WDL147 Monitoring Report – Leanyer Sanderson WWTP

2023/2024

PowerWater

DOCUMENT HISTORY

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EXECUTIVE SUMMARY

The 2023/2024 compliance assessment for the SLESB02 monitoring point at Buffalo Creek, under Waste Discharge Licence (WDL) 147, confirms that all monitored water quality parameters remain within the acceptable limits outlined in the licence. The pH and dissolved oxygen levels are conducive to a consistent aquatic environment, with no significant deviations from expected norms. Enterococci counts, both in the dry and wet seasons, are well below the Site-Specific Trigger Values (SSTVs), indicating minimal influence from Leanyer Sanderson WWTP effluent discharge. Chlorophyll concentrations are low, reducing the potential for harmful algal blooms, and ammonia levels are well below toxicity thresholds, ensuring confidence in preservation for aquatic life.

The analysis of discharge volumes from the Leanyer Sanderson Wastewater Treatment Plant (WWTP) to Buffalo Creek highlights significant seasonal variability, with higher discharge rates during the wet season, particularly in February and March 2024. Despite the increased discharge during these months, the overall contaminant loads, including Biochemical Oxygen Demand (BOD), nitrogen, phosphorus, and trace metals (zinc and copper), remain stable, reflecting consistent treatment processes at the WWTP.

Sediment and porewater analyses further support that environmental impacts from the WWTP's operations are minimal. Metal concentrations, nutrient levels, and organic content in sediments are within the guidelines provided by the ANZECC (Australian and New Zealand Environment and Conservation Council), indicating that the estuarine environment of Buffalo Creek is stable. The use of the "Reference Site 2 x 80th Percentile" method for monitoring provides an effective early warning system for potential environmental risks, ensuring continued protection of the Buffalo Creek ecosystem.

Overall, the comprehensive assessment confirms that the Leanyer Sanderson WWTP is operating within its regulatory requirements, effectively managing its environmental impact to Buffalo Creek. Continued monitoring and adherence to best management practices are recommended to maintain this compliance and protect the aquatic ecosystem in the future.

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Glossary

Abbreviation	Definition
Al	Aluminium
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BOD	Biochemical oxygen demand
CFU	Colony forming units (expressed per unit of a specified volume of sample)
Chl-a	Chlorophyll-a, a photosynthetic pigment present in plants, algae and cyanobacteria that is used in oxygenic photosynthesis. It can be used as a measure of algal biomass and subsequently primary production
Cu	Copper
DHWQO(s)	Darwin Harbour water quality objective(s)
DO	Dissolved oxygen
EC	Electrical conductivity
E. coli	Escherichia coli
EP	Equivalent population
FRP	Filterable reactive phosphorous (orthophosphate)
ERA	Environmental risk assessment
HCl	Hydrochloric acid
ISQG	Interim sediment quality guidelines
kg	Kilograms
kL	Kilolitres
L	Litres
LOP	Level of protection (species %)
LOR	Limit of reporting for chemical analysis
µg	Micrograms
mg	Milligrams
ML	Megalitres
N	Nitrogen
NH_3-N	Total ammonia as N (NH3 and NH4+ as N) as per ANZECC and ARMCANZ (2000)

NHMRC	National Health and Medical Research Council
NOX-N	Oxidised nitrogen as N – the sum of nitrate and nitrite
NRETAS	Department of Natural Resources, Environment, The Arts and Sports, Northern Territory
NT	Northern Territory
NT DOH	Northern Territory Department of Health
NTEPA	Northern Territory Environment Protection Authority
NTU	Nephelometric Turbidity Units
Pheo-a	Pheophytin-a, a degradation product of chlorophyll-a
PWC	Power and Water Corporation
SMP	Sediment monitoring program
SSTV(s)	Site specific trigger value(s)
TKN	Total Kjeldahl nitrogen
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorous
TSS	Total suspended solids
TV(s)	Trigger value(s)
WDL(s)	Waste discharge licence(s)
WQO(s)	Water quality objective(s)
WSP(s)	Waste stabilisation pond(s)
Zn	Zinc

Reporting Objective

The submission of this report fulfils Power and Water Corporation's (PWC's) requirement to provide a Monitoring Report pursuant to Item 13 and Condition 39 to 40 of WDL 147-08.

WDL147 Reporting Conditions

39. *The licensee must complete and provide to the Administering Agency a report of data and information obtained through the implementation and performance of the Monitoring Program (the Monitoring Report), as prescribed by this licence, on the dates specified in Item 13.*

13. Monitoring Report (condition 39 and 40)	1) The Monitoring Report is due on: a. 1 September for the preceding year of the licence; and b. the Expiry Date of this licence; and c. in the event the licensee applies to renew the licence, 90 days prior to the Expiry Date. 2) The Monitoring report must: d. comply with condition 40 e. include a tabulation of data and trend analysis for the indicators in Appendix 5 for both surface water and discharge monitoring locations; and f. use the assessment protocols in accordance with Appendix 6

Table 1. Item 13, WDL147-09

40. *The licensee must ensure that each Monitoring Report:*

   40.1. *is prepared in accordance with the requirements of the Administering Agency 'Guideline for Reporting on Environmental Monitoring' (or any other guideline as adopted by the Administering Agency from time to time);*

   40.2. *includes a tabulation, in Microsoft ® Excel ® format or another format requested by the Administering Agency, of all monitoring data required to be collected in accordance with this licence for the preceding 12-month period;*

   40.3. *includes a tabulation of monthly and annual contaminant loads discharged from the authorised discharge point specified in Item 5 for the preceding 12-month period. Contaminant loads must be calculated for metals, metalloids, nutrients, and other parameters (excluding field parameters) listed in the monitoring program specified in Item 11. The calculations must be based on the daily discharge volume and the concentration of contaminant present in the discharge on that day. On the days when a sample was not taken then the concentration of the contaminant must be estimated using Linear Interpolation methodology;*

   40.4. *includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licensed Action over a minimum period of three years (of part thereof);*

   40.5. *includes a summary of any investigations undertaken by the licensee in accordance with this licence for the preceding 12-month period; and*

   40.6. *includes an assessment of environmental impact from the Licensed Act*

Monitoring

Water Quality Monitoring

Sampling is conducted monthly during neap tides, beginning one hour after the highest tide and following the flow from the discharge point to the mouth of Buffalo Creek. Surface water samples are consistently collected at a depth of 20 cm below the surface, in accordance with the monitoring protocols outlined in Appendix 4 of WDL147-9.

