

Tuesday 8 August 2023

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Re: Annual Surface Water Quality Monitoring Results & Report for the Tweed Valley Hospital Project

Reporting period: July 2022 to June 2023

1.0 INTRODUCTION

Ecoteam is engaged to undertake monthly and event-based surface water monitoring on behalf of Lendlease Building as part of the main works for the Tweed Valley Hospital Project. This report presents an annual summary of results over the 12-month sampling period from July 2022 to June 2023.

2.0 PROJECT AIMS AND SAMPLING OBJECTIVES

The surface water monitoring objectives for the site are to detect changes during construction in receiving water quality resulting from the project, with stormwater discharges potentially containing increased sediment loads, nutrients, total and dissolved metals, hydrocarbons or other contaminants such as pesticides. Baseline water quality data was performed on the 19 & 26 November and 19 December 2018 to record water quality conditions under the existing land use prior to construction (Lendlease Building, 2019).

3.0 WEATHER CONDITIONS

Total annual rainfall prior to and during the sampling period (July 2022 to June 2023) was 1,388.8 mm with the highest 24-hour rainfall occurring on 16 May 2023, being 118.6 mm. The highest monthly total was 226.3 mm during the month of October 2022 (Kingscliff BOM Station 058137). **Table 1** presents a graph of monthly rainfall and highest daily rainfall each month during the sampling period.

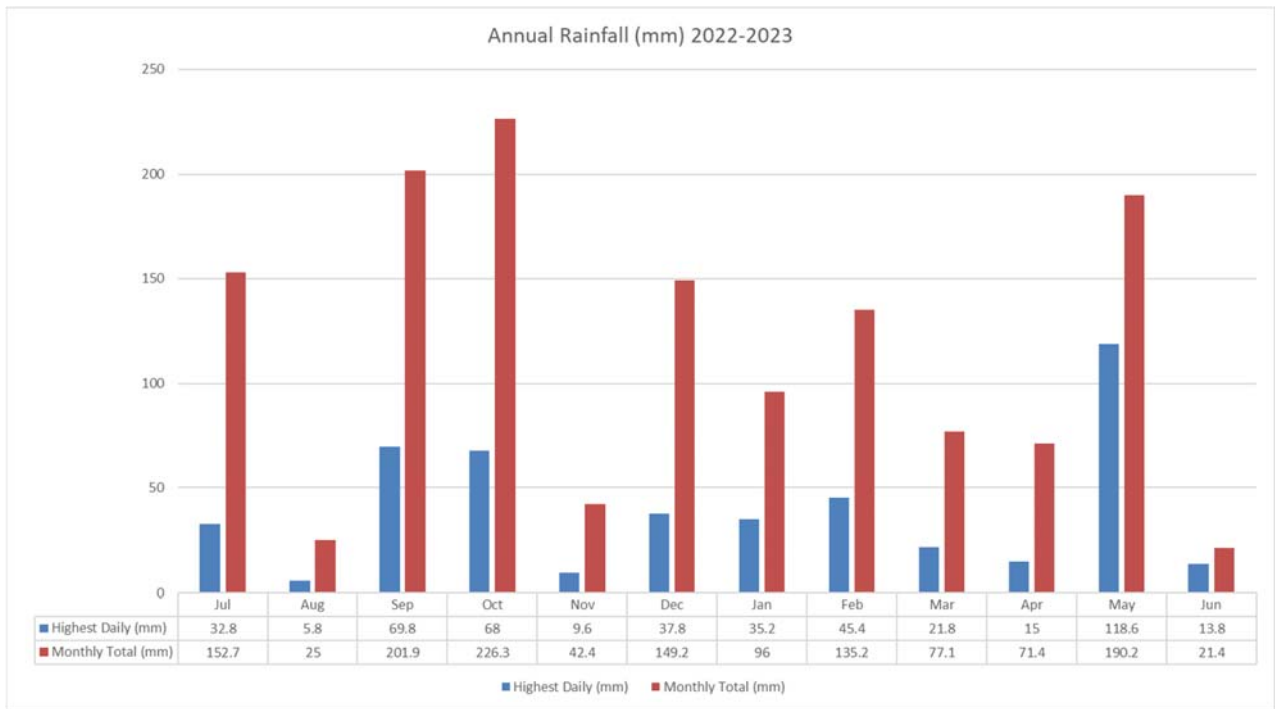


Figure 1. Annual rainfall during the 1-year sampling period.

4.0 SAMPLING LOCATIONS

Samples were collected from four of the five monthly sampling Sites (001 – 003 and 005). Site 004 has been infilled and has been removed from sampling rounds. Control samples were also collected and analysed (013 – 015). Sample codes and corresponding sampling locations are shown in **Table 1** and **Figure 2**. Site photos taken in June 2023 are included in **Appendix A**. Northwest Creek (Site 002) is tidal and is assessed as upstream or downstream depending on the direction of flow at the site.

