600 - 2233	2033	2000	77	2000
MB03P12 S	293 - 437*	293 -437	321	328	27	320
MB03P12 M	No data	1747 - 2090	1842	1785	90	1800
MB05P03S	No data	No data	3683	3525	166	3600
MW_14S	Not constructed	1940 – 3940**	3217	3031	189	3100
MW_15S	Not constructed	835 – 2710**	902	842	26	830
MW_16S	Not constructed	368 – 970**	612	758	191	840
MW_17S	Not constructed	605 - 2000**	1498	1488	231	1600
MW_18S	Not constructed	365 - 780**	461	402	24	400
MW_20S	Not constructed	614 - 2700**	650	710	66	700
MW_21S	Not constructed	1000 - 1440**	916	932	43	920
MW_22S	Not constructed	1090 - 2550**	1650	1402	204	1400
MW_23S	Not constructed	2200 - 3577**	1800	1438	139	1400
MW_24S	Not constructed	1276 – 3430**	613	362	25	370

* CM23 was unable to be sampled from January 2021 due to access restrictions. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access to the pit wall is closed in this area.

4.2.4 Redox Potential – Monthly

The data for monthly groundwater Redox potential (in-field) is summarised in 6. There is limited pre-2018 baseline data and construction/commissioning phase data for redox potential, as indicated by the number of observations recorded. The majority of bores displayed a trend of lowering Redox Potential in comparison to the previous reporting period.

Table 6 Summary of monthly groundwater Redox potential data

Monitoring point	Historical (mV)			Current Reporting Period (mV)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	153- 557 (3)	-35 – 560.2 (5)	455.88	332.80	152.69	306.30
CM10S	-100 – 100(2)	-	DRY	DRY	DRY	DRY
CM11 S	No data	No data	240.07	80.05	168.50	131.00
CM11 M	75.1 – 153.0 (3)	-253.7 – 151.7 (5)	299.83	234.55	69.12	250.90
CM16S	63 – 155.1 (7)	43.7 – 143.7 (5)	144.23	121.86	39.53	130.05
CM17S	97.4 – 240 (5)	75.6 – 247.2 (5)	310.33	275.93	45.96	287.00
CM23 S	11.7 – 124 (4)	21.9 – 175.8 (8)	273.65	N/A	N/A	N/A
CM23 M*	No data	79.5 – 209.4 (4)	344.22	N/A	N/A	N/A
CM24 S*	No data	No data	278.59	210.24	33.53	242.65
CM24 M	No data	No data	320.04	262.51	103.11	266.95
CM25S	-40.8 - 37.6 (8)	-23.4 – 11.6 (4)	7.58	-2.92	26.18	-5.35
CM26 S	85.8 – 202.1 (4)	26.0 – 198.0 (7)	179.68	154.12	97.93	196.25
CM26 M	89.6 – 235.4 (4)	34.4 – 173.6 (4)	171.45	181.98	42.33	175.65
CM32S	129.0 – 205.9 (3)	73.0 – 220.3 (6)	300.11	298.23	42.57	316.95
CM34S	117.3 – 199.1 (3)	90.8 – 274.0 (7)	382.62	288.25	99.58	323.95
GDE_MW_05S	No data	-158.4 – 135.2 (3)	-51.30	-105.93	52.79	-94.25
MB03P12 S	No data	-19.4 – 187.0 (6)	299.96	184.03	70.31	203.15
MB03P12 M	No data	22.7 – 142.5 (4)	257.88	184.02	58.55	189.45
MB05P03S	No data	No data	314.43	184.03	103.91	241.40
MW_14S	No data	-175.2 – 100.0 (6)	268.69	259.86	39.88	268.00
MW_15S	No data	-177.4 - -54.9 (6)	-56.08	-68.94	31.95	-72.55
MW_16S	No data	-97.1 – 178.0 (5)	345.62	298.39	43.69	314.90
MW_17S	No data	24.8 – 167.0 (5)	340.73	276.15	54.91	293.65
MW_18S	No data	-120.9 - -42 (4)	-19.63	20.81	110.93	0.80
MW_20S	No data	-134.8 – 68.7 (5)	226.06	223.23	44.19	208.45
MW_21S	No data	-225.9 – 13.8	-64.99	-18.87	68.58	-35.25
MW_22S	No data	-201 - -44.8 (5)	57.91	180.23	46.95	181.35
MW_23S	No data	- 378.3 - -287.3 (3)	-216.46	-157.22	181.71	-241.10



Monitoring point	Historical (mV)			Current Reporting Period (mV)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
MW_24S	No data	150.4 --103(3)	-47.79	128.65	41.51	131.50

* CM23 was unable to be sampled from January 2021 due to access restrictions. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access to the pit wall is closed in this area.

4.2.5 Titratable Acidity – Monthly

The data for monthly groundwater Titratable Acidity (TA) is summarised in 7. The data provided is determined by a NATA accredited laboratory.

The licence conditions require TA to be measured as both ambient groundwater quality (Table 13 of L9176) and dewatering as measured at the CWD inflow point (Table 10 of L9176) which is detailed in section 4.2.3 and 4.2.5. With limited pre-mining baseline data available for TA and operational dewatering data in its relatively early stages (3rd year), the data will continue to evolve to build the dataset required to set groundwater triggers for pH and titratable acidity (TA) based upon the (to be determined) upper threshold limit (UTL) of background water quality in the area. There are no statistically significant changes in titratable acid levels during the period.