APPENDIX 4: SURFACE WATER AND DISCHARGE-MONITORING PLAN

	Sampling Locations[a]					
Classification	Discharge	Upper zone		Transition zone	Outer zone	
Site Code	SLEBCDP	SLEBC01	SLEBC03	SLEBC06	SLEBC08	SLESB02
Indicator	**Monitoring Frequencies**					
Physico-chemical						
Flow	C	NR				
pH	M					
Electrical conductivity						
Dissolved oxygen						
Temperature						
Turbidity						
Biological						
Biochemical oxygen demand	M					
Chlorophyll-a						
Nutrients and Suspended Solids						
NH_3-N (Total Ammonia as N)	M					
Total nitrogen						
Oxidised nitrogen (NO_X as N)						
Total phosphorus						
Filterable reactive phosphorus						
Total suspended solids						
Metals						
Copper (filtered)	M					
Zinc (filtered)						
Pathogen indicators						
Escherichia coli	NR	M				
Enterococci						
Other						
PFAS^	Annual – Dry Season	NR				
EDCs :4-t-octylphenol; Nonylphenol; Bisphenol A; Andosterone; Etiocholanolone						

[a]As identified in Appendix 1 and Appendix 2

^ Must be analysed using the PFAS Extended Suite (28 analytes, trace level)

Where: *Annual - **Dry Season** = between May and September*, **NR** = Not required; **C** = Continuous (with minimum of hourly records and 80% capture rate. If flow monitoring equipment is impaired data may be based on reasonable estimates for the period that the data is affected); **M** = monthly

Table 2. Buffalo Creek surface water and discharge monitoring plan.

Due to recent WDL renewals and changes in monitoring requirements, PFAS and EDC monitoring were not conducted at the discharge monitoring point during the reporting period. However, monitoring contracts have been updated to ensure that the required monitoring will be performed in the next monitoring and reporting period.

Sediment Monitoring

Sediment samples are collected in the dry season in accordance with the Sediment Monitoring Plan, Appendix 2 of WDL 147-08. Sediment sampling was undertaken during spring tides to facilitate sufficient access to the sites. This program includes test sites in Buffalo Creek and control/reference sites in both Mickett and Kings Creek. Due to the timing of the WDL renewal approval coinciding immediately after the scheduled 2024 sediment monitoring, the new parameters (PFAS) were not collected or analysed within the 2023/2024 reporting period.

APPENDIX 5: SEDIMENT MONITORING PLAN

Test Estuary – Buffalo Creek[a]						Reference – Mickett Creek[a]			Reference – Kings Creek[a]		
SLEBC01	SLEBC03	SLEBC04	SLEBC05	SLEBC06	SLEBC08	SLEMC01	SLEMC02	SLEMC03	SLEKC01	SLEKC02	SLEKC03

Indicators	Matrix: Sediment	Matrix: Pore waters	Monitoring Frequency
Interpretive			
Total organic carbon	✓	✗	Annual - Dry season
Aluminium	✓	✗	
pH	✗	✓	
Biological			
Chlorophyll-a	✓	✗	Annual - Dry season
Nutrients[#]			
Total nitrogen	✓	✓	Annual - Dry season
NH_3-N (Total Ammonia as N)	✗	✓	
Total phosphorus	✓	✓	
Filterable reactive phosphorus	✗	✓	
Metals[#]			
Copper	✓ T,B	✓ F	Annual - Dry season
Zinc	✓T,B	✓ F	
Other			
PFAS[^*]	✓	✗	SLEBC01: Annual - Dry season; all other sites: NR

*Key: **T** = Total; **B** = bioavailable estimated by dilute 1 M HCL extraction; **F** = filtered; Annual - **Dry Season** = between May and September, **NR** = Not required*

a *As identified in Appendix 1 and Appendix 2*

^ *Must be analysed using the PFAS Extended Suite (28 analytes)*

<63 µm sediment fraction analysed, (Munksgaard, N. C. (2013). Recommendations for sampling and analysis of Darwin Harbour sediment. Charles Darwin University.)

* *Using the sampling methodology specified in Darwin Harbour Integrated Marine Monitoring and Research Program Benthic Sediment Monitoring Report 2022-23 and Ambient Per- and Polyfluoroalkyl Substance (PFAS) Study*

Table 3. Buffalo, Mickett and King Creek sediments monitoring plan.

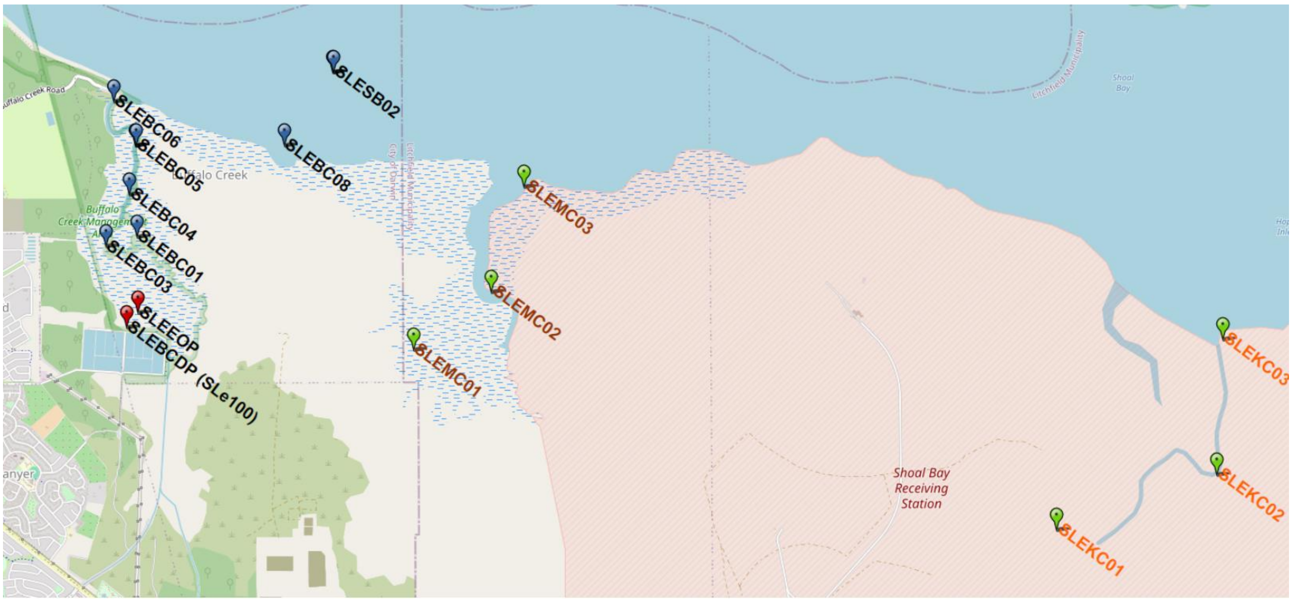

Figure 1. Power and Water Corporation - Shoal Bay monitoring sites.

Assessment and QA/QC Protocols

In accordance with WDL147-09, the water quality compliance assessment is conducted as outlined in Item 16 and Condition 21, as well as in Appendix 5 of the WDL. The compliance point is the monitoring site SLESB01, as specified in Item 8 and Condition 21 of the WDL.

