HYDRO ENGINEERING & CONSULTING PTY LTD

2 September 2020

Policy Manager
NSW Minerals Council
Via email
Attention: Craig Milton

Craig,

Re: Hunter River Nitrate Assessment

1. INTRODUCTION AND BACKGROUND

In March 2018, the University of Newcastle (UON, 2018) reported on an assessment of metals and metalloids across key storage dams that are part of mining operations in the Hunter Valley, NSW. Water from these storage dams can be released in a controlled fashion to the Hunter River as part of the Hunter River Salinity Trading Scheme (HRSTS), subject to the Environment Protection Licence (EPL) associated with each individual operation. In addition to analysis of metals and metalloids, UON (2018) reported elevated nitrogen in the site storage dams – most notably nitrate. This contrasted with lower values at sample sites located on the Hunter River. It was suspected that the elevated nitrate levels were due to a prolonged dry period and the associated effects on the site storages without significant turnover.

Hydro Engineering & Consulting Pty Ltd (HEC) were commissioned to undertake further assessment of recorded nitrate data and the potential effects on the Hunter River as a result of licensed discharge. Recorded data are summarised in Table 1 and Table 2 for the site storage dams and Hunter River sample sites respectively. Samples were collected during the last week of August 2017.

Table 1 Monitored Nitrate Values in Hunter Valley Mine Site Storage Dams (UON, 2018)

	Bengalla Mine	Liddell Coal	Ravensworth Operations	Hunter Valley Operations			Mt Thorley Warkworth		Bulga Coal	
		Reservoir North	Narama Dam	Parnells Dam	Dam 11	Lake James	Dam 1N	Dam 9S	Surge Dam	Northern Dam (ND2)
Nitrate (mg/L N)	3.02	2.9	11.2	0.837	3.27	0.447	0.781	1.91	3.62	0.133

Table 2 Monitored Nitrate Values at Hunter River Locations (UON, 2018)

	Dartbrook	Keys Bridge	Denman	Jerrys Plains	Glennies Creek	Singleton
Nitrate (mg/L N)	0.009	0.204	0.115	0.016	0.005	0.007

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The ANZG (2018) default guideline trigger value for the protection of freshwater aquatic ecosystems at the 95% level of species protection for nitrate is 2.4 mg/L (toxic effects)[1]. The default guideline trigger value for eutrophication is 0.35 mg/L (total of all nitrogen oxides) for NSW east flowing lowland rivers.

2. ANALYSIS – RAVENSWORTH OPERATIONS HISTORICAL DATA

Given the UoN (2018) sampling was a one off sample at a point in time, a detailed assessment was undertaken of available historical monitoring data to contextualise the data and assess if elevated nitrate levels have been persistent historically.

An extended period of monitored nitrate was able to be obtained for Ravensworth Operations Narama Dam (formerly the 1,000 ML Dam) from which licensed discharges can occur in line with the provisions of the HRSTS.

A time series plot of recorded nitrate concentrations for the Narama Dam is given in Figure 1. Also included in the plot is the UON (2018) value – highlighted in red.