Table 7 Summary of monthly groundwater TA data

Monitoring point	Historical (mg/L)			Current Reporting Period (mg/L)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	No data	18 - 79	28	14.64	6.41	14.00
CM10S	No data	DRY	DRY	DRY	DRY	DRY
CM11 S	No data	21 - 70	40	53.25	10.24	50.50
CM11 M	No data	17 – 64	39	50.42	9.75	51.50
CM16S	No data	14 – 72	59	50.47	13.28	46.00
CM17S	No data	7 – 52	25	27.38	13.39	26.00
CM23 S*	No data	8 – 22	4	<5	-	<5
CM23 M*	No data	19 – 44	9	46	-	41
CM24 S	No data	5 – 40	22	30.36	13.69	27
CM24 M	No data	14 – 59	43	50.00	12.62	54.50
CM25S	No data	31 – 190	142	161.54	30.23	160.00
CM26 S	No data	9 – 41	21	21.62	6.17	22.00
CM26 M	No data	9 – 60	31	39.54	9.89	36.00
CM32S	No data	1 – 57	40	47.50	16.61	44.50
CM34S	No data	11 – 45	24	21.92	6.54	20.50
GDE_MW_05S	No data	7 – 50	34	39.80	10.35	40.50

Monitoring point	Historical (mg/L)			Current Reporting Period (mg/L)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
MB03P12 S	No data	7 – 17	12	13.23	3.72	12.00
MB03P12 M	No data	14 – 49	29	30.54	9.63	29.00
MB05P03S	No data	22 – 74	49	48.17	12.65	47.00
MW_14S	No data	18 – 79	52	52.00	13.18	57.00
MW_15S	No data	10 – 40	34	38.92	8.94	39.50
MW_16S	No data	14 – 63	28	24.08	13.25	20.00
MW_17S	No data	5 – 40	9	9.69	7.16	8.00
MW_18S	No data	10 – 74	45	50.00	11.96	50.00
MW_20S	No data	5 – 24	12	11.20	0.84	11.00
MW_21S	No data	10 – 25	22	20.82	7.35	21.00
MW_22S	No data	5 – 34	34	53.31	21.40	56.00
MW_23S**	No data	5 – 12	<5	<5	N/A	<5
MW_24S	No data	24 - 58	37	41.00	15.38	38.00

* CM23 was unable to be sampled from January 2021 due to access restrictions. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access to the pit wall is closed in this area

** Parameter below detectable limit - unable to apply standard deviation to results

4.2.6 Total Alkalinity – Monthly

The data for monthly groundwater Total Alkalinity (TAlk) is summarised in Table 8. The data provided is determined by a NATA accredited laboratory.

With limited pre-mining baseline data available for TAlk and operational dewatering data in its relatively early stages (3rd year), the data will continue to evolve to build the dataset required to set groundwater triggers for pH and titratable acidity (TA) based upon the (to be determined) upper threshold limit (UTL) of background water quality in the area.

Monitoring wells CM24S, CM34S, MW16S and MW17S recorded TAlk values less than 10mg/L in certain months throughout the reporting period. A comparison between groundwater TAlk and TA identified that TA was generally greater than TAlk throughout the reporting period and above the limit of 5.5pH. Licence condition 10 (Table 8 of L9176) requires dewatering water to be managed to ensure $\text{pH} \geq 5.5$ and $\text{TAlk} > \text{TA}$. As all recorded values met this criteria during the 2021 reporting period there was no management actions required as per the dewatering trigger values provided in Table 9 of L1976.

Total alkalinity is an indicative measure of the buffering capacity of the groundwater. The lower the total alkalinity and the higher the total acidity, the more vulnerable groundwater is to acidification (reduced pH) (DER, 2015).

ASS investigations undertaken for the Cataby Project identify the inherently acidic nature of soils sampled, typical for surficial soils on the Swan Coastal Plain, reflecting poor buffering capacity. This is reflected in Table 8, with most locations associated with low alkalinity capacity. Specifically, monitoring wells CM24S, CM34S and MW17S that recorded very low alkalinity values (<10 mg/L) throughout certain months of reporting period, associated with a pH less than 6.0 but greater than 5.0. On the contrary, monitoring wells CM25S, MW21S, MW22S and MW23S showed high (60-180 mg/L) to very high (>180 mg/L) alkalinity capacity (DER, 2015), indicating a stronger buffering capacity.

Table 8 Summary of monthly groundwater TAlk data

Monitoring point	Historical (mg/L)			Current Reporting Period (mg/L)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM08S	40 – 50 (2)*	28 – 31 (2)*	42	36	27	31
CM10S	No data	No data	DRY	DRY	DRY	DRY
CM11 S	15 – 20 (3)*	No data	20	28	11	29
CM11 M	15- 22 (3)*	60 – 65 (4)*	16	17	2	17
CM16S	23 – 25 (3)*	12 – 14 (2)*	17	17	3	16
CM17S	11 – 30 (3)*	7 – 10 (2)*	11	13	1	13
CM23 S*	35 -55 (2)*	21 – 28 (2)*	26	N/A	N/A	N/A
CM23 M*	15 – 38 (2)*	13 – 14 (2)*	17	N/A	N/A	N/A
CM24 S	12 – 38 (2)*	No data	6	8	2	5