The QA/QC protocol incorporates an approach that includes z-score flagging to identify potential outliers and anomalies in the data. Additionally, the protocol utilises duplicate samples and field blanks to ensure the accuracy, precision, and reliability of the monitoring results. Duplicate samples are employed to assess the consistency of the data, while field blanks are used to detect any contamination that might occur during sample collection or analysis. Together, these methods provide a framework for maintaining high data quality and integrity throughout the monitoring process.

WDL147-08 Compliance Point

The compliance assessment of the SLESB02 monitoring point for the year 2023/2024, in reference to Waste Discharge Licence (WDL) 147, indicates that all SSTV monitored water quality parameters are within the acceptable limits as stipulated by the licence. The pH level is within the safe range, and the dissolved oxygen levels are above the minimum threshold, supporting a healthy aquatic environment. Both dry and wet season Enterococci counts are well below the SSTVs, indicating low impact from effluent discharge. Chlorophyll concentrations are low, reducing the risk of harmful algal blooms, and ammonia levels are significantly lower than the SSTV, minimising the risk of toxicity to aquatic life. Total nitrogen and phosphorus levels are also within the safe range, reducing the potential for nutrient-induced eutrophication. Furthermore, the concentrations of soluble copper and zinc are below their respective SSTVs. Overall, the SLESB02 site is fully compliant with the requirements of WDL147.

SLESB02			
Indicator	SSTV	2023/2024	Compliant Y/N
pH (field) (pH units)	<6 & >8.5	8.10	Y
Dissolved Oxygen (DO) - field (%sat)	<75	92.60	Y
Enterococci MPN/CFU/100ml/L- Dry	>50	2	Y
Enterococci MPN/CFU/100ml/L- Wet	>200	10	Y
Chlorophyll a (ug/L)	>1	0.70	Y
Ammonia (NH3-N) (ug/L)	>910	5	Y
Total Nitrogen (ug/L	>440	135	Y
Total Phosphorus (ug/L)	>16	7	Y
Copper - Soluble (ug/L)	>1.3	1	Y
Zinc - Soluble (ug/L)	>8	5	Y

(green)	Compliant
(orange)	Non-compliant

Table 4. Compliance assessment table for the SLESB02 monitoring point.

Monitoring Results

Discharge Volumes & Contaminant loads.

Discharge Volumes

Monthly discharge volumes from Leanyer Sanderson to Buffalo Creek for the period from July 2023 to June 2024, total discharge over the year amounts to approximately 6,506,105.94 kL. This assessment reviews the variability in monthly discharge to the receiving environment, Buffalo Creek.

Key Findings:

1. **Seasonal Variation in Discharge**:
    - The data shows significant seasonal variability in discharge volumes. The 2024 wet season (January to March 2024) exhibits higher discharge rates, with peaks in February 2024 (1,359,955 kL) and March 2024 (1,276,250 kL).
    - Conversely, the dry season months (July to October 2023, and April to June 2024) show much lower discharge volumes.
2. **Wet Season Impact**:
    - The peak in discharge during the wet season (January to March) is due to increased rainfall, which contributes to higher inflows into the wastewater treatment plant.
3. **Dry Season Stability**:
    - The lower discharge volumes during the dry season months indicate more stable and potentially less impactful flows into Buffalo Creek.
4. **Annual Discharge Total**:

- The total annual discharge of approximately 6.51 million kL reflects the overall contribution of the Leanyer Sanderson WWTP to Buffalo Creek. This volume represents the treated wastewater released into the creek.

Discharge to Buffalo Creek		
Date	**Days**	**Average Monthly Flow kL/month**
July-2023	**31**	**432,460**
August-2023	**31**	**132,516**
September-2023	**30**	**323,209**
October-2023	**31**	**200,681**
November-2023	**30**	**320,324**
December-2023	**31**	**403,112**
January-2024	**31**	**1,205,518**
February-2024	**28**	**1,359,955**
March-2024	**31**	**1,276,250**
April-2024	**30**	**43,340**
May-2024	**31**	**457,263**
June-2024	**30**	**351,477**
Yearly Total	**365.00**	**6,506,105.94**

Table 5. 2023/2024 Leanyer/Sanderson WWTP discharge volume

Contaminant Loads

The figures (Figure 2 & Figure 3) provided outlines the mass load discharge of various parameters from the Leanyer Wastewater Treatment Plant (WWTP) to Buffalo Creek over three fiscal years (2021/2022 to 2023/2024). Key parameters include Biochemical Oxygen Demand (BOD), Nitrogen (in different forms), Phosphorus, Suspended Solids, and trace metals (Zinc and Copper). This assessment show trends, potential environmental impacts, and considerations for future monitoring and management.

Key Findings:

1. **Biochemical Oxygen Demand (BOD)**:

- There is a noticeable decrease in BOD discharge from 231.19 tonnes/year in 2021/2022 to 175.58 tonnes/year in 2023/2024. This decline suggests improved treatment efficiency or reduced organic load entering the treatment plant, which is positive for minimising oxygen depletion risks in Buffalo Creek.

2. **Nitrogen Compounds**:
    - **Ammonia Nitrogen (NH3-N)**: A gradual decrease from 75.89 tonnes/year to 68.87 tonnes/year across the three years indicates improved nitrification processes or reduced nitrogen inputs.
    - **Nitrogen Oxide (NOx-N)**: The discharge of NOx-N increased slightly from 4.51 tonnes/year in 2021/2022 to 6.22 tonnes/year in 2023/2024.
3. **Total Nitrogen**:
    - Total Nitrogen discharge remained relatively stable around 107-110 tonnes/year, suggesting consistent nitrogen removal.
4. **Phosphorus Compounds**:
    - **Reactive Phosphorus**: The increase in reactive phosphorus from 5.71 tonnes/year to 6.69 tonnes/year is observed.
    - **Total Phosphorus**: There is a slight decline in total phosphorus discharge, which is positive; however, the levels remain significant.
5. **Suspended Solids (SS and VSS)**:
    - Both Suspended Solids (SS) and Volatile Suspended Solids (VSS) show a consistent decline over the three years. This reduction in particulate matter improves water clarity and reduces the potential for sedimentation and habitat disruption in Buffalo Creek.

