Hydrobiology

COMPLIANCE LDWQOS

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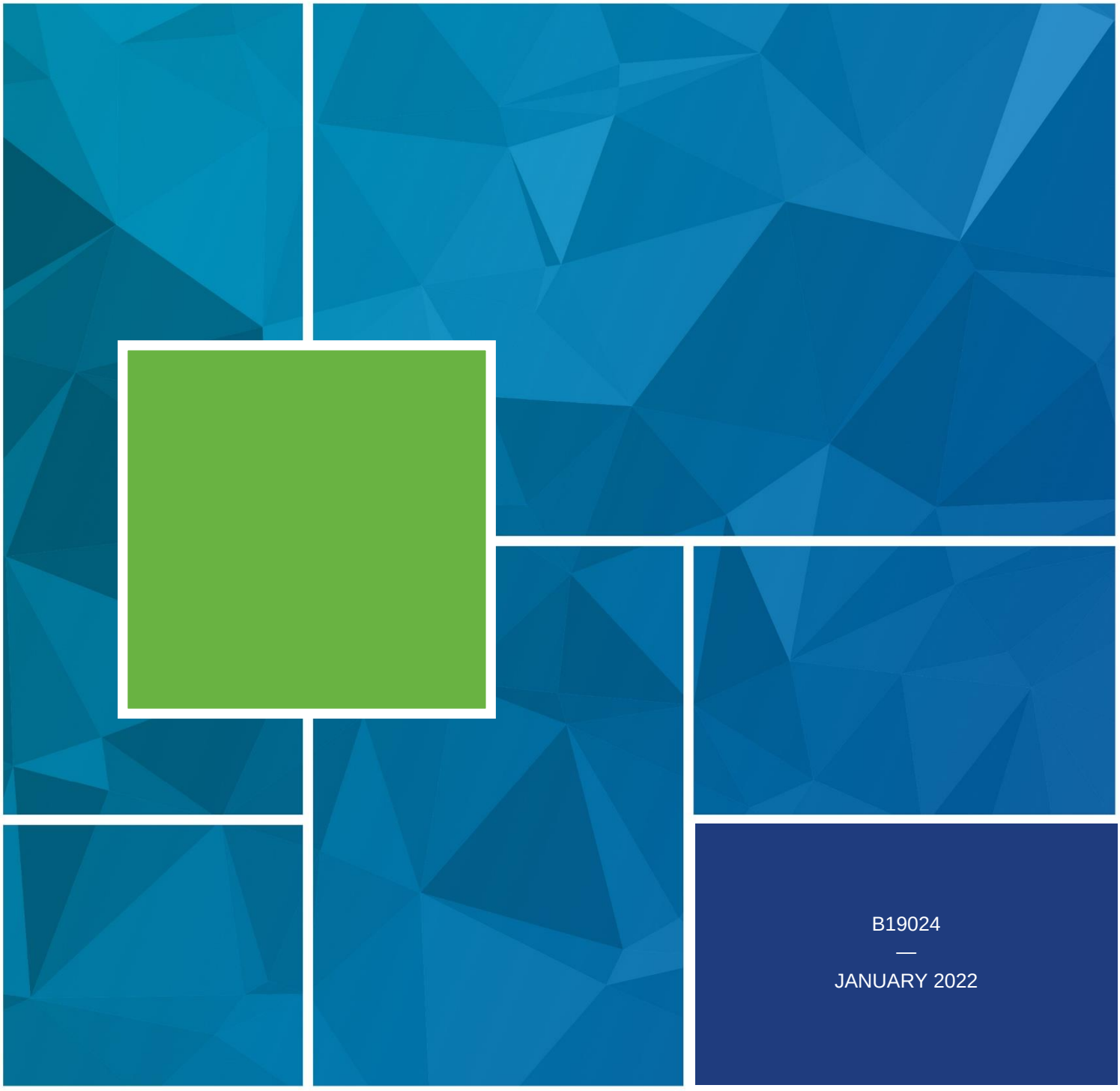
PREPARED FOR NT DITT