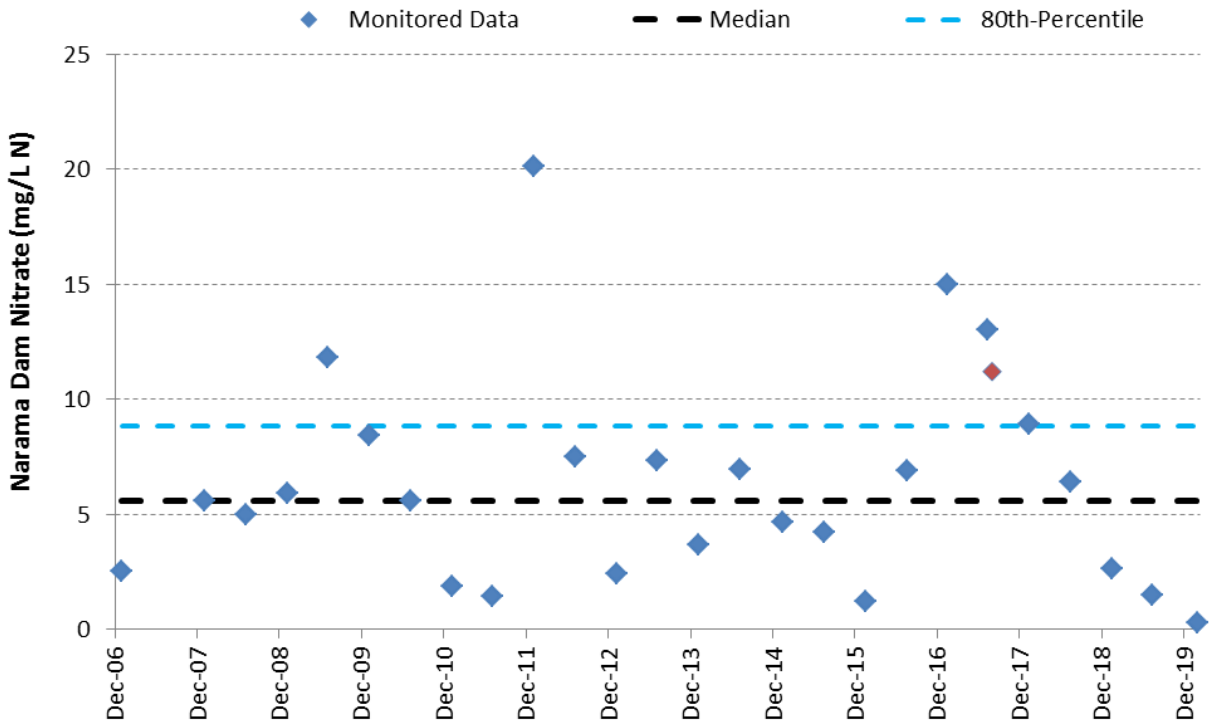

Figure 1 Recorded Nitrate Values – Ravensworth Operations Narama Dam

The following points are worth of note regarding the data plotted in Figure 1:

- the recorded nitrate values vary over a wide range: from 0.27 mg/L to 20 mg/L;
- the median and 80th percentile values (also plotted) are 5.6 mg/L and 8.8 mg/L; and
- the UON (2018) value is higher than the 80th percentile of all values and is the fifth highest recorded value.

Nitrate values in the Narama Dam will vary with source water transferred to the dam and will be affected by antecedent rainfall. In order to assess the effect that rainfall may have had on recorded nitrate values, daily site rainfall data was analysed and compared with recorded nitrate data. Where recorded data from Ravensworth Operations was missing, data from the nearby Glendell Mine was

[1] As recommended by ANZG (2018), value obtained from NIWA (2013) which was used to inform the current New Zealand nitrate toxicity attribute.

used. Rainfall data was able to be obtained from February 2009 onwards – therefore nitrate data for the first three data points in Figure 1 were not used in the analysis. Nitrate data prior to February 2015 did not have a date recorded (month and year only) and therefore a day of the month had to be assumed in the analysis

Daily rainfall totals were calculated for different periods of time prior to the date of each nitrate sample. Periods of 7, 14 and 21 days were used and the corresponding plots of nitrate concentrations versus preceding rainfall are given in Figure 2 to Figure 4. Also plotted are curves of best fit (exponential plots) and corresponding coefficients of determination (R^2).