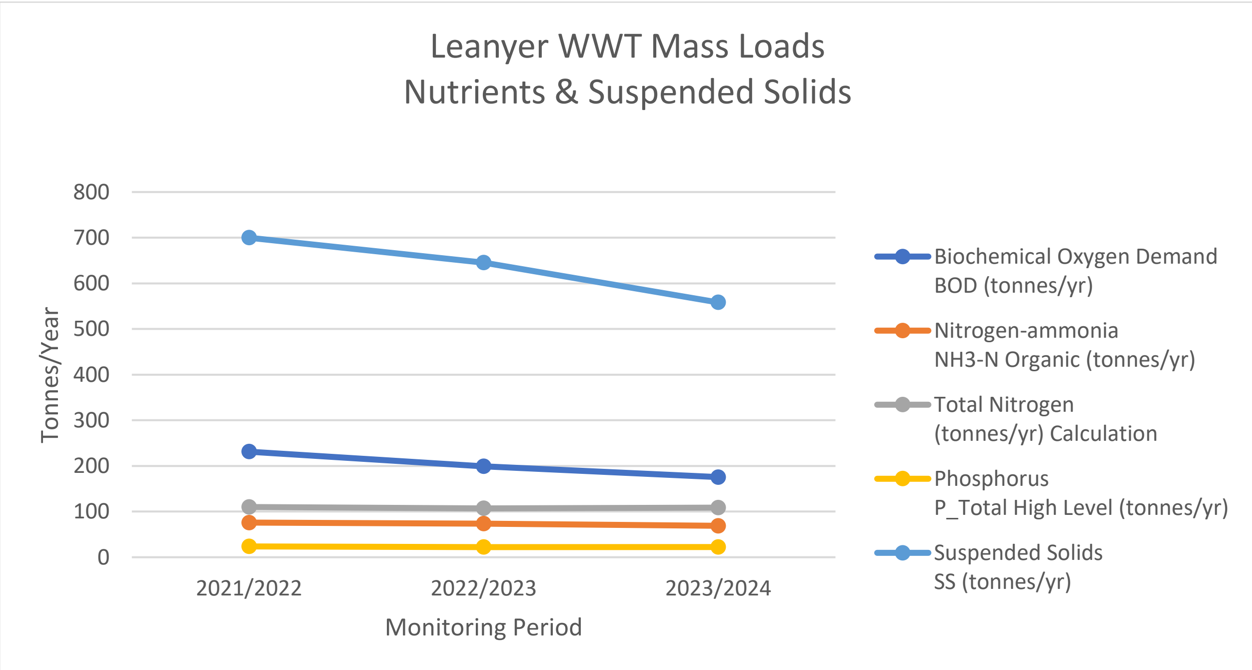

Figure 2. 2021 - 2024 Leanyer Sanderson contaminant loads (Nutrients & General Chemistry).

6. **Trace Metals (Zinc and Copper)**:
    - **Zinc**: There is a notable decrease in zinc discharge from 0.0266 tonnes/year in 2021/2022 to 0.0095 tonnes/year in 2023/2024. This reduction is positive, considering the toxicity of zinc to aquatic organisms.
    - **Copper**: Copper levels remain relatively stable around 0.03 tonnes/year, with a slight decrease in 2022/2023 followed by a slight increase in 2023/2024.

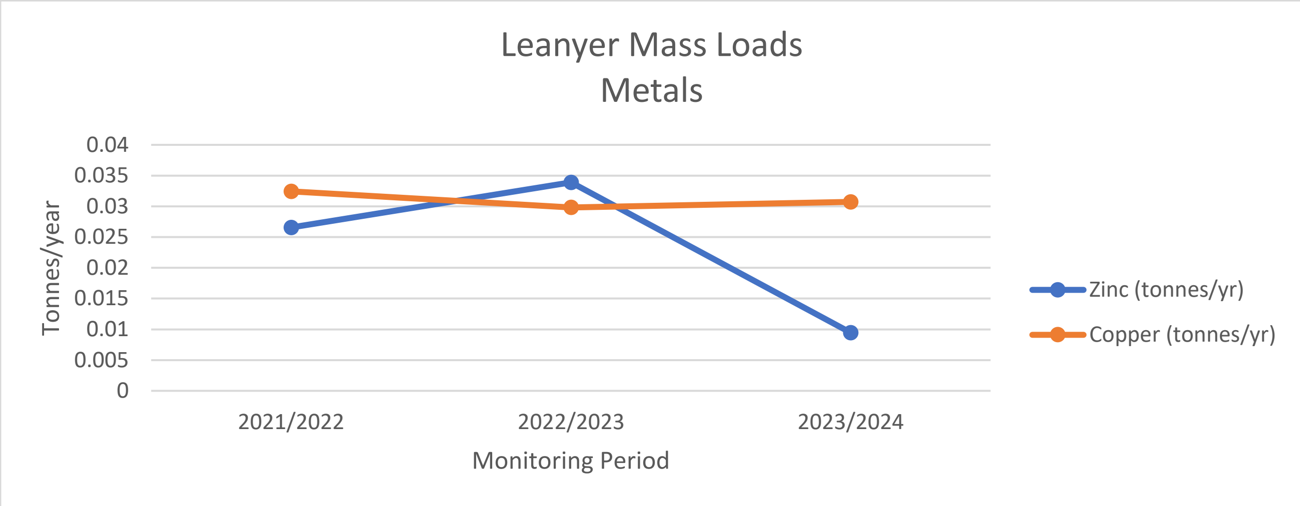

Figure 3. 2021 - 2024 Leanyer Sanderson contaminant loads (Metals).

Water Quality Monitoring Results Assessment

Metals

Metals data presents the 95th percentile concentrations of soluble **Copper** and **Zinc** across multiple sampling sites (SLEBC01, SLEBC03, SLEBC06, SLEBC08, SLESB02) with SLEBCDP as the discharge point. This summary highlights the trends observed over three consecutive years, with a focus on potential impacts of the discharge point and data consistency.

Key Findings:

1. **Copper - Soluble (µg/L) (**Figure 8**)**:
    - **2023/2024**: Copper concentrations remained low across most sites, with SLESB02 showing a consistent value of 1 µg/L. The highest concentration is observed at the discharge point (SLEBCDP) at 9.255 µg/L, however this does not appear to significantly impact downstream concentrations, which remain stable.
    - **2022/2023**: An anomaly at SLESB02 (1.6 µg/L) suggests a slight increase, but Copper levels across other sites remain low, indicating stable conditions despite the higher levels at SLEBCDP (9.6 µg/L).
    - **2021/2022**: Copper levels were consistently low, with SLESB02 at 1 µg/L, showing minimal impact from upstream activities or the discharge point.
2. **Zinc - Soluble (µg/L) (**Figure 9**)**:

- **2023/2024**: Zinc concentrations are uniform at 5 µg/L across all sites, including SLESB02, with the discharge point (SLEBCDP) showing a lower concentration of 2 µg/L.
- **2022/2023**: Zinc levels are consistent across most sites at 5 µg/L, including SLESB02, even though the discharge point showed an elevated level of 8 µg/L.
- **2021/2022**: Zinc levels were slightly lower overall, with most sites below 5 µg/L, and SLESB02 at 4.45 µg/L, indicating that the reporting limit change in 2022 did affect observed trends.