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1. BACKGROUND AND OBJECTIVES

The Northern Territory Department of Industry, Tourism and Trade (DITT) would like to set compliance water quality objectives for the Finniss River, downstream from the former Rum Jungle mine to adopt during rehabilitation of the site. The various impact assessments and data reviews that Hydrobiology performed to date for the DITT have indicated that each river zone, both in the East Branch and the Finniss River, had individual exceedances of the standard ANZG (2018) guideline values. More recently, Hydrobiology (2020) demonstrated that many individual measurements of concentration exceeded even the locally derived water quality objectives (LDWQOs) for a number of parameters, notably for the main Finniss River downstream of the East Branch in Zones 6 and 7, but also including for some tributaries not influenced by the Rum Jungle mine site.

The LDWQOs have been developed over a number of years. A majority of them were derived incrementally by Hydrobiology (2013, 2015, 2016), starting with the use of national default Guideline Values (DGVs) in 2013 with LDWQOs subsequently developed and refined for the East Branch zones for some parameters in 2015 and 2016. Uranium and selenium were added by Hydrobiology (2019).

In Hydrobiology (2016), LDWQOs were derived for all parameters for which there were available water quality measurement data for time periods relevant to the biological sampling in 2014 and 2015, and for which there was a gradient of taxonomic richness declining with increasing parameter concentration (or reducing value for pH). The Weibull function fits for parameter concentrations (Cu, Zn, Ni, Co, Mn, EC, SO_4, Mg) were presented versus percent of average reference site number of taxa

and selected LDWQOs based on a decision tree rule. Mn and EC defaulted to the standard national guideline values (or default approach for EC) as a result of poor model fit and absence of clear threshold response data.

The proposed LDWQOs represented targets of very substantial improvement in the current condition of the river. A recent assessment of the historical data collected from all zones between 2010 and 2020 (Hydrobiology, 2020) suggested that some of the LDWQOs adopted in Hydrobiology (2016), in particular those that defaulted to standard guideline values from ANZG (2018), were not met even in zones where the biological monitoring indicated no significant effect on the receptors investigated (Zones 1, 5, 6 and 7). These LDWQOs would not be suitable as compliance objectives.

This report aims to provide DITT with

- a summary of LDWQOs derived to date for Zone 2 to 4; and
- a solution to define suitable compliance LDWQOs for the zones in the Finniss River downstream of the East Branch, for which no impacts from elevated toxicant concentrations were previously observed (Zones 6 and 7).

2. METHODS

The proposed compliance LDWQOs presented in this report were largely based on the existing LDWQOs. However, some values were further refined following the process below.

The existing LDWQOs, designed to provide protection of 95% of species in the ecosystem, were set to the national default water quality guideline values (DGVs) for many toxicants in Hydrobiology (2016) where there was no clear evidence available for different sensitivity of the Finniss River biota, compared with the national dataset, from the 2014 and 2015 sampling. However, in Zones 5, 6 and 7, for which no impacts to biodiversity were observed in the 2014 and 2015 sampling, several of these DGVs were subsequently found to be regularly exceeded (Hydrobiology, 2020).

In this report, the 50th, 80th and 95th percentiles of seasonal measurements from 2012 to 2019 were calculated for Zones 5, 6 and 7. The Finniss River being perennial in these zones, sites were accessed frequently providing a representative dataset with sufficient seasonal coverage.

The calculated percentiles (80th for EC and 95th for toxicants) were compared with the existing LDWQOs, including those based on DGVs, and exceedances of the LDWQOs were identified. For those parameters with calculated percentiles exceeding the LDWQOs, an alternative strategy for a compliance value was developed to reflect the ecosystem status observed in Hydrobiology (2016) and is further detailed in the results section.