Monitoring point	Historical (mg/L)			Current Reporting Period (mg/L)		
	Baseline Range (pre-2018)	Construction/ Commissioning (2018)	2020 Mean	2021 Mean	2021 Std Dev.	2021 Median
CM24 M	No data	No data	22	22	1	22
CM25S	92-169 (3)*	79 – 83(2)*	131	129	20	130
CM26 S	38 – 79(2)*	24 – 25 (2)*	20	18	2	17
CM26 M	No data	No data	17	18	1	18
CM32S	No data	No data	25	23	1	24
CM34S	No data	No data	11	9	2	9
GDE_MW_05S	No data	121 – 163 (4)*	57	48	3	48
MB03P12 S	No data	10 – 58(4)*	15	14	3	14
MB03P12 M	No data	38 – 40 (4)*	42	43	6	42
MB05P03S	No data	No data	15	18	3	17
MW_14S	Not constructed	110- 362**	27	24	2	24
MW_15S	Not constructed	11 – 131**	57	51	3	50
MW_16S	Not constructed	58 – 246**	14	11	6	9
MW_17S	Not constructed	11 – 59**	9	6	2	6
MW_18S	Not constructed	55 – 100**	53	49	2	49
MW_20S	Not constructed	63 -500**	79	104	26	100
MW_21S	Not constructed	97 – 286**	133	113	17	110
MW_22S	Not constructed	410 – 577**	160	67	34	65
MW_23S	Not constructed	441 – 621**	270	202	47	<5
MW_24S	Not constructed	550 – 1070**	144	45	10	47

* CM23 was unable to be sampled from January 2021 due to site access restrictions. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access to the pit wall is closed in this area

4.2.7 Major Ions – Quarterly

The quarterly data for major ions are presented in Table 9. The data provided is determined by a NATA accredited laboratory. As per L9176, the four inclusive periods are from 1 January to 31 March (Q1), 1 April to 30 June (Q2), 1 July to 30 September (Q3) and 1 October to 31 December (Q4) during the reporting year. Where multiple data points exist within the quarterly period, the maximum value has been used.

Table 9 Quarterly major ion data

Monitoring point	2021 Sampling period	Parameter (mg/L)							
		HCO ₃	Ca	Cl	Mg	K	Na	SO ₄	TDS
CM08S	Q1	34	1.2	130	6.7	4.1	110	74	450
	Q2	34	0.8	120	4.5	2.6	110	69	310
	Q3	22	0	55	1.3	1.5	55	30	700
	Q4	23	0	54	1.4	1.4	58	35	370
CM10S	Q1	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Q2	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Q3	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Q4	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
CM11S	Q1	17	15	3100	190	24	1700	170	6200
	Q2	18	19	2200	140	17	1300	110	4300
	Q3	37	13	1200	82	10	540	83	2000
	Q4	35	12	1100	70	9.4	540	80	2000
CM11M	Q1	15	20	1300	100	9.2	690	92	2700
	Q2	17	18	790	57	6.7	400	58	1700
	Q3	19	12	760	58	6.6	350	62	1400
	Q4	18	15	800	64	6.9	350	59	1500
CM16S	Q1	14	5.9	190	17	2.6	79	7	420
	Q2	18	4.3	170	15	2.4	74	7	340
	Q3	20	7.7	220	18	2.9	110	13	480
	Q4	19	6.4	210	15	3	100	17	480
CM17S	Q1	14	8	530	31	5.4	280	65	1100
	Q2	12	5.7	420	23	4.1	220	53	850
	Q3	13	3.6	250	13	2.7	140	43	530
	Q4	14	6	440	24	3.6	240	62	840
CM23S	Q1	N/A (No Access)							
	Q2								
	Q3								
	Q4								
CM23M	Q1	N/A (No Access)							
	Q2								
	Q3								
	Q4								
CM24S	Q1	0	0.6	54	5.5	0.6	31	11	150
	Q2	10	1.8	130	12	1.1	83	39	410

Monitoring point	2021 Sampling period	Parameter (mg/L)							
		HCO ₃	Ca	Cl	Mg	K	Na	SO ₄	TDS
	Q3	0	1.2	48	5.7	0	30	15	160
	Q4	0	0.7	45	3.7	0	27	12	160
CM24M	Q1	24	1.9	240	15	4.2	160	49	620
	Q2	22	2.2	230	15	4	160	48	560
	Q3	22	2.3	260	16	4	150	57	570
	Q4	22	2.3	250	15	3.9	150	57	580
CM25S	Q1	140	48	2300	160	13	1300	230	4700
	Q2	130	53	2500	170	14	1400	240	5200
	Q3	130	51	2800	160	15	1400	280	4800
	Q4	130	57	2900	190	15	1500	300	5800
CM26S	Q1	16	5.5	440	30	5.5	240	59	920
	Q2	23	6.9	450	35	5.9	260	56	1000
	Q3	17	7.3	520	37	6.3	240	68	1100
	Q4	18	7.7	530	39	6.2	270	65	1000
CM26M	Q1	18	21	920	67	9.1	450	100	2000
	Q2	17	20	880	72	9.5	450	86	2000
	Q3	20	20	940	63	8.7	410	100	1700
	Q4	19	21	920	68	9.3	420	97	1700
CM32S	Q1	25	0	96	3	1.8	80	56	290
	Q2	23	0	55	1.6	1.9	70	49	260
	Q3	24	0	74	2.7	1.7	82	52	280
	Q4	24	2.1	48	14	3.8	150	47	190
CM34S	Q1	9	0.7	69	4.1	2.4	59	25	240
	Q2	10	0.7	96	5.7	2.6	72	23	270
	Q3	12	0.6	63	2.3	1.4	51	23	210
	Q4	11	0.6	82	3.2	1.8	60	23	250
GDE_MW_05 S	Q1	47	9.9	580	26	15	320	32	1200
	Q2	44	10	560	27	15	340	29	1200
	Q3	48	8.5	620	25	14	320	32	1200
	Q4	46	8.9	580	25	13	310	32	1200
MB03P12S	Q1	18	1.1	60	2.6	1.8	52	20	490
	Q2	18	1.9	65	3.3	1.7	56	19	400
	Q3	10	0.6	56	2.4	1.5	44	16	530
	Q4	11	0.8	64	3.4	1.8	47	14	410