3. **Data Integrity Considerations**:
    - The data set notes contamination events during the 2022/2023 monitoring period, which led to the removal of unreliable data.
    - The change in reporting limits for Zinc from < 3 µg/L to < 5 µg/L in 2022 is also noted and explains the lower levels in the 2021/2022 reporting period.

Nutrients

Median nutrient concentrations of various nitrogen and phosphorus compounds across four key sampling sites (SLEBC01, SLEBC03, SLEBC06, SLEBC08) with SLESB02 as the compliance point, covering three consecutive years. These sites reflect the flow of water and potential contaminants from upstream to downstream. The parameters analysed include Ammonia Nitrogen (NH3-N), Nitrate + Nitrite as N (NOx-N), Total Nitrogen as N, Phosphorus - Filterable Reactive as P, and Total Phosphorus.

Key Findings:

1. **Ammonia Nitrogen (NH_3-N) (µg/L) (**Figure 10**)**:
    - There is a significant reduction in median ammonia nitrogen concentrations from 2022/2023 to 2023/2024 across all sites. For example, SLEBC01 shows a decrease from 533 µg/L in 2022/2023 to 76 µg/L in 2023/2024.
    - The reduction in ammonia levels suggests improved nitrogen management and treatment processes upstream, leading to lower ammonia concentrations as the water flows downstream to SLESB02, which remains stable at <5 µg/L.
2. **Nitrate + Nitrite as N (NO_x-N) (µg/L) (**Figure 11**)**:
    - Nitrate and nitrite levels remained relatively stable across most sites from 2021/2022 to 2023/2024. Notably, SLEBC01 and SLEBC03 recorded low and consistent values, with slight fluctuations observed in other sites.
    - The stable NO_x-N levels indicate consistent nitrification processes, with minimal variation in nitrate and nitrite levels across the flow path from SLEBC01 to SLESB02.
3. **Total Nitrogen as N (µg/L) (**Figure 12**)**:
    - Total nitrogen levels show a general decrease from 2022/2023 to 2023/2024, particularly at SLEBC01 and SLEBC03. For instance, SLEBC01 decreased from 1950 µg/L in 2022/2023 to 485 µg/L in 2023/2024.
4. **Phosphorus - Filterable Reactive as P (µg/L) (**Figure 13**)**:
    - Median concentrations of filterable reactive phosphorus (FRP) decreased significantly from 2022/2023 to 2023/2024 across all sites. SLEBC01, for example, decreased from 196 µg/L to 41 µg/L.

- The reduction in FRP levels reflects improved phosphorus inputs, which is crucial for reducing the risk of eutrophication as water flows downstream to SLESB02.

5. **Phosphorus - Total (µg/L) (**Figure 14**)**:

   - Total phosphorus concentrations have generally decreased across all sites from 2022/2023 to 2023/2024. SLEBC01 saw a drop from 445 µg/L to 120.5 µg/L.
   - The consistent decrease in total phosphorus highlights successful management practices upstream, contributing to reduced phosphorus levels at the downstream site, SLESB02.

General Chemistry

The data presents median concentrations of Total Suspended Solids (TSS), Fixed Suspended Solids (FSS), and Volatile Suspended Solids (VSS) across multiple sampling sites (SLEBC01, SLEBC03, SLEBC06, SLEBC08, SLESB02) with SLEBCDP being the discharge point. This assessment focuses on understanding the relationship between the discharge point (SLEBCDP) and downstream sites, with particular emphasis on how an additional tributary contributing to SLEBC03 could explain elevated readings between SLEBC01 and SLEBC03.

Key Findings:

1. **Total Suspended Solids (TSS)**:

   - The TSS levels at the discharge point (SLEBCDP) are significantly higher compared to all other sites. For example, in 2023/2024, TSS at SLEBCDP is 139 mg/L, while at SLESB02 (the furthest downstream site), it drops to 6 mg/L.

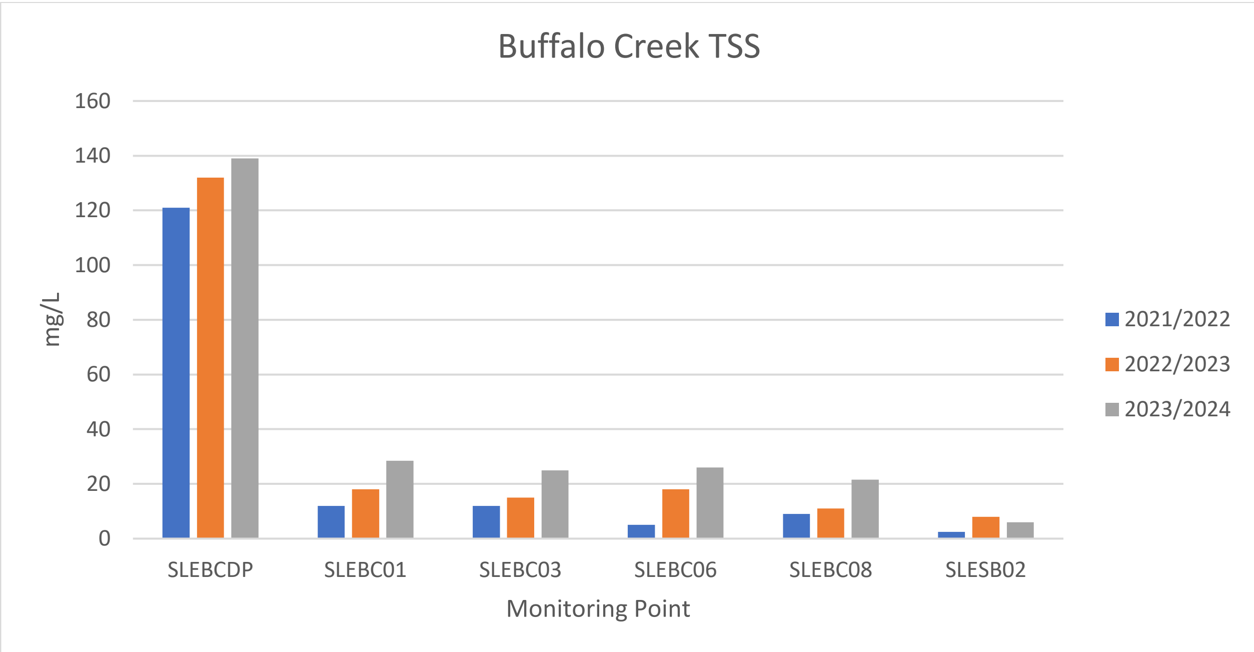

Figure 4. Buffalo Creek Total Suspended Solids Median).

   - From SLEBC01 (28.5 mg/L) to SLEBC03 (25 mg/L), there is a slight decrease, but the presence of another tributary contributing to SLEBC03 could account for elevated readings here compared to the upstream site SLEBC01. This indicates that the increase at SLEBC03 might be due to inputs from this additional source rather than from the discharge point.