Table 1. Monthly sampling sites, control samples, sample codes and applicable WQOs.

Sample Codes	Sampling Site Name	Short Name	WQOs
001	West Creek (Downstream)	WC	Estuarine
002	North West Creek (Variable)	NWC	Estuarine
003	East Creek (Upstream)	EC	Freshwater
004	Dam (Downstream)-Removed	Dam	Freshwater
005	Dam Drain (Downstream)	DD	Freshwater
013	Trip Blank	Trip	NA
014	Field Blank	Field	NA
015	Field Duplicate	Duplicate	NA

5.0 SAMPLING METHODOLOGY

Sampling was undertaken monthly at the four (4) water sampling locations. In situ physico-chemical parameters were monitored using a SmarTROLL and turbidity was measured using a Turbimeter Plus turbidity meter. Oil and grease were visually assessed. The SmarTROLL and Turbimeter Plus are calibrated before each sampling round. Water quality samples were collected at 300 mm below the surface where possible. Samples were collected from the bank using an extension pole. Samples were filtered and preserved on site where necessary, stored on ice and couriered over night to the NATA accredited Envirolab in Sydney. Trip blank samples (013) were sent from Envirolab and transported to all sites, then returned to Envirolab with the field samples. The field blank samples (014) were assessed at different sites each month. Field and trip blanks were pre-filled with deionized water and do not represent water quality from the site.

6.0 ASSESSMENT CRITERIA

Water quality results were compared against the Water Quality Objectives (WQO) in the following guidelines:

- *NSW Water Quality Objectives for the Tweed River Catchment for Aquatic Ecosystems (Tweed 2006) - Trigger criteria for estuaries.*
- *Australian and New Zealand guidelines for fresh and marine water quality (ANZECC 2000) – Trigger values for freshwater (level of protection 95% species).*