Monitoring point	2021 Sampling period	Parameter (mg/L)							
		HCO ₃	Ca	Cl	Mg	K	Na	SO ₄	TDS
MB03P12M	Q1	44	7.7	500	38	11	270	51	1100
	Q2	62	11	430	34	11	240	49	950
	Q3	40	7.3	490	37	9.8	230	53	990
	Q4	42	8.1	500	38	9.8	250	49	1100
MB05P03S	Q1	15	8.4	1100	74	14	590	100	2200
	Q2	16	8.9	1100	75	14	590	88	2400
	Q3	17	7.1	1000	57	12	520	87	2000
	Q4	18	6.1	1000	54	12	490	87	1900
MW_14S	Q1	27	18	910	79	10	430	96	2000
	Q2	23	18	950	87	10	500	92	1900
	Q3	22	13	830	59	8.5	400	83	1700
	Q4	28	16	880	67	9	410	87	1700
MW_15S	Q1	57	7.5	220	19	5.2	120	23	520
	Q2	50	5.7	220	18	5.1	130	21	490
	Q3	51	5.5	220	16	4.4	110	25	450
	Q4	50	5.4	220	17	4.6	110	22	520
MW_16S	Q1	25	5.7	150	10	3.2	96	48	390
	Q2	11	0.8	53	4.7	1.9	71	35	240
	Q3	8	2.7	270	18	4.2	140	42	580
	Q4	8	2.2	230	16	3.8	130	36	530
MW_17S	Q1	0	8.3	540	33	5.3	310	68	880
	Q2	6	7.3	400	27	5	230	51	860
	Q3	6	6.4	430	27	4.9	220	56	820
	Q4	7	6.7	430	27	4.6	230	54	890
MW_18S	Q1	53	3.9	80	7	3.9	59	28	290
	Q2	50	3.8	67	7.2	4	53	23	270
	Q3	45	3.3	72	6.8	3.6	48	27	270
	Q4	50	3.6	84	7.4	3.7	60	26	370
MW_20S	Q1	120	14	27	6.6	4.8	120	160	590
	Q2	84	14	26	6.1	3.4	110	150	1100
	Q3	-	-	-	-	-	-	-	-
	Q4	-	-	-	-	-	-	-	-
MW_21S	Q1	130	13	210	16	8.1	160	13	630
	Q2	120	11	200	15	6.6	140	13	610

Monitoring point	2021 Sampling period	Parameter (mg/L)							
		HCO ₃	Ca	Cl	Mg	K	Na	SO ₄	TDS
	Q3	93	12	240	17	6.8	130	17	620
	Q4	98	12	250	19	6.7	140	20	620
MW_22S	Q1	110	33	390	29	11	230	70	970
	Q2	41	12	360	24	10	210	63	950
	Q3	55	18	380	24	9.7	200	64	820
	Q4	31	8.3	350	19	7.9	180	71	730
MW_23S	Q1	120	20	340	6.6	4.4	250	53	1100
	Q2	66	36	430	8	6.2	270	48	1000
	Q3	110	21	330	9.5	4.4	200	52	800
	Q4	97	27	410	9.7	5.2	250	55	920
MW_24S	Q1	51	1.4	54	4	2.5	65	27	320
	Q2	54	1.5	53	4	1.7	66	23	430
	Q3	18	0.8	48	3.4	1.1	55	19	280
	Q4	45	1.5	62	4.3	1.7	63	23	290

* CM23 was unable to be sampled from January 2021 due to access restrictions. CM23 occurs close to a pit wall that has geotechnical stability concerns, As a precaution access to the pit wall is closed in this area

4.2.8 Metals and Metalloids – 6 Monthly

The 6-monthly data for dissolved metals and metalloids is presented in Table 10. The data provided is determined by a NATA accredited laboratory. The two periods are 1 January to 30 June (H1) and 1 July to 31 December (H2). Where multiple data points exist within the period, the maximum value has been used.

The below summary review of the data indicates that most analytes (dissolved metals and metalloids) remained close to or moved below the limit of reporting (LOR) or recorded lower values during the reporting period relative to 2020 data. Metals and metalloid data was compared with ANZECC guideline values for ecosystem protection and pre-2018 baseline data and/or construction/commissioning data were available. There are no significant concerns with the 2021 monitoring data. The increase in Iron (Fe) in CM25S will be monitored against other analytes and indicators to assess any further changes in 2022.

Aluminium (Al)

- Increase from LOR to 2.1 mg/L at MBO3P12S in 2021, all other sites remain below or close to LOR.