2. **Fixed Suspended Solids (FSS)**:
    - FSS concentrations are relatively low across all sites. For example, in 2023/2024, FSS at SLEBCDP is 5 mg/L, while at SLESB02 it is only 1 mg/L.
    - There is a noticeable increase in FSS from SLEBC01 (10.5 mg/L) to SLEBC03 (15 mg/L) in 2023/2024. This increase is likely influenced by the additional tributary contributing to SLEBC03, rather than being a result of the discharge from SLEBCDP.

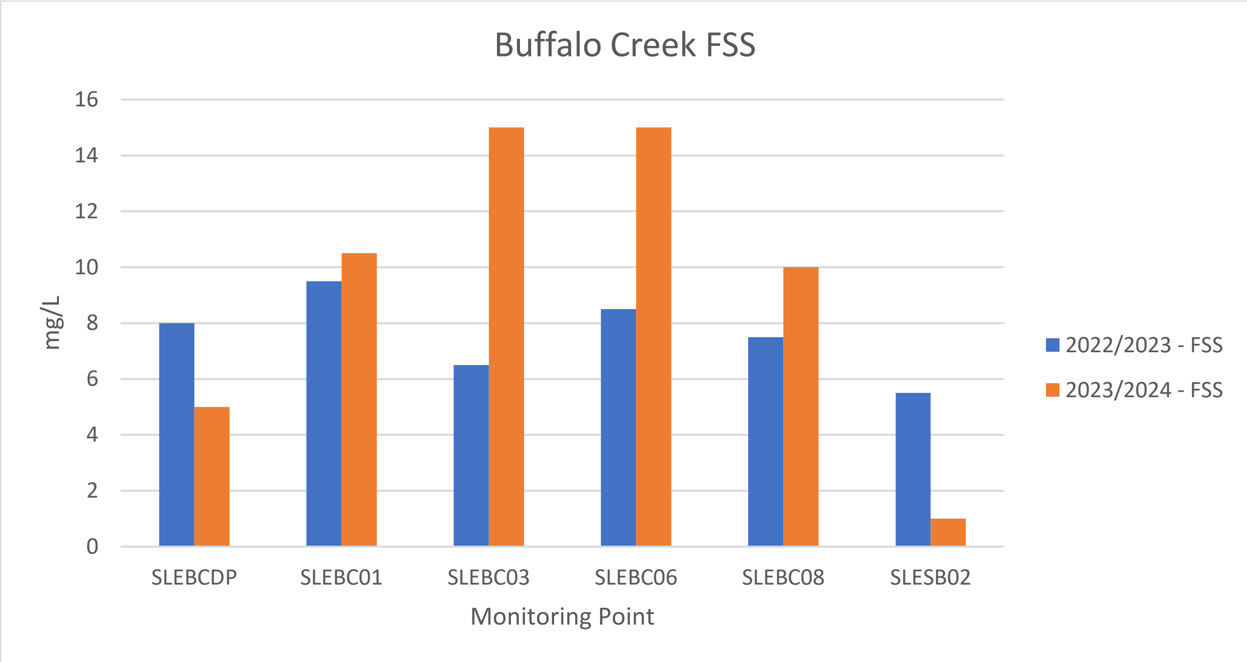

Figure 5. Buffalo Creek Fixed Suspended Solids (Median)

3. **Volatile Suspended Solids (VSS)**:
    - VSS levels at SLEBCDP are significantly higher (131 mg/L in 2023/2024) compared to the downstream sites (5 mg/L at SLESB02 in the same year).

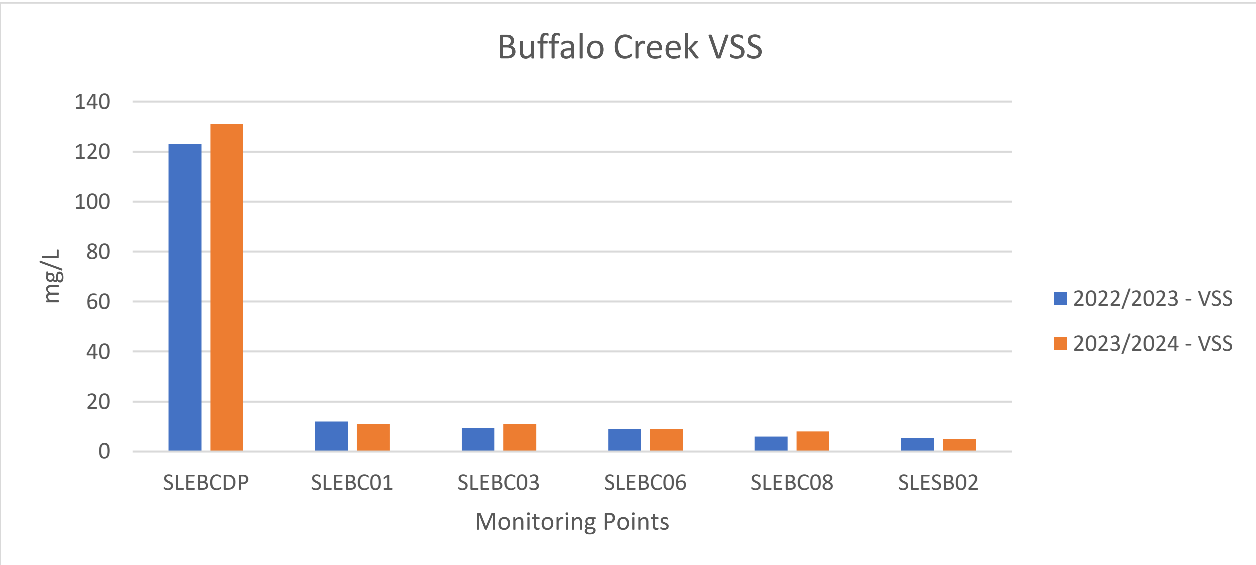

Figure 6. Volatile Suspended Solids (Median).

- The VSS levels remain stable from SLEBC01 to SLEBC03, with a slight decrease, which could be due to dilution or natural sedimentation processes. The relatively small increase in VSS at SLEBC03 may also be attributed to inputs from the tributary rather than the discharge point.

4. **Chlorophyll-a (**Figure 15**)**

   - The chlorophyll-a concentrations show a high level at the discharge point (SLEBCDP), with values decreasing progressively downstream. This indicates effective dilution as the water flows from SLEBCDP through to SLESB02. The reduction in Chlorophyll-a level suggests that the impact of the discharge diminishes with distance, with the lowest concentrations observed at the compliance point.