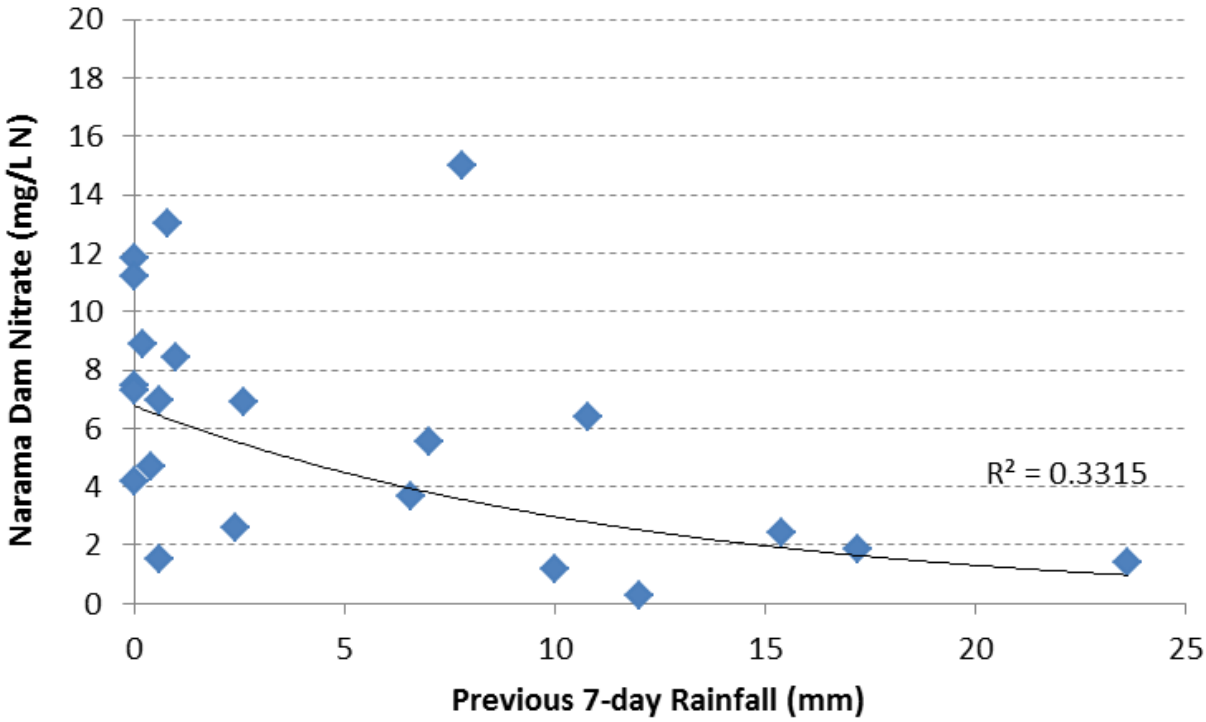

Figure 2 Ravensworth Operations Narama Dam Recorded Nitrate Values Versus Previous 7-Day Rainfall