3. LDWQOS FOR COMPLIANCE

3.1 ZONE 1 AND 5

No compliance requirements were set for Zone 1 and 5. These two zones are not directly 'impacted' by the former Rum Jungle mine site, thus they are indicative of local variability of the water quality. The monitoring results obtained from these two zones should be used to cross-check variability in the measurements for Zones 2/3/4 and Zones 6/7, respectively.

3.2 ZONES 2 TO 4

The LDWQOs defined in Hydrobiology (2013, 2016, 2019) were adopted as compliance LDWQOs for Zones 2 to 4. These represented realistic objectives based on recent data collected (Hydrobiology, 2020).

3.3 ZONES 6 AND 7

Flow from the main Finniss River (Zone 5) is the greatest contributor to flow in downstream Zones 6 and 7.

Table 3-1 summarises water quality measurements taken in Zone 5 between 2012 and 2019. These measurements were split into two reaches in the Finniss river: upstream (FRUSMB) and downstream

(FRDSMB and FRUSEB) from Mt Burton. Higher copper (Cu), cobalt (Co), nickel (Ni) and sulphate (SO_4) concentrations were found downstream from Mt Burton compared with upstream. Conversely, the manganese (Mn) concentrations measured upstream were greater than downstream.

Table 3-2 presents a summary of the new proposed compliance LDWQOs for Zones 6 and 7, which were partly defaulted to the existing LDWQOs and partly based on the percentiles of data collected in Zone 5 downstream from Mt Burton. These data were selected for the derivation of compliance LDWQOs on the basis that these sites downstream from Mt Burton reflected the water quality that was delivered to the junction with the East Branch. That is, the water quality of this reach of Zone 5 represents the best water quality that can be achieved downstream of the East Branch.

At the time of writing, the compliance LDWQOs were set based on the calculated 80th and 95th percentiles (for EC and toxicants, respectively) of lower Zone 5 from the dataset available (including data from 2012 to 2019). Some of these proposed LDWQOs were exceeded in one or both of the downstream zones based on the dataset analysed. However, they represented reasonable post-construction objectives:

- In Zone 6, the water quality measured exceeded these compliance LDWQOs for cobalt (Co), magnesium (Mg) and uranium (U) for both seasons.
- In Zone 7, the water quality measured exceeded the compliance levels for iron (Fe) in the wet season only.

Albeit demonstrating typical seasonal variability, the water quality appeared to have remained relatively unchanged over the period investigated in both reaches of the river in Zone 5. We recommend that temporal changes in the water quality of Zone 5 be monitored in the future as any changes in water quality occurring in Zone 5 can be expected to constrain contemporary water quality in Zones 6 and 7. In the case of a future change in water quality in the lower Zone 5, the proposed LDWQOs should be re-calculated based on the previous 4 years of data collected (sites FRDSMB and FRUSEB combined). This is consistent with the recommendations of ANZG (2018) for monitoring of toxicants (1,2).

1 https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/local-conditions#default-guideline-values-and-background-concentrations
2 https://www.waterquality.gov.au/anz-guidelines/monitoring/data-analysis/derivation-assessment

Table 3-1 Comparison of surface water quality measured in the Finniss River upstream (U/S) and downstream (D/S) from Mt Burton (Zone 5) between 2012 and 2019.

Zone	Season*	EC	SO_4	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
		µS/cm	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANZG (2018)		-	-	55	13	0.2	1.4	*1.4*	-	-	1900	11	3.4	8	*0.5*
LDWQO		190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	*2.7*
5 U/S Mt Burton	Wet (80/95th percentile**)	**355**	0.91	**150**	1.5	0.02	1.1	0.15	**321**	36.3	**36.7**	0.59	0.17	3.4	1.8
	Dry (80/95th percentile**)	419	1.4	53.9	1.2	0.02	1.6	0.15	177	37.0	**44.9**	0.49	**0.11**	**4.7**	**2.2**
5 D/S Mt Burton	Wet (80/95th percentile**)	354	**3.8**	142	**1.9**	**0.03**	**14.0**	**0.36**	294	**41.1**	24.6	**0.93**	0.17	3.4	**1.9**
	Dry (80/95th percentile**)	**438**	**4.1**	**56.9**	**1.5**	0.02	**7.9**	**0.40**	**194**	**39.9**	27.2	**0.89**	0.085	3.4	1.7