Arsenic (As)

- New detection during H2 (0.008mg/L) in CM11S.
- All other sites remain below or close to LOR.

Cadmium (Cd)

- One first detect above LOR in CM16S (H1) at 0.0002mg/L returning to LOR in H2.

Iron (Fe)

- Reduced levels in CM11S, CM16S, CM24S/M (CM24M major reduction from 60mg/L to 0.04mg/L), CM25S, MW05S, MW14S, MW18S, MW22S, MW23S and MW24S (minor reduction from 7.1mg/L to 2mg/L).
- Major increase in CM25S from 51mg/L (2020) to 106mg/L.

Mercury (Hg)

- No Mercury detected during this reporting period relative to 2020, all sites at or below LOR.



Table 10 6-monthly Metals and Metalloids

Monitoring Point	2021 Sampling Period	Analytes mg/L													
		Al	As	Cd	Cr	Cr (VI)	Co	Cu	Fe	Hg	Ni	Se	Tl	U	Zn
CM08S	H1	0.03	<0.001	<0.0001	<0.002	0.005	<0.001	0.006	0.03	<0.0005	<0.001	<0.001	<0.001	0.0005	0.017
	H2	0.03	<0.001	<0.0001	<0.001	0.005	<0.001	0.007	0.12	<0.0005	<0.001	<0.001	<0.001	0.0006	0.012
CM10S	H1	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	H2	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
CM11S	H1	0.03	<0.001	<0.0001	<0.001	0.005	<0.002	0.009	0.11	<0.0005	<0.002	<0.001	<0.001	0.0005	0.013
	H2	0.06	0.008	<0.0001	<0.002	0.005	<0.002	<0.001	9.4	<0.0005	<0.002	<0.001	<0.001	0.0005	0.009
CM11M	H1	0.01	<0.001	<0.0001	<0.002	0.005	<0.001	0.013	0.03	<0.0005	<0.001	<0.001	<0.001	0.0005	0.013
	H2	0.01	<0.001	<0.0001	<0.002	0.005	<0.002	0.006	0.14	<0.0005	<0.002	<0.001	<0.001	0.0005	0.013
CM16S	H1	0.02	<0.002	0.0002	<0.002	0.01	0.006	0.012	8.4	<0.0001	0.006	<0.002	<0.002	<0.001	0.02
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.002	<0.002	2.9	<0.0005	<0.002	<0.001	<0.001	0.0005	0.005
CM17S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.01	0.02	<0.0005	<0.001	<0.001	<0.001	0.0005	0.01
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.006	0.04	<0.0005	<0.001	<0.001	<0.001	0.0005	0.017
CM23S	H1	No data (no access)													
	H2														
CM23M	H1	No data (no access)													
	H2														
CM24S	H1	0.03	<0.002	<0.0001	<0.001	0.005	0.003	0.007	5	<0.0005	<0.002	<0.001	<0.001	0.0005	0.012
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.014	0.07	<0.0005	<0.001	<0.001	<0.001	0.0005	0.008
CM24M	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.012	0.01	<0.0005	<0.001	<0.001	<0.001	0.0005	0.014
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.01	0.04	<0.0005	<0.001	<0.001	<0.001	0.0005	0.018
CM25S	H1	0.01	<0.002	<0.0001	<0.001	0.005	0.012	0.008	52	<0.0005	0.011	<0.001	<0.001	0.0005	0.012
	H2	0.01	<0.001	<0.0001	<0.001	0.005	0.009	0.004	106	<0.0005	0.009	<0.001	<0.001	0.0005	0.008
CM26S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.002	0.05	<0.0005	<0.001	<0.001	<0.001	0.0005	0.011
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.004	0.03	<0.0005	<0.002	<0.001	<0.001	0.0005	0.01
CM26M	H1	0.02	<0.001	<0.0001	<0.001	0.005	0.003	0.004	0.19	<0.0005	0.003	<0.001	<0.001	0.0005	0.01
	H2	0.01	<0.001	<0.0001	<0.001	0.005	0.003	0.01	0.21	<0.0005	0.007	<0.001	<0.001	0.0005	0.076
CM32S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.011	0.02	<0.0005	<0.001	<0.001	<0.001	0.0005	0.016
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.01	0.04	<0.0005	<0.001	<0.001	<0.001	0.0005	0.012