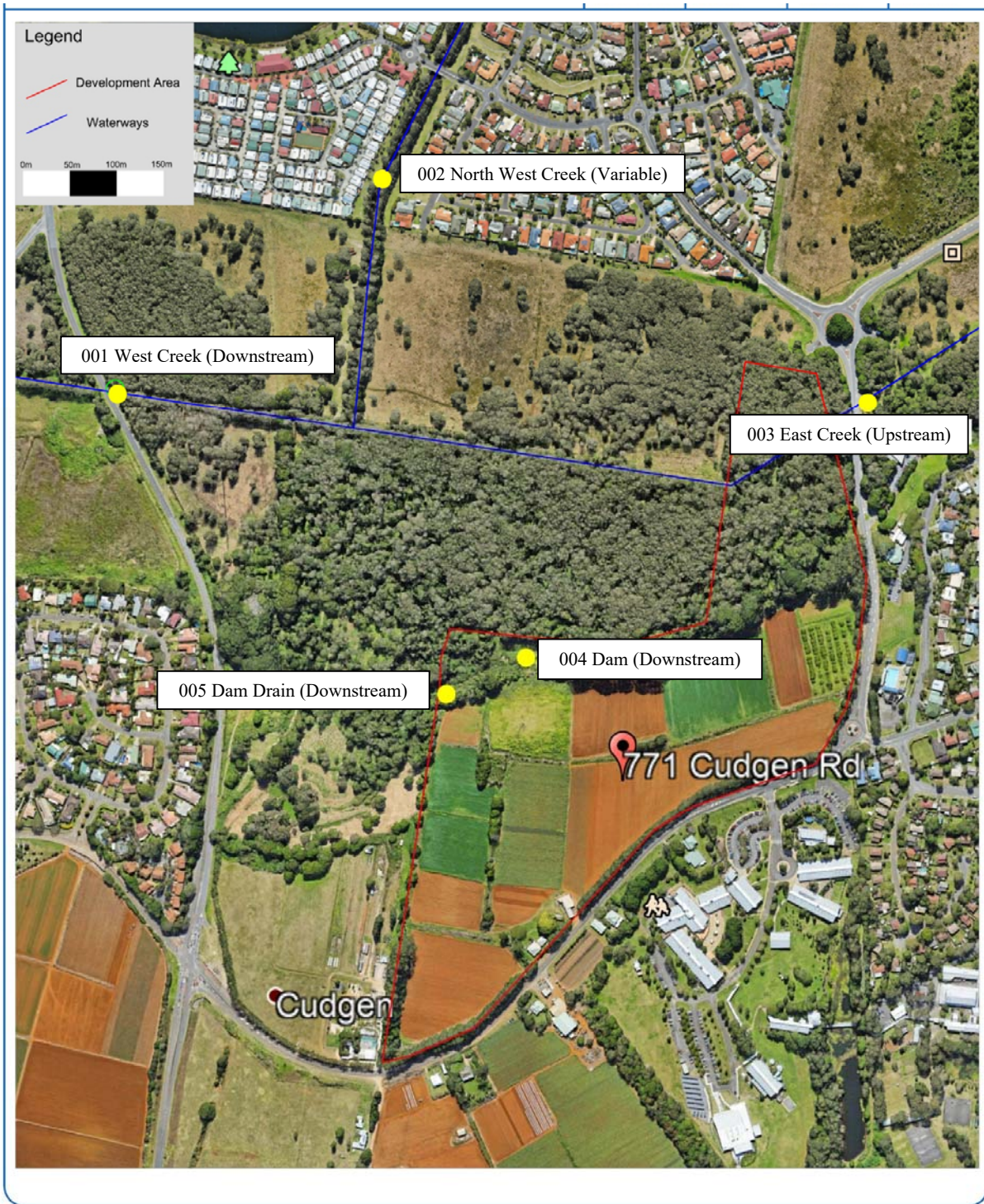


Figure 2. Map of monthly sampling sites (Source: Google Earth).

7.0 RESULTS

7.1 Physico-chemical Results

In situ physico-chemical monitoring was completed every month and compared to WQOs. Annual statistics are presented in **Table 2**.

Table 2. Results of physico-chemical parameters collected in situ at monthly sampling sites. Results above guideline objectives are highlighted.

Analyte	Water Quality Objectives (WQOs)		Annual Statistics	Sample Codes & Results			
	Estuary	Fresh Water		WC 001 (Down)	NWC 002 (Variable)	EC 003 (Up)	DD 005 (Down)
pH	7.0-8.5	6.5-8.5	Average	7.16	6.87	6.63	6.37
			Minimum	6.30	6.26	6.11	5.86
			Maximum	7.59	7.18	7.18	7.15
Turbidity (NTU)	0.5-10	6.0-50	Average	92.44	13.55	3.58	5.63
			Minimum	4.64	1.15	1.51	0.74
			Maximum	696.20	46.30	7.56	25.90
Electrical Conductivity (EC) (µS/cm)	125-2,200	125-2,200	Average	832.76	375.44	184.23	344.36
			Minimum	153.80	66.10	85.34	137.69
			Maximum	1927.00	674.00	337.43	1445.00
Dissolved Oxygen (DO) % Saturation	80-110	85-110	Average	33.15	40.06	28.14	22.62
			Minimum	12.24	6.72	2.38	4.09
			Maximum	56.40	71.45	99.73	58.51
Temperature (°C)	N/A	N/A	Average	20.13	20.91	20.57	20.36
			Minimum	14.50	14.70	15.00	15.50
			Maximum	25.54	26.22	25.68	24.64
Oxidation Reduction Potential (ORP)	N/A	N/A	Average	100.89	90.28	136.81	94.69
			Minimum	41.20	5.50	93.80	1.90
			Maximum	222.60	167.52	238.60	152.10

When compared to the WQOs for freshwater and estuaries:

- pH was out of the WQO ranges for Sites 002 and 005 on average during the year. pH was lowest at Site 005 (5.86 pH) and highest at Site 001 (7.59 pH).
- Turbidity was out of the WQO ranges at all sites on average during the year. Turbidity was lowest at Site 005 (0.74 NTU) and highest at Site 001 (696.20 NTU).
- EC was within the WQO ranges for all sites on average during the year. EC was lowest at Site 002 (66.10 µS/cm) and highest at Site 001 (1,927.00 µS/cm).
- DO was out of the WQO ranges for all sites on average during the year. DO was lowest at Site 003 (2.38 %) and highest at Site 003 (99.73 %).

7.2 Laboratory Results

Ammonia, Chlorophyll-a, Filtrable Reactive Phosphorus (FRP), Oxides of Nitrogen (NO_x), Total Nitrogen, and Total Phosphorus (TP) were above the WQOs for some sample sites during the year. Aluminium, cobalt, copper and zinc were also outside WQOs at some sites during the year. Parameters which exceeded the WQOs are shown in **Tables 3 and 4**. **Table 3** presents average, minimum and maximum concentrations of nutrients and chlorophyll-a which exceeded WQOs during the 12-month sampling period. **Table 4** presents average, minimum and maximum concentrations of metals which exceeded WQOs during the 12-month sampling period. **Appendix B** presents monthly results and annual graphs for each analyte which exceed WQOs during the 12-month sampling period.

Table 3. Parameters (nutrients and chlorophyll-a) in exceedance of the trigger criteria for sampling conducted July 2022 to June 2023. Results above guidelines objectives are highlighted.