5. **Biochemical Oxygen Demand (**Figure 16**)**

   - The data indicates that although the discharge point (SLEBCDP) has higher Biochemical Oxygen Demand (BOD) levels, these elevated levels do not persist downstream. BOD levels at downstream sites (SLEBC01 through SLESB02) remain consistently low, suggesting effective dispersion, dilution, or even biodegradation of organic material as water moves downstream. This pattern indicates that the discharge from SLEBCDP is not causing elevated BOD levels in downstream areas, thereby minimising the risk of oxygen depletion, and consistent ecological health of the aquatic environment.

In-situ Physicochemical

The analysis examines the water quality data for Buffalo Creek across several sites from the discharge point (SLEBCDP) to the final monitoring point near the creek's mouth at Shoal Bay (SLESB02). The focus are on the dissolved oxygen (DO), pH, and turbidity over three monitoring periods: 2021/2022, 2022/2023, and 2023/2024. The analysis also considers how water quality changes as it moves downstream from SLEBCDP through SLEBC01, SLEBC03, SLEBC06, SLEBC08, and ultimately to SLESB02.

Key Findings:

1. **Dissolved Oxygen (DO) - Field (% Saturation) (**Figure 17**)**:

   - Dissolved oxygen levels show a general improvement downstream from the discharge point, SLEBCDP, to the final monitoring point, SLESB02. The data for 2023/2024 shows a progressive increase in DO from 53.8% at SLEBCDP to 92.6% at SLESB02. This suggests that oxygen levels recover well as the water flows downstream, likely due to re-aeration and reduced biological oxygen demand (BOD).
   - The trend of increasing DO from the discharge point to SLESB02 indicates effective natural recovery mechanisms in Buffalo Creek, with the downstream sites showing DO levels well within the acceptable range for aquatic life according to ANZECC guidelines. The high DO levels at SLESB02 (92.6% in 2023/2024) are particularly encouraging for maintaining healthy aquatic ecosystems at the creek's mouth.

2. **pH (Field) - pH Units (**Figure 18**)**:

   - pH values remain stable and slightly alkaline as water moves from SLEBCDP downstream through SLEBC01 to SLESB02. The data indicates that pH values vary only slightly, from 7.61

at SLEBCDP to around 8.1 at the downstream sites (e.g., SLEBC08 and SLESB02 in 2023/2024).

  - The consistent pH values across the creek suggest that the water maintains a stable and healthy pH environment, which is crucial for the survival of aquatic organisms. The slight alkalinity is typical of estuarine environments and falls within the recommended pH range (6.5-8.5) provided by the ANZECC water quality guidelines.

3. **Turbidity (Field) – NTU (**Figure 19**)**:
   - Turbidity levels decrease significantly as water moves downstream from SLEBCDP (212 NTU in 2023/2024) to SLESB02 (4.43 NTU in 2023/2024). This decrease indicates that sediment and particulate matter settle out as the water flows, leading to clearer water at the creek's mouth.
   - The reduction in turbidity downstream is a positive sign, suggesting that any sediment or particulate matter introduced at the discharge point is effectively filtered or settled by the time water reaches SLESB02.

Bacteriological

The data presents the 80th percentile concentrations of **E. coli** and **Enterococci** across multiple sampling sites (SLEBC01, SLEBC03, SLEBC06, SLEBC08, SLESB02) with SLEBCDP being the discharge point. These microbial indicators are measured during both wet and dry seasons over three consecutive years. This assessment focuses on understanding the impact of the discharge point (SLEBCDP) on downstream sites and evaluating how microbial levels at these sites reflect the influence of the discharge.

Key Findings:

1. **E. coli (CFU/MPN/100 mL) (**Figure 20**)**:
   - **Dry Season (2023/2024)**: E. coli levels are notably higher at SLEBCDP (1579.4 CFU/100 mL) compared to the downstream site SLESB02 (12 CFU/100 mL). This significant reduction as water moves downstream suggests effective dilution.
   - **Wet Season (2023/2024)**: A similar trend is observed, with E. coli levels at SLEBCDP (444.6 CFU/100 mL) decreasing to 168.2 CFU/100 mL at SLESB02. This pattern is consistent across the years, indicating that while the discharge point has higher microbial levels, these do not persist or cause elevated levels downstream.

2. **Enterococci (MPN/CFU/100 mL) (**Figure 21:
   - **Dry Season (2023/2024)**: Enterococci levels are significantly higher at SLEBCDP (2377.8 MPN/100 mL) compared to downstream sites, with levels dropping to 10 MPN/100 mL at SLESB02. This decrease suggests that the impact of the discharge on microbial contamination is mitigated as water moves downstream.
   - **Wet Season (2023/2024)**: Similarly, Enterococci levels at SLEBCDP (444.6 MPN/100 mL) decrease to 168.2 MPN/100 mL at SLESB02, further supporting the notion that SLESB02 Compliance with SSTV Limits.

3. **SLESB02 - Compliance with SSTV Limits (**Figure 7**):**
   - Throughout the monitoring periods, Enterococci levels at SLESB02 remained well below the Site-Specific Trigger Values (SSTVs) during both wet and dry seasons.

- The chart shows fluctuations in Enterococci levels with noticeable peaks during the wet season of 2023/2024, where Enterococci levels reached 168.2 MPN/100 mL. However, even this peak remains below the wet SSTV limit, indicating that the site remains compliant despite increased microbial load potentially due to higher rainfall.
- During dry seasons, Enterococci levels are consistently low, further supporting the notion that there is minimal impact from upstream sources or from the discharge point, SLEBCDP, on this (SLESB02) downstream site.
- The chart also indicates a potential correlation between rainfall and Enterococci levels, particularly during the wet seasons. Higher rainfall appears to coincide with increased Enterococci levels, likely due to increased runoff contributing to the microbial load. However, despite these increases, levels remain within compliant ranges.

4. **Seasonal Variations**:
    - Microbial concentrations tend to be higher during the wet season, likely due to increased runoff. However, even during these periods, the downstream sites show much lower concentrations when compared to the discharge, indicating that the water body is resilient to the microbial inputs from the discharge point.