Monitoring Point	2020 Sampling Period	Al	As	Cd	Cr	Cr (VI)	Co	Cu	Fe	Hg	Ni	Se	Tl	U	Zn
CM34S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.018	0.02	<0.0005	<0.001	<0.001	<0.001	0.0005	0.045
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.006	0.02	<0.0005	<0.001	<0.001	<0.001	0.0005	0.085
MW_05S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	3.3	<0.0005	0.004	<0.001	<0.001	0.0005	0.006
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	3.5	<0.0005	0.005	<0.001	<0.001	0.0005	0.032
MB03P12S	H1	0.02	<0.001	<0.0001	<0.001	0.005	<0.001	<0.002	0.72	<0.0005	<0.001	<0.001	<0.001	0.0005	0.006
	H2	2.1	<0.001	<0.0001	0.006	0.005	<0.001	<0.002	3.96	<0.0005	<0.002	<0.001	<0.001	0.0005	0.004
MB03P12M	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.016	0.02	<0.0005	0.01	<0.001	<0.001	0.0005	0.12
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	0.05	<0.0005	<0.002	<0.001	<0.001	0.0005	0.005
MB05P03S	H1	0.01	<0.001	<0.0001	<0.002	0.005	0.003	0.01	0.04	<0.0005	0.004	<0.002	<0.001	0.0005	0.025
	H2	0.01	<0.001	<0.0001	<0.002	0.005	<0.002	0.004	0.11	<0.0005	0.003	<0.001	<0.001	0.0005	0.013
MW_14S	H1	0.02	<0.001	<0.0001	<0.001	0.005	<0.002	0.01	0.16	<0.0005	<0.002	<0.002	<0.001	0.0005	0.018
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.002	0.005	0.05	<0.0005	<0.002	<0.002	<0.001	0.0005	0.016
MW_15S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	4.5	<0.0005	<0.001	<0.001	<0.001	0.0005	0.004
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	9.2	<0.0005	<0.001	<0.001	<0.001	0.0005	0.004
MW_16S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.006	0.02	<0.0005	<0.001	<0.001	<0.001	0.0005	0.008
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.007	0.03	<0.0005	<0.001	<0.001	<0.001	0.0005	0.01
MW_17S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.004	0.02	<0.0005	0.008	<0.001	<0.001	0.0005	0.007
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.002	0.06	<0.0005	<0.001	<0.001	<0.001	0.0005	0.003
MW_18S	H1	0.01	0.003	<0.0001	<0.001	0.005	<0.001	<0.001	5	<0.0005	<0.001	<0.001	<0.001	0.0005	0.007
	H2	0.01	0.003	<0.0001	<0.001	0.005	<0.001	<0.001	10.4	<0.0005	<0.002	<0.001	<0.001	0.0005	0.006
MW_20S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.015	0.26	<0.0005	<0.002	0.003	<0.001	0.0007	0.021
	H2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW_21S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.003	3.2	<0.0005	0.006	<0.001	<0.001	0.0005	0.012
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	<0.002	8.5	<0.0005	0.003	<0.001	<0.001	0.0005	0.012
MW_22S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.023	0.28	<0.0005	0.004	<0.001	<0.001	0.0005	0.055
	H2	0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.014	0.07	<0.0005	0.004	<0.001	<0.001	0.0005	0.06
MW_23S	H1	0.1	<0.002	<0.0001	<0.001	0.005	0.004	<0.001	0.09	<0.0005	0.008	<0.001	<0.001	0.0005	0.005
	H2	0.05	<0.002	<0.0001	<0.001	0.005	0.005	<0.001	0.15	<0.0005	0.009	<0.001	<0.001	0.0005	0.006
MW_24S	H1	0.01	<0.001	<0.0001	<0.001	0.005	<0.002	0.007	2	<0.0005	0.008	<0.001	<0.001	0.0005	0.017
	H2	0.02	<0.001	<0.0001	<0.001	0.005	<0.002	0.006	1.98	<0.0005	0.01	<0.001	<0.001	0.0005	0.014

5 Acid Sulfate Soils Controls

Acid Sulfate Soils controls, dewatering trigger criteria and corresponding actions required are detailed under condition 10 (Table 8 and 9 of L9176). During the reporting period there were no exceedances of these trigger criteria as measured at the CWD inflow point.

During the reporting period removal of topsoil, overburden and ore in Pit 8 triggered the requirement to conduct field surveys and pH_F and pH_{FOX} tests before and during earth moving processes. Upstream and downstream groundwater was also monitored for any PASS indicative quality changes (Table 11). Field sheets and laboratory test results were recorded and reviewed with no immediate management actions required (i.e. addition of lime or burial) to mitigate any predictive risks generated from PASS. More information can be provided if required.

6 Public Complaints

Public complaints, if received, are recorded in Iluka's incident database, Cintellate and managed in accordance with Iluka's HSEC Group Procedure Grievance Management. No public complaints were received during the reporting year.

Table 11 Public Complaints

Incident Date	Incident #	Incident Type	Summary	Level	Details	Management Actions
No Public Complaints were received						

7 Environmental Incidents

Iluka records all incidents and hazards via the electronic Incident Management System, Cintellate. The severity of an incident is determined by the Iluka Group Guideline, *Hazard Incident Emergency Classification* (August 2020) and is used to determine the appropriate level of risk for an incident. Level 1 and 2 incidents were recorded in 2021 which generally do not require a detailed investigation. All level 3 incidents were investigated. 33 Environmental incidents were recorded during this reporting period and are listed in Table 12.

Table 12 Environmental Incidents

Date	Incident #	Summary	Management	Level	Risk
18/12/2021	INC294997	Hydrocarbon spill	Spill contained and area remediated	2	LOW
7/12/2021	INC294632	Pit 1 dust emissions	Equipment stand down in Pit 1.	2	HIGH
7/12/2021	INC294642	Pit 1 Non-NORM fugitive dust emissions - 3 recurrent L2 incidents	Deploy additional off road water cart to Pit 1.	3	HIGH
3/12/2021	INC294555	Dust from Pit 1 over Brand Highway	Stand down equipment operating at pit 1	2	HIGH
25/11/2021	INC294551	Dust over Brand highway from pit 1	Increased frequency of road-going water truck	2	HIGH