Analyte Unit	Water Quality Objectives (WQOs)		Annual Statistics	Sample Codes			
	Estuary	Fresh Water		WC 001 (Down)	NWC 002 (Variable)	EC 003 (Up)	DD 005 (Down)
Ammonia (mg/L)	0.015	0.02	Average	0.122	0.120	0.047	0.013
			Minimum	0.008	0.007	<0.005	<0.005
			Maximum	0.330	0.250	0.180	0.042
Chlorophyll-a (mg/L)	4	5	Average	3.583	16.167	7.083	2.750
			Minimum	<1	<1	<1	<1
			Maximum	10.000	45.000	45.000	10.000
Filterable Reactive Phosphorus (mg/L)	0.005	0.02	Average	0.006	0.004	0.053	0.002
			Minimum	<0.005	<0.005	0.010	<0.005
			Maximum	0.020	0.020	0.089	0.010
Oxides of Nitrogen (mg/L)	0.015	0.040	Average	0.145	0.388	0.034	2.633
			Minimum	<0.005	<0.005	<0.005	1.200
			Maximum	0.300	1.400	0.070	3.600
Total Nitrogen (mg/L)	0.30	0.35	Average	0.800	0.925	0.558	3.008
			Minimum	0.300	0.500	0.400	1.700
			Maximum	1.800	1.700	0.800	3.700
Total Phosphorus (mg/L)	0.030	0.025	Average	0.058	0.050	0.135	0.068
			Minimum	<0.02	<0.02	0.060	<0.02
			Maximum	0.220	0.100	0.290	0.530

Note: For the purposes of the statistical analysis above results below the LOR were assumed to be 0.

When compared to the Annual Average WQOs for Freshwater and Estuaries:

- Average ammonia concentrations were above the WQOs at sites 001, 002 and 003. Ammonia was above the WQOs at comparison sites in background sampling. Ammonia was highest at Site 001 (0.330 mg/L) and lowest, below the LOR (<0.005 mg/L) at Sites 003 and 005 during the year.
- Average chlorophyll-a concentrations were above the WQOs criteria at Sites 002 and 003. Chlorophyll-a results were varied across comparison sites in background sampling. Chlorophyll-a

was highest at Sites 002 and 003 (45 mg/L) and lowest, below the LOR (<1 mg/L) at all sites during the year.

- Average FRP was above the WQOs at Sites 001 and 003. FRP results varied across comparison sites in background sampling though were lowest at Site 005. FRP was highest at Site 003 (0.089 mg/L) and lowest, below the LOR (<0.005 mg/L) at Sites 001, 002 and 005 during the year.
- Average NOx was above the WQOs criteria at sites 001, 002 and 005. NOx was highest at Site 005 (3.6 mg/L) and lowest, below the LOR (<0.005 mg/L) at Sites 001, 002 and 003 during the year.
- Average TN was above the WQOs at all sites. TN was above the WQOs at comparison sites in baseline sampling. TN was highest at Site 005 (3.7 mg/L) and lowest at Site 003 (0.8 mg/L) during the year.
- Average TP was above the WQOs at all sites. TP was above the WQOs at comparison sites in baseline sampling. TP was highest at Site 005 (0.53 mg/L) and lowest, below the LOR (<0.02 mg/L) at Sites 001, 002 and 005 during the year.

Table 4. Parameters (metals) in exceedance of the trigger criteria for sampling conducted July 2022 to June 2023. Results above guideline objectives are highlighted.

Analyte Unit	Water Quality Objectives (WQOs)		Annual Statistics	Sample Codes			
	Estuary	Fresh Water		WC 001 (Down)	NWC 002 (Variable)	EC 003 (Up)	DD 005 (Down)
Aluminium (µg/L)	N/A	55	Average	33	54	89	12
			Minimum	<10	10	40	<10
			Maximum	240	320	200	30
Cobalt (µg/L)	1	N/A	Average	<1	<1	<1	<1
			Minimum	<1	<1	<1	<1
			Maximum	2	1	<1	<1
Copper (µg/L)	1.3	1.4	Average	<1	<1	<1	<1
			Minimum	<1	<1	<1	<1
			Maximum	2	1	2	<1
Zinc (µg/L)	15	8.0	Average	5	4	5	4
			Minimum	<1	<1	<1	<1
			Maximum	30	19	23	9

Note: For the purposes of the statistical analysis above results below the LOR were assumed to be 0.

When compared to the WQOs for Freshwater and Estuaries:

- Average aluminium was above the WQO at Site 003. Aluminium was observed above WQO during baseline sampling. Aluminium was highest at Site 002 (320 mg/L) and below the LOR (<10 mg/L) at Sites 001 and 005 during the year.
- Average cobalt was below the WQO at all sites. Cobalt was observed above WQO during baseline sampling. Cobalt was highest at Site 001 (2 mg/L) and lowest, below the LOR (<1 mg/L) at all sites during the year.