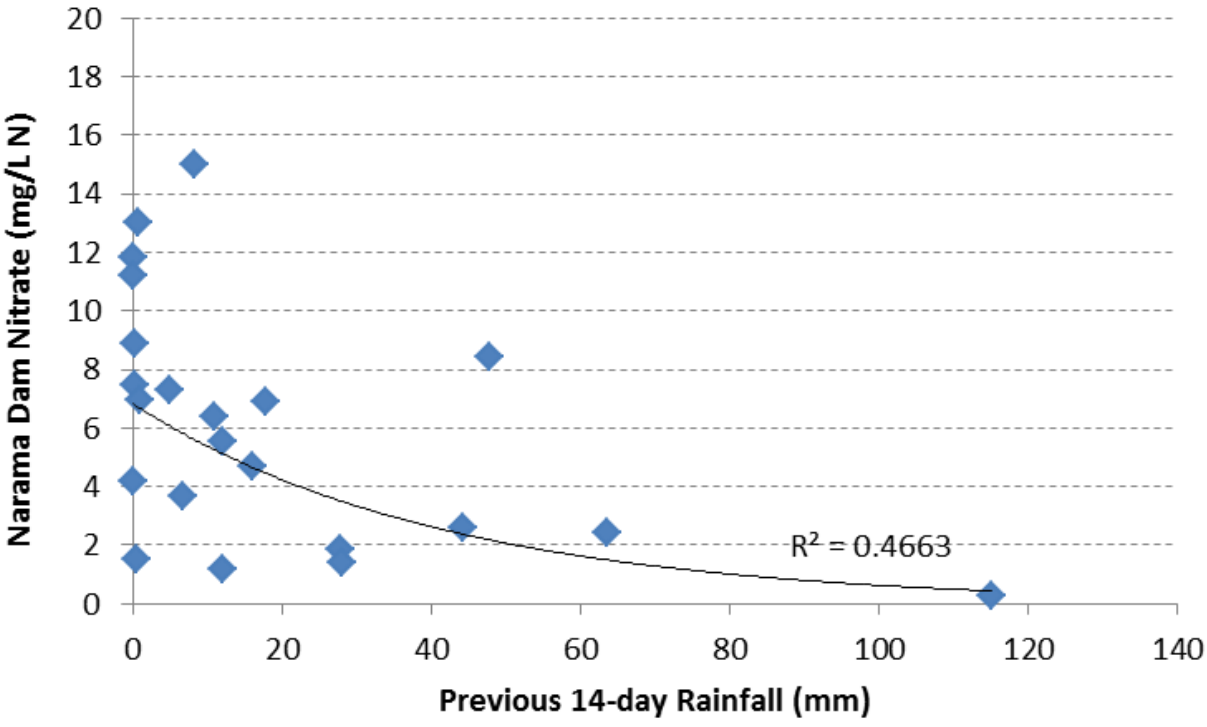

Figure 3 Ravensworth Operations Narama Dam Recorded Nitrate Values Versus Previous 14-Day Rainfall

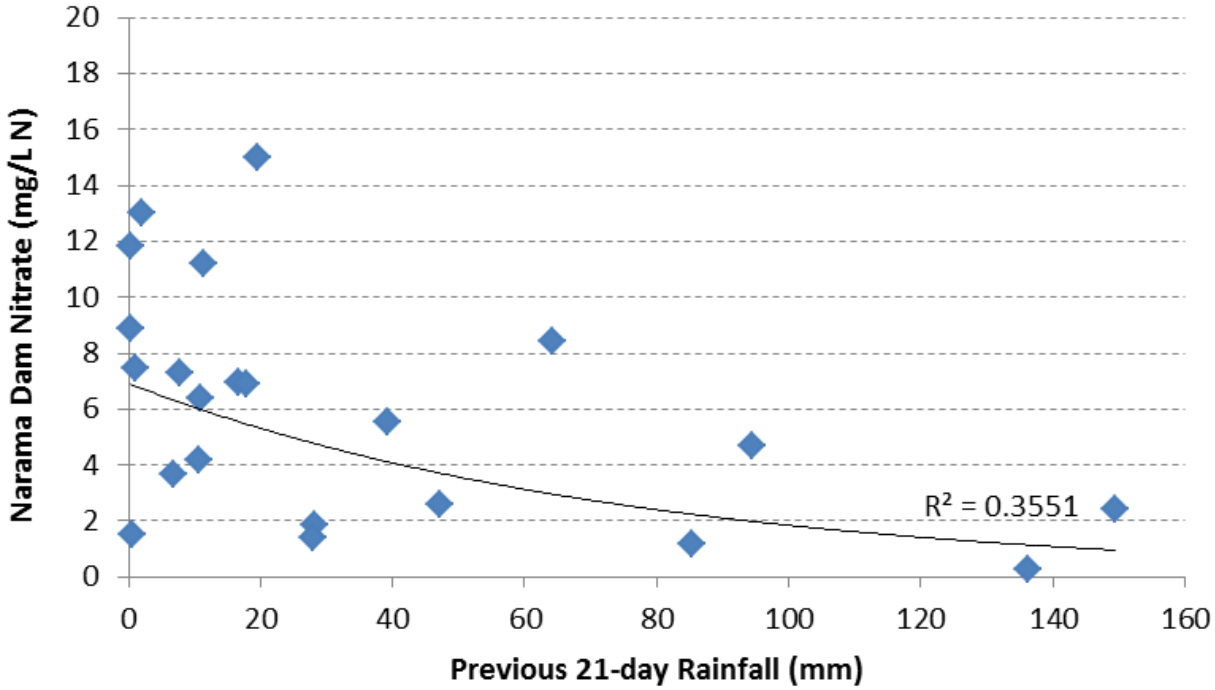

Figure 4 Ravensworth Operations Narama Dam Recorded Nitrate Values Versus Previous 21-Day Rainfall