Notes: metal and sulphate concentrations correspond to dissolved concentrations, not total; the LDWQOs presented correspond to previously locally derived water quality objectives as per Hydrobiology (2013, 2016, 2019); the data presented correspond to the 80th percentile of data for EC and the 95th percentile of measured data for all other parameters; *Wet season includes November to March, dry season includes April to October; orange cells indicate exceedances compared with LDWQOs; **bold** values indicate the higher concentration between U/S and D/S.

Table 3-2 Summary of proposed surface water seasonal compliance LDWQOs for Zone 6 and 7.

Zone	Season*	EC	SO_4	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
		µS/cm	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
6	ANZG (2018)	-	-	55	13	0.2	1.4	*1.4*	-	-	1900	11	3.4	8	*0.5*
	LDWQO	190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	*2.9*
	Wet (50/95th percentile**)	175.3	21.6	89.7	2.2	0.088	9.7	**6.2**	236	**44.3**	111	14.6	0.51	24.0	**5.3**
	Dry (50/95th percentile**)	327.4	23.4	37.4	1.8	<0.02	5.2	**4.4**	136	**40.5**	136	7.3	0.14	6.5	**4.3**
	Wet season Compliance LDWQOs	**354****	594	**142****	13	0.54	**14.0****	2.8	300	**41.1****	140	20	3.4	26.1	2.7
	Dry season Compliance LDWQOs	**438****	594	117	13	0.54	**7.9****	2.8	300	**39.9****	140	20	3.4	26.1	2.7
7	ANZG (2018)	-	-	55	13	0.2	1.4	*1.4*	-	-	1900	11	3.4	8	*0.5*
	LDWQO	190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	*2.7*
	Wet (50/95th percentile**)	58.9	11.4	121	0.73	0.02	8.3	1.6	**317**	9.9	39.6	2.9	0.34	8.3	0.59
	Dry (50/95th percentile**)	59.6	7.3	51.6	0.49	<0.02	3.8	0.82	243	6.3	24.6	1.8	0.12	4.1	0.33
	Wet season Compliance LDWQOs	**354****	594	**142****	13	0.54	**14.0****	2.8	300	**41.1****	140	20	3.4	26.1	2.7
	Dry season Compliance LDWQOs	**438****	594	117	13	0.54	**7.9****	2.8	300	**39.9****	140	20	3.4	26.1	2.7

Notes: metal concentrations correspond to dissolved concentrations, not total; the LDWQOs presented correspond to previously locally derived water quality objectives as per Hydrobiology (2013, 2016, 2019); the data presented correspond to the median (50th percentile) of data for EC and the 95th percentile of data for all other parameters; *Wet season includes November to March, dry season includes April to October (if applicable); - denotes missing data; orange cells indicate exceedances compared with LDWQOs; ** these compliance LDWQOs are based on 80th/95th percentiles of data collected between 2012 and 2019 from Zone 5 (downstream from Mt Burton).

4. SUMMARY

4.1 PROPOSED COMPLIANCE LDWQOS

A summary of all proposed compliance LDWQOs for the Finniss River is presented in Table 4-1.

Table 4-1 Summary of proposed surface water compliance LDWQOs.