- Average copper was below the WQO at all sites. Copper was observed above WQO during baseline sampling. Copper was highest at Site 001 (2 mg/L) and lowest, below the LOR (<1 mg/L) at all sites during the year.
- Average zinc was below the WQO at all sites. Zinc was observed above WQO during baseline sampling. Zinc was highest at Site 001 (30 mg/L) and lowest, below the LOR (<1 mg/L) at all sites during the year.
- All other metals were within estuarine and freshwater during the sampling period.
- Demeton and Lindane were analysed and returned non-detectable results during the sampling period.
- TRH (C₁₀-C₄₀) was not detected at any sample site.

8.0 Summary of Results and Recommendations

- Rainfall during the annual sampling period was below average (Average rainfall 1,812 mm year, 1969-2023). October 2022 experienced the highest monthly rainfall (226.3 mm). The months of August 2022 received the lowest monthly rainfall (25 mm).
- Chlorophyll-a was present at all sites during the sampling period. Algal blooms are naturally occurring and are not considered a result of construction activities.
- Nutrients (Ammonia, NO_x, TN, TP and FRP) were high and exceeded some water quality parameters for some sites. This includes upstream and downstream sites in past sampling events. Exceedances in nutrients are therefore considered of natural occurrence.
- Aluminium averages exceeded WQOs at Site 003 during the year. Cobalt, copper and zinc averages did not exceed WQOs. Metals have been present in upstream and downstream sampling sites in previous sampling rounds. Elevation in metals may be due to pH and redox changes, microbial mineralisation and naturally occurring sediment transportation. Changes in metal concentrations are also likely following heavy rainfall events.
- Elevated nutrients and metals have been observed at all sampling locations including upstream and downstream sites in previous months and during baseline sampling. Therefore, based on the assessment of the Annual (July 2022 to June 2023) water quality data, the Tweed Valley Hospital Project construction activities are unlikely to be adversely impacting the downstream water quality. As such, the current soil and erosion controls implemented on site are considered to be effective.

Kind regards,

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Appendix A. Site Photos June 2023

			<p>Site 001 – West Creek (Downstream) (14/06/2023)</p>
			<p>Site 002 – North-west Creek (Upstream) (14/06/2023)</p>

		<p>Site 003 – East Creek (Upstream) (14/06/2023)</p>
		<p>Site 005 – Dam Drain (Downstream) (14/06/2023)</p>