Date	Incident #	Summary	Management	Level	Risk
8/11/2021	INC293724	Truck leaking non mag mineral	Truck was back to site clean up arranged immediately	2	MODERATE
1/11/2021	INC293499	AASS indicated ore mined without being sampled and analysed	Mine face and ore stockpile inspected for AASS and none observed	1	LOW
31/10/2021	INC293459	Oil spill in pit 2 sand tails return water pumps	Shut down pump and contain spillage	1	LOW
23/10/2021	INC293244	Septic system overflow	Arranged for vac truck to empty out the system and remove spillage material	2	MODERATE
28/09/2021	INC292355	Fauna collision Cataby mine access road	Checked Kangaroo. Remove from roadside.	1	LOW
19/09/2021	INC292067	Untreated raw effluent being exposed to personnel and the environment	Vaccum truck removed material	3	VERY HIGH
30/08/2021	INC291575	Truckwash failed to activate when loaded HMC truck was leaving the site.	Upgrade the washbay system for more reliable trigger mechanism	1	MODERATE
28/08/2021	INC291405	Minor hydraulic oil spill on dredge	Spill kit deployed	1	MODERATE
10/08/2021	INC291117	Loaded Qube truck failing to wait for automated weighbridge/wash-down to activate.	Upgrade the washbay system for more reliable trigger mechanism	1	MODERATE
28/07/2021	INC290395	Minor Diesel fuel spill after fuel hose broke off tank	Absorbent mats placed over spillage area and beneath machine	1	MODERATE
21/07/2021	INC290148	Oil leak due to "O" ring failure on top of excavator 258 boom	Capped valve bank trammed to workshop for washdown, replaced o ring	1	LOW
14/07/2021	INC289809	Uncontrolled stormwater release pit 2 pipe trace	Gradual release of water from pipe trace to prevent break through	3	MODERATE
14/07/2021	INC290116	Erosion from stormwater release	Inspection of crop damage and extent of erosion	2	LOW
2/07/2021	INC289397	HMC spillage at weighbridge	HMC recovered	1	LOW
10/06/2021	INC288632	Mineral/NORM build up and spread to West of concentrator	Continued focus on clean up of NORM in and around the WCP	2	MODERATE
3/05/2021	INC287216	Hydraulic oil spill from leak on backhoe	Machine shut down and parked up. Spill cleaned up	1	LOW
26/04/2021	INC287092	Fire truck diesel spillage	Spill kit deployed	1	LOW
20/04/2021	INC286864	Oil spill from pump PU252	Pump shut down spill kit deployed	1	LOW

Date	Incident #	Summary	Management	Level	Risk
8/04/2021	INC286527	IT loader LO1 blown hydraulic line (quick hitch)	Parked up loader spill pads deployed	1	LOW
4/04/2021	INC286419	Qube Truck Failing to Wash Down After Loading HMC	Spoke to driver regarding wash down requirements	1	LOW
25/03/2021	INC286106	Snake removed from site	Snake catcher removed snake	1	LOW
27/02/2021	INC285225	Rubbish along access road to site	Rubbish collected	1	LOW
15/02/2021	INC284994	Bee swarm building hive on front of LV	Pest controller engaged	1	MODERATE
13/02/2021	INC284840	Fuel leak from fast attack vehicle	Spill kit deployed	1	LOW
30/01/2021	INC284488	Water overflow irrigation tank	Tristart contacted for pump repair	1	LOW
19/01/2021	INC286373	Mineral/NORM spread away from the concentrator to the North and west of the Concentrator	Gamma survey conducted	1	LOW
13/01/2021	INC284144	Release of slurry from containment bund	Bunded area	1	LOW
1/01/2021	INC283854	Small diesel spill - 5 litres	Spill kit deployed	1	MODERATE

7.1 Regulator Notifications

During the reporting period of 1 January to 31 December 2021, Iluka Resources reported a potential non compliance event relating to a controlled discharge of stormwater to the downstream environment. The controlled discharge was undertaken to prevent failure of the haul road drainage bund releasing stormwater and causing downstream erosion. An aquatic survey of the downstream wetland Eneminga Swamp (EL1,2 and 3) and existing aquatic sampling locations was undertaken. The study found the area is considered to support a high diversity of aquatic invertebrates, based on the DBCA reference ranges for wetland evaluation. Water quality sampling of the general study areas including Eneminga found surface waters to be highly coloured (visually tannin-stained), neutral to basic (pH 7.24 – 8.31), and conductivity in the range of 388 - 3330 $\mu\text{S}/\text{cm}$. No impacts to Eneminga Swamp were reported as a result of the stormwater release.

At the time of reporting Iluka are in the process of providing further information to DWER Compliance and Enforcement. (Ref-DWERA-000019).

7.2 Rehabilitation

A project to fence and rehabilitate a native vegetation corridor from Cataby Brook to Eneminga Reserve commenced during the reporting period. The initial program fenced and planted a 5ha area. Seed collection was also ongoing throughout 2021. Progressive backfilling of completed mining voids has continued with areas of Pit 2 nearing preparation for topsoil spreading. The southernmost end of Pit 2 has been backfilled with subsoil replaced. Cover crops have been planted to reinstate organic matter in preparation for topsoil replacement in the next 12 to 24 months.