Zone	Season*	Protection level (% species protected)	EC	SO_4	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
			µS/cm	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
2	All	70	2985	1192	236	140#	4.3	60.2	89	300	86.6	759	130.4	12.9#	210.5	31
3	All	80	2985	997	150	140#	2.16	27.5	25.9	300	86.6	443	43.1	9.4#	180	22.5
4	All	90	427	761	117	42#	1.08	7.86	3.6	300	33.2	228	32.5	5.6#	180	13.2
6	Wet season	95	354**	594	142**	13	0.54	14.0**	2.8	300	41.1**	140	20	3.4	26.1	2.7
	Dry season	95	438**	594	117	13	0.54	7.9**	2.8	300	39.9**	140	20	3.4	26.1	2.7
7	Wet season	95	354**	594	142**	13	0.54	14.0**	2.8	300	41.1**	140	20	3.4	26.1	2.7
	Dry season	95	438**	594	117	13	0.54	7.9**	2.8	300	39.9**	140	20	3.4	26.1	2.7

Notes:
metal concentrations correspond to dissolved concentrations, not total;
*Wet season includes November to March, dry season includes April to October (if applicable);
the LDWQOs presented correspond to previously locally derived water quality objectives as per Hydrobiology (2013, 2016, 2019), except for values flagged with ** which are newly derived compliance LDWQOs based on 80^{th}/95^{th} percentiles of data collected between 2012 and 2019 from Zone 5 (downstream from Mt Burton), and # which are defaulted to the ANZG (2018) guideline values for the relevant protection levels adopted.

4.2 USING THE COMPLIANCE LDWQOS

Table 4-2 summarises compliance LDWQOs and corresponding assessment rules.

By default, the ANZG (2018) guidelines recommend that the median quality values of surface water should be lower than the 80th percentile of concentration values of a suitable reference site. This rule was adopted for EC.

In the case of toxicants, a more conservative approach is adopted by selecting the 95th percentile of surface water concentrations for comparison instead of the median, i.e. action will be triggered if the 95th percentile of the test distribution exceeds the compliance LDWQO. This is consistent with the discussion of referential assessment for toxicants of ANZG (2018).

Table 4-2 Summary of compliance LDWQOs and assessment rules

Parameter		Compliance LDWQOs for Zones 2 to 4	Compliance LDWQOs for Zone 6 and 7	Value to compare to LDWQO
EC		Existing LDWQOs, see Table 4-1	Newly derived LDWQO (this report), based on the 80th percentile of historical data for Zone 5 (sites FRDSMB and FRUSEB combined)	median
Toxicants	**SO_4, Al (dry season only) As, Cd, Co, Fe, Mn, Ni, Pb, Zn, U**	Existing LDWQOs, see Table 4-1	Existing LDWQOs, see Table 3-2	95th percentile
	Al (wet season only), Cu, Mg		Newly derived LDWQO (this report), based on the 80th percentile of the historical data for Zone 5 (sites FRDSMB and FRUSEB combined)	95th percentile

5. CONCLUSION

This report provides compliance LDWQOs for Zones 2 to 4 and Zone 6 and 7 of the Finniss River. It is not expected that Zones 6 and 7 will be compliant during the construction phase, but these GVs represent achievable post-construction objectives.

LDWQOs for Zones 8 and 9 were not addressed as part of this report. Zone 8 remains classified as a high conservation value system.

6. REFERENCES

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, *Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia*. Available at: www.waterquality.gov.au/anz-guidelines (Accessed: 23 July 2021).

Hydrobiology (2013) 'Environmental Values Downstream of the Former Rum Jungle Mine site – Phase 2', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy*.

Hydrobiology (2015) 'Rum Jungle Impact Assessment Preliminary Report', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy*.

Hydrobiology (2016) 'Rum Jungle Impact Assessment', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy*, p. 98.

Hydrobiology (2019) 'Rum Jungle - Refinement of LDWQTVs', *Hydrobiology Pty Ltd prepared for Northern Territory Department of Primary Industry and Resources*.

Hydrobiology (2020) 'Rum Jungle Surface Water Quality Data Summaries', *prepared for NTDITT*.

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