Appendix B. Annual Laboratory Results and Graphs

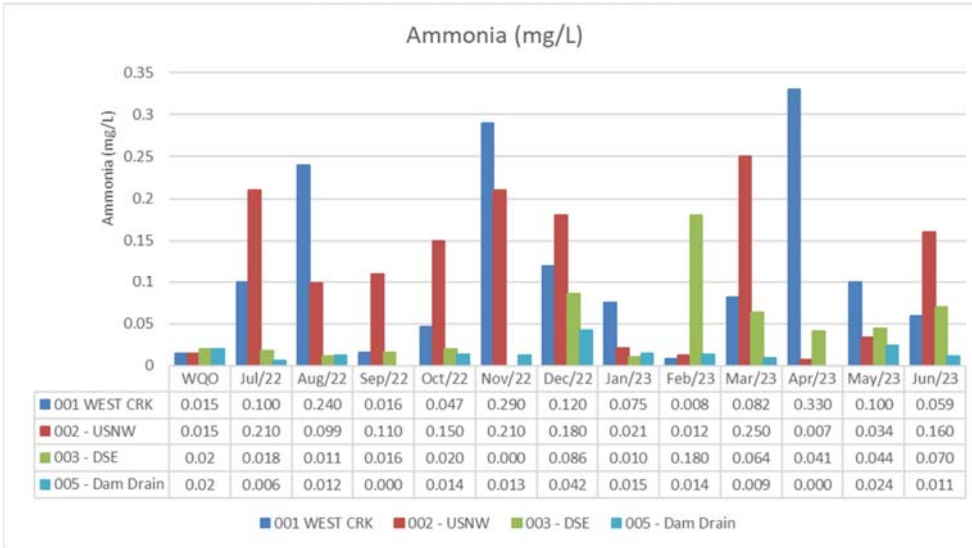


Figure 3. Annual Ammonia Results

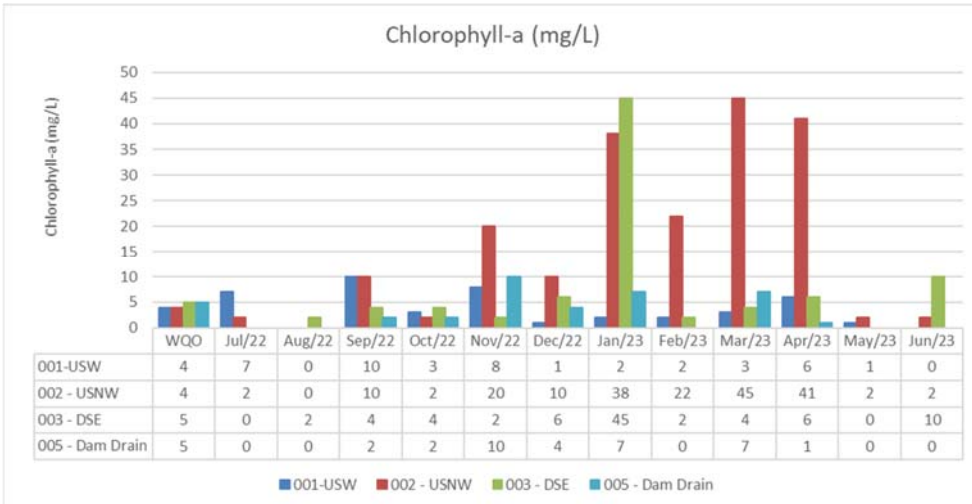


Figure 4. Annual Chlorophyll-a Results

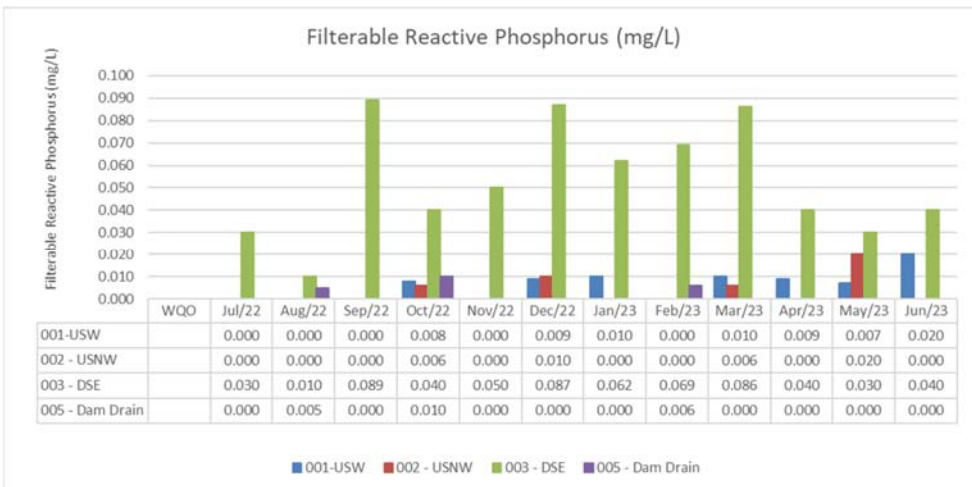


Figure 5. Annual FRP Results