8 References

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APPENDIX A

Annual Audit Compliance Report



Annual Audit Compliance Report Form

Environmental Protection Act 1986, Part V Division 3

Once completed, please submit this form either via email to info@dwer.wa.gov.au, or to the below postal address:

Department of Water and Environmental Regulation
Locked Bag 10
Joondalup DC WA 6919

Section A – Licence details			
Licence number:	L9176/2018/1	Licence file number:	DER2018/001555
Licence holder name:	Iluka Resources Limited		
Trading as:	Iluka Resources Limited		
ACN:	008 675 018		
Registered business address:	Level 17, 240 St Georges Terrace, Perth WA 6000		
Reporting period:	01 / 01 / 2021 to 31 / 12 / 2021		

Section B – Statement of compliance with licence conditions
Did you comply with all of your licence conditions during the reporting period? (please tick the appropriate box)
<input type="checkbox"/> Yes – please complete: <ul style="list-style-type: none">• section C;• section D (if required); and• sign the declaration in Section F.
<input checked="" type="checkbox"/> No – please complete: <ul style="list-style-type: none">• section C;• section D (if required);• section E; and• sign the declaration in Section F.

Section C – Statement of actual production	
Provide the actual production quantity for this reporting period. Supporting documentation is to be attached.	
Prescribed premises category	Actual production quantity
8 – Mineral Sands mining or processing	541, 251 t HMC
6 – Mine Dewatering	4,877,413 kL

Section D – Statement of actual Part 2 waste discharge quantity	
Provide the actual Part 2 waste discharge quantity for this reporting period. Supporting documentation is to be attached.	
Prescribed premises category	Actual Part 2 waste discharge quantity
Tailings	8,715,708 t
Water to allow mining of ore	0

Section E – Details of non-compliance with licence condition			
Please use a separate page for each condition with which the licence holder was non-compliant at a time during the reporting period.			
Condition no:	16	Date(s) of non-compliance:	20/01/2021
Details of non-compliance:			
<p>Failure to complete all required Total Suspended Particle (TSP) monitoring as per the licence condition frequency “ At least once every six days” for a duration of “Minimum 24-hours”.</p> <p>Multiple sampling events in Q1 , Q3 and Q4 2021 failed to reach a total of 24hrs run time.</p>			
<p>What was the actual (or suspected) environmental impact of the non-compliance?</p> <p>NOTE – please attach maps or diagrams to provide insight into the precise location of where the non-compliance took place.</p>			
<p>There are no expected environmental impacts due to this non-compliance. The location of the non-compliance is AQ1 and AQ2 shown in the map Figure 15 provided.</p>			
Cause (or suspected cause) of non-compliance:			
<p>Multiple sampling events failed to reach a total of 24 hours sampling time at sites AQ2 due a fault with the sampling equipment. Trouble shooting with the equipment supplier and field technician has determined it is likely due to a faulty temperature sensor which has prevented the sampler to complete a 24 hour run when programmed. Due to National supply shortages of the required part, a replacement part did not arrive in the 2021 reporting season.</p> <p>AQ1 experienced a data taker failure at the end of January 2021. Due to parts shortages and delivery delays, the problem was not rectified until late February.</p>			
Action taken to mitigate any adverse effects of non-compliance and prevent recurrence of the non-compliance:			
<p>As soon as this issue was identified Iluka’s (external) technical support contractor provided remote assistance to Iluka environmental personnel to help manually reset the instrumentation as a temporary fix. The maintenance contractor attended site and attempted to complete the repair. Iluka were advised of the temperature sensor fault and inability to source a replacement in a timely manner.</p>			
Was this non-compliance previously reported to DWER?			
<input checked="" type="checkbox"/> **NO – this non-compliance was not reported to DWER			
<input type="checkbox"/> Reported to DWER verbally		Date: / /	
<input type="checkbox"/> Reported to DWER in writing		Date: / /	

Section E – Details of non-compliance with licence condition			
Please use a separate page for each condition with which the licence holder was non-compliant at a time during the reporting period.			
Condition no:	18	Date(s) of non-compliance:	28/01/2021
Details of non-compliance:			
Monitoring of ambient groundwater quality and monitoring point CM23 has not been undertaken since Early 2021.			
What was the actual (or suspected) environmental impact of the non-compliance? NOTE – please attach maps or diagrams to provide insight into the precise location of where the non-compliance took place.			
There are no expected environmental impacts due to this non-compliance. The location of the non-compliance is shown in the map Figure 15 provided.			
Cause (or suspected cause) of non-compliance:			
CM23 has had access restricted due to geotechnical stability concerns of the adjacent pit wall. This is a precautionary measure and likely to be assessed upon backfill completion of the adjacent pit.			
Action taken to mitigate any adverse effects of non-compliance and prevent recurrence of the non-compliance:			
N/A Other monitoring bores available within the area.			
Was this non-compliance previously reported to DWER?			
<input checked="" type="checkbox"/> **NO – this non-compliance was not reported to DWER			
<input type="checkbox"/> Reported to DWER verbally		Date: / /	
<input type="checkbox"/> Reported to DWER in writing		Date: / /	

Section F – Declaration

I / We declare that the information in this Annual Audit Compliance Report is true and correct and is not false or misleading in a material particular¹.

I / We consent to the Annual Audit Compliance Report being published on the Department of Water and Environmental Regulation's (DWER) website.

Signature ² :		Signature:	
Name: (printed)		Name: (printed)	
Position:		Position:	
Date:		Date:	
Seal (if signing under seal):			

Handwritten in the Date field: 30-03-22

¹ It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular.

² AACRs can only be signed by the licence holder or an authorised person with the legal authority to sign on behalf of the licence holder.