The R^2 values are representative of the proportion of variance in the recorded data that is predictable from the rainfall in the preceding period. The highest R^2 value occurs for the 14-day preceding rainfall. The plots indicate that recorded nitrate values tend to decrease with increasing preceding rainfall. The relatively low R^2 values indicate that other factors affect the nitrate concentrations and intuitively these would include rainfall intensity, time of year and catchment characteristics at the time. Nevertheless the above analysis illustrates that nitrate concentration would be lower following periods of rainfall in the weeks preceding and higher following periods of low rainfall. Only 11.4 mm of rainfall was recorded at Ravensworth Operations in the 21 days prior to the UON (2018) sampling and zero rainfall in the 14 days prior.

Discharge from mining operations in the Hunter Valley can only occur during “high” and flood” flow events in the Hunter River. Furthermore, mining operations tend to release only during times of water excess, following rainfall periods. This is illustrated by the data in Table 3 which shows monthly recorded releases from the Narama Dam from 2015 onwards together with corresponding monthly rainfall totals.

Table 3 Narama Dam HRSTS Releases and Monthly Rainfall

Month and Year	HRSTS Release Volume (ML)	Monthly Rainfall (mm)
Mar-14	131.68	77.6
Apr-15	325.81	204.6
Aug-15	21.77	50.8
Jan-16	42.3	202
Jun-16	95.9	83.8
Jul-16	0	39.6
Aug-16	420.11	34.2
Sep-16	675.73	77.8

Month and Year	HRSTS Release Volume (ML)	Monthly Rainfall (mm)
Mar-17	76.45	227.2
Apr-17	11.11	40.8

The data in Table 3 indicates that releases tend to occur in months with higher rainfall and/or which have had higher rainfall in the preceding month. The data in Figure 2 to Figure 4 indicates that this would coincide with periods of lower nitrate concentrations.

3. DATA ANALYSIS – HUNTER MINING OPERATIONS 20TH FEBRUARY 2020

In order to augment the UON (2018) data (recorded following a period of low rainfall) a campaign of sampling was undertaken by a number of mining operations on 20th February 2020. This corresponded to a period of high preceding rainfall, with 115 mm recorded at Ravensworth Operations in the preceding 14 days while 156 mm was recorded in the month preceding this date. Recorded nitrate concentrations are shown in Figure 5. Sampling and analysis for nitrate occurred at several site storage dams from which licensed discharge can occur (shown as grey bars) as well as a number of locations on the Hunter River (shown as green bars).