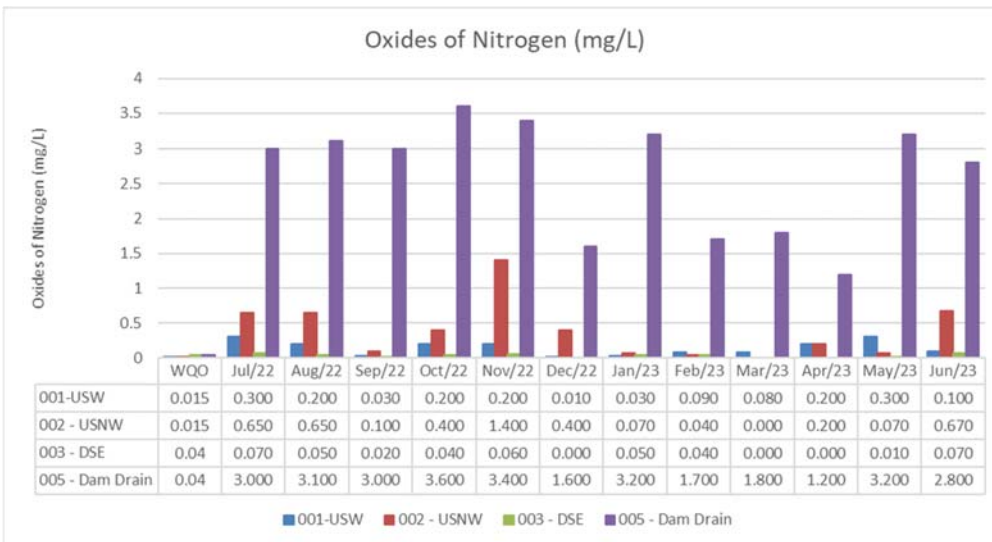


Figure 6. Annual NO^x Results

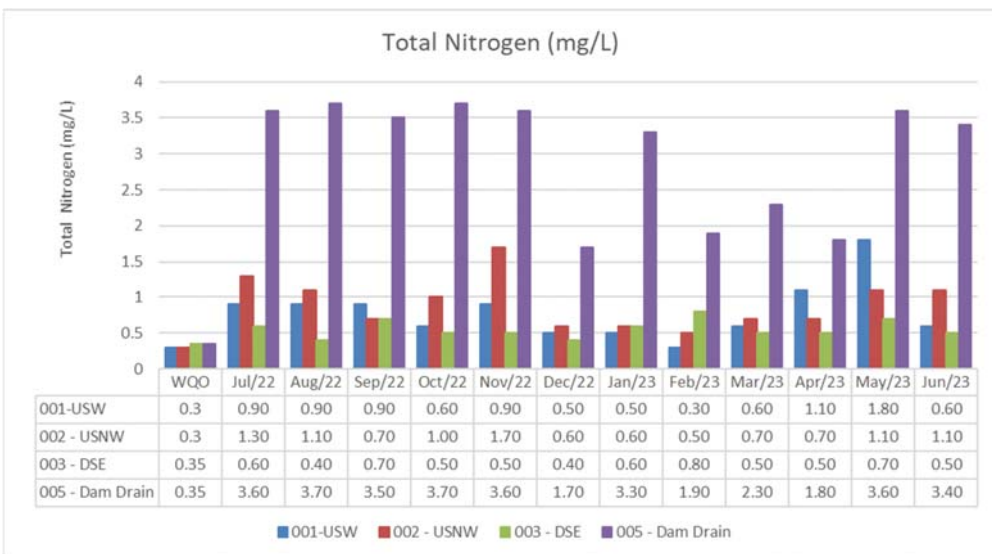


Figure 7. Annual TN Results

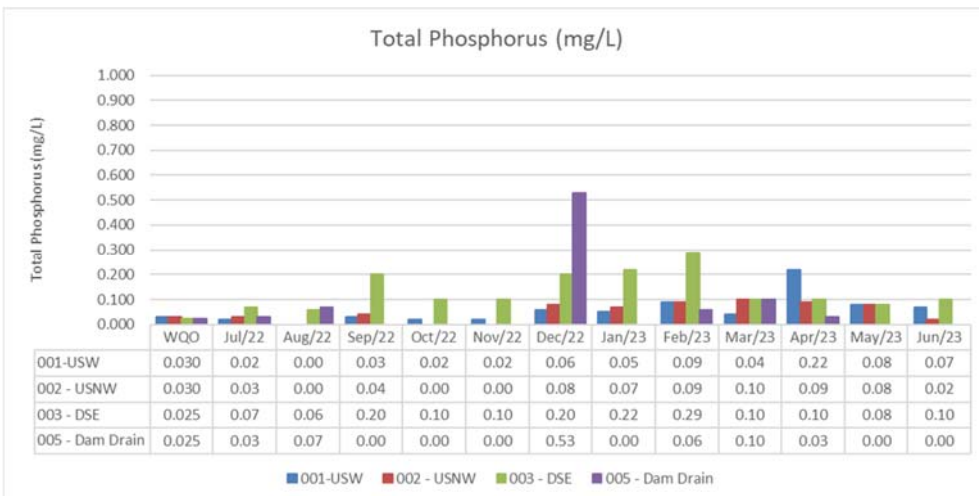


Figure 8. Annual TP Results

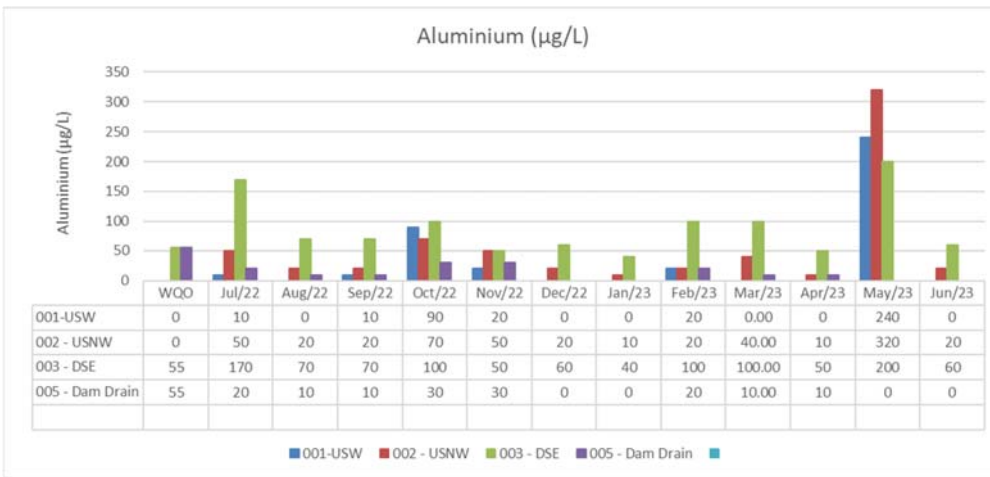


Figure 9. Annual Aluminium Results

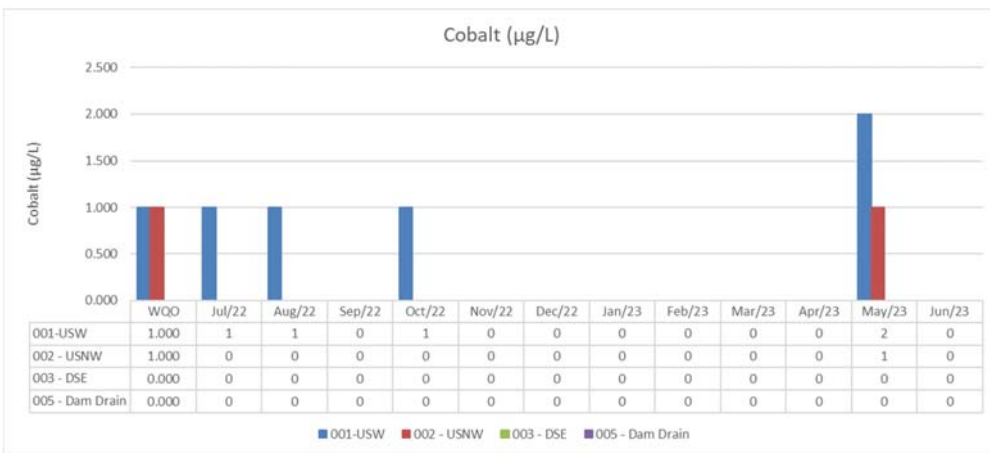


Figure 10. Annual Cobalt Results

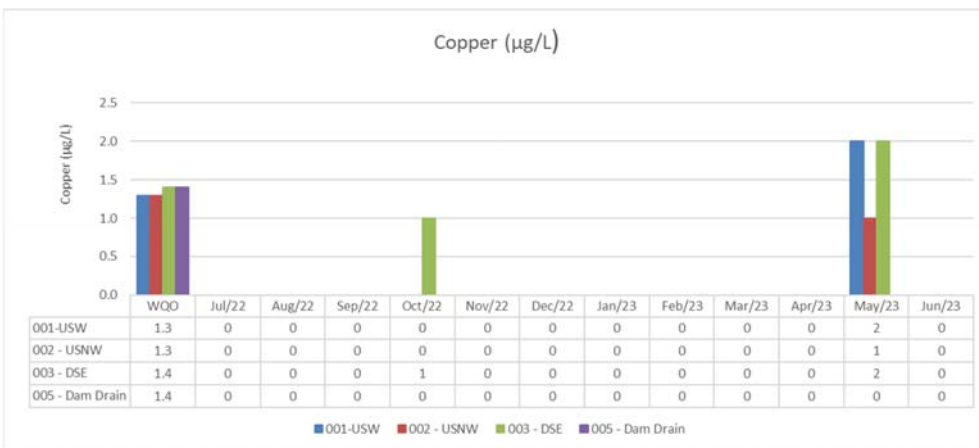


Figure 11. Annual Copper Results

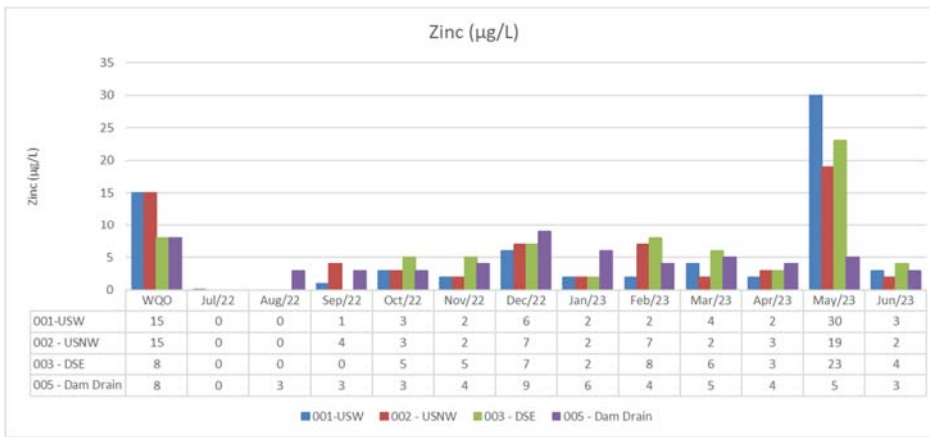


Figure 12. Annual Zinc Results