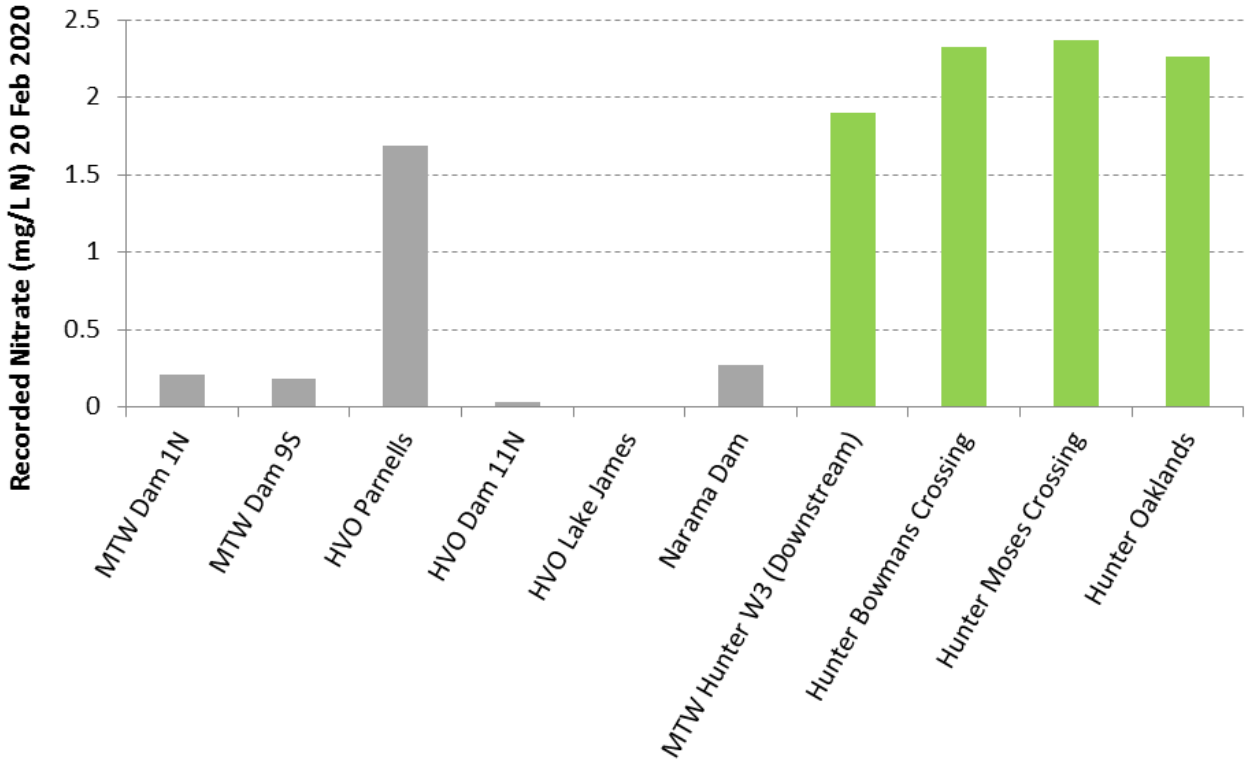

Figure 5 Recorded Nitrate Concentrations – 20th February 2020

The recorded data from the sampling campaign of 20th February 2020 indicates that monitored nitrate concentrations in the site water storage dams were all below concentrations in the Hunter River. Only one storage (Hunter Valley Operations Parnells Dam) had concentrations comparable to those in the Hunter River, while all other values were below 0.3 mg/L which is below the ANZG (2018) default guideline trigger value for eutrophication.

The above data further indicates that lower nitrate concentrations are likely to occur in mine site storage dams following rainfall.

It is noteworthy that the water quality in the Hunter River is subject to a number of influences other than licensed discharge from mining operations, including the following.

- Licensed discharge from other operations including municipal wastewater treatment plants, a landfill, waste depot, composting facility and livestock processing facilities.
- Runoff from rural agricultural and pastoral operations.
- Town runoff.
- Regulated release from two large water storages.

4. CONCLUSION

The following conclusions are drawn from the assessment outlined above.

1. The elevated nitrate concentrations monitored by UON (2018) during the last week of August 2017 in Hunter Valley mine site storage dams occurred following a period of prolonged low rainfall where there was no HRSTS discharge event or opportunity.
2. There is a relationship between recorded nitrate concentrations and preceding rainfall evident from data obtained from Ravensworth Operations Narama Dam, with lower concentrations recorded following periods of higher rainfall.
3. Licensed discharge from Hunter Valley mining operations typically occurs following periods of higher rainfall.
4. During such periods, it is likely that nitrate values would be lower than they would be following periods of low rainfall (when discharge is unlikely).
5. A campaign of monitoring undertaken on 20th February 2020, following a period of high rainfall confirms lower nitrate concentrations in mine site storage dams than was recorded in the Hunter River. The recorded nitrate concentrations in the mine site storage dams were less than the ANZG (2018) default guideline trigger value.

Please contact the undersigned if you have any queries.

Yours faithfully,

Tony Marszalek
Director

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

NIWA (2013). "Updating Nitrate Toxicity Effects on Freshwater Aquatic Species". Report by National Institute of Water & Atmospheric Research Ltd, Hamilton, NZ for the NZ Ministry of Building, Innovation and Employment, January.

UON (2018). "Assessment of Metals and Metalloids in Surface Water Discharged from Upper Hunter Coal Mines and Power Stations". Report by the International Centre for Balanced Land Use, University of Newcastle prepared for the Upper Hunter Mining Dialogue, March.