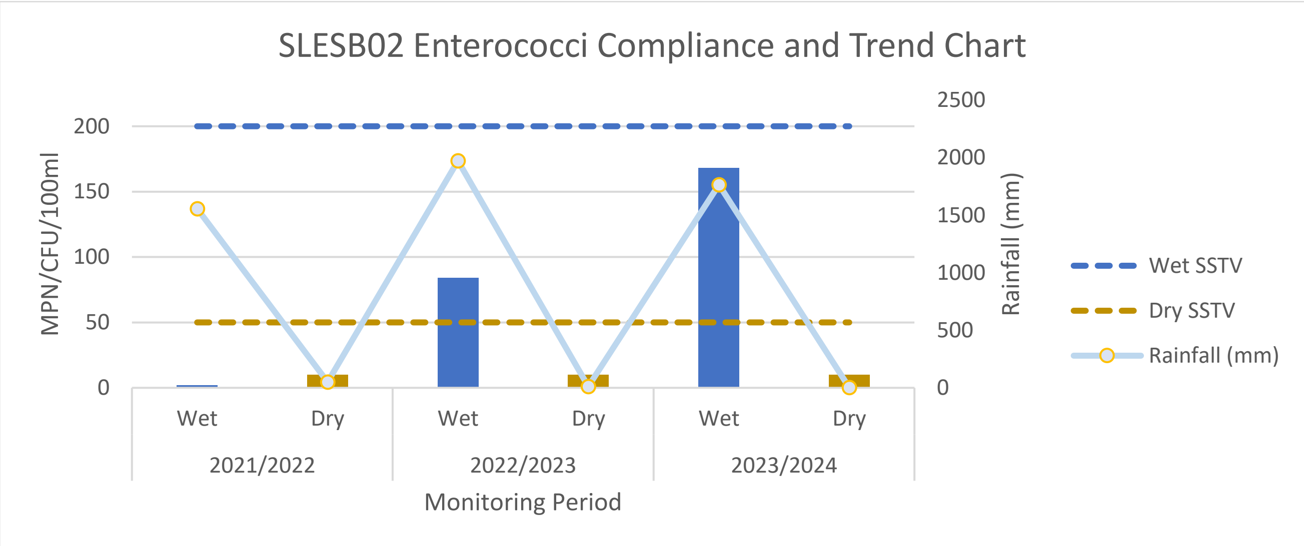

Figure 7. Compliance point (SLESB02) Enterococci compliance and trend chart.

Event Based Water Quality Assessment

In accordance with item 10 and Appendix 3: Surface Water Trigger Values of WDL147-08, an event-based assessment of the 2023/2024 monitoring results has been conducted and as detailed in Table 6. The assessment utilised both maximum and minimum statistical metrics to identify any exceedances within the datasets, with the specific statistic applied being contingent on the guideline value.

The assessment identified two exceedance events for dissolved oxygen saturation (DO%) at SLBC03 in November and December 2023, and one exceedance event at SLEBC06 in October. However, as per item 10 of WDL147-08, these exceedances are not classified as notifiable incidents and occurred during the wet season.

Sediments and Porewater Monitoring Results Discussion

The data (Table 7) provided assesses sediment and porewater quality from various sites including Buffalo Creek, Kings Creek, and Mickett Creek. The key analytes include metal concentrations (Aluminum, Copper, Zinc), nutrient content (Nitrite + Nitrate as N, Total Phosphorus, Total Organic Carbon), and biological indicators (Chlorophyll a, Pheophytin a, and their ratios). The assessment is performed with reference to ANZECC (Australian and New Zealand Environment and Conservation Council) sediment quality guidelines, which provide default and high guideline values (DGV and GV-High) for environmental protection.

Sediment Quality Assessment

Key Findings:

1. **Metal Concentrations (Copper, Zinc, Aluminum)**:
    - **Copper**: Sediment samples across the sites, including Buffalo Creek, Kings Creek, and Mickett Creek, show Copper concentrations ranging from 1 to 18.5 mg/kg. The highest Copper concentration at SLEBC01 (18.5 mg/kg) is well below the DGV of 65 mg/kg and the GV-High of 270 mg/kg. This indicates that Copper levels are within acceptable limits across all sites.
    - **Zinc**: Zinc concentrations are similarly low, ranging from 10.2 to 58.7 mg/kg, with the highest recorded at SLEBC01. These concentrations are also well within the DGV of 200 mg/kg and the GV-High of 410 mg/kg.
    - **Aluminum Normalisation**: Normalised values for Copper and Zinc against Aluminum indicate that the metal concentrations are consistent with natural background levels and are not elevated due to pollution.
2. **Nutrient Levels (Nitrite + Nitrate as N, Total Phosphorus, Total Organic Carbon)**:
    - **Nitrite + Nitrate as N**: These levels were generally low across all sites, with the highest concentration observed at SLEBC03 (3.4 mg/kg). This suggests limited nitrogen enrichment, which is beneficial for preventing eutrophication in the aquatic environment.
    - **Total Phosphorus**: The Total Phosphorus concentrations varied, with the highest at SLEBC01/TRIPLICATE 2A (1.83 mg/kg), which is within the acceptable range. The overall low levels of phosphorus indicate effective nutrient management.
    - **Total Organic Carbon (TOC)**: TOC levels range from 0.35% to 3.16%, indicating varying levels of organic matter across the sites. These levels are typical for estuarine environments and do not indicate excessive organic pollution.
3. **Biological Indicators (Chlorophyll a, Pheophytin a)**:
    - **Chlorophyll-a** and **Pheophytin-a** levels indicate active photosynthetic processes but are not excessively high, suggesting that primary productivity is within normal ranges and there is no significant algal bloom. The highest values were recorded at SLEBC01/TRIPLICATE 2B, but these remain within expected levels for healthy estuarine systems.
4. **Porewater Quality**:
    - **Ammonia as N (pH adjusted)**: The ammonia concentrations in porewater, adjusted for pH, were generally low and well within the ANZG 2018 SMD Trigger Values (0.8 mg/L), indicating that there are no immediate risks of ammonia toxicity to aquatic life. The highest value recorded was 0.13 mg/L at SLEBC01, which remains within limits.

Environmental Implications:

- **Compliance with ANZECC Guidelines**: The sediment and porewater quality across all sites are well within the ANZECC sediment quality guidelines. There are no exceedances of the DGV or GV-High for any of the measured parameters.
- **Ecosystem Health**: The low levels of metals, nutrients, and organic content suggest that the estuarine environment is stable. The low nutrient levels reduce the risk of eutrophication, while the controlled metal concentrations prevent potential toxicity to aquatic organisms.

Environmental Impact Assessments

The compliance assessment for the 2023/2024 monitoring period at SLESB02, the compliance point for Buffalo Creek under Waste Discharge Licence (WDL) 147, demonstrates full compliance across all key water quality indicators. The pH, dissolved oxygen, nutrient levels, and microbial counts are all within the stipulated Site-Specific Trigger Values (SSTVs), indicating no immediate environmental risks from the discharge of treated wastewater from the Leanyer Sanderson WWTP. The data highlights effective management practices that have kept contaminant loads, such as ammonia, nitrogen, and phosphorus, within safe limits, ensuring the protection of the aquatic ecosystem in Buffalo Creek. The sediment and porewater analyses also confirm that metal concentrations and nutrient levels remain within acceptable guidelines, further supporting the conclusion that the WWTP's operations are environmentally sound and compliant with regulatory standards.

Declaration of Accuracy

I, ***Lenin Aquino Villamar*** (Water and Wastewater Quality Officer, Power and Water Corporation), have created and reviewed this report and I confirm that to the best of my knowledge and ability, all the information provided in the report is true and accurate.

Signature: ________________________

Date: 28/08/2024

Appendix 2 - Water Quality Trend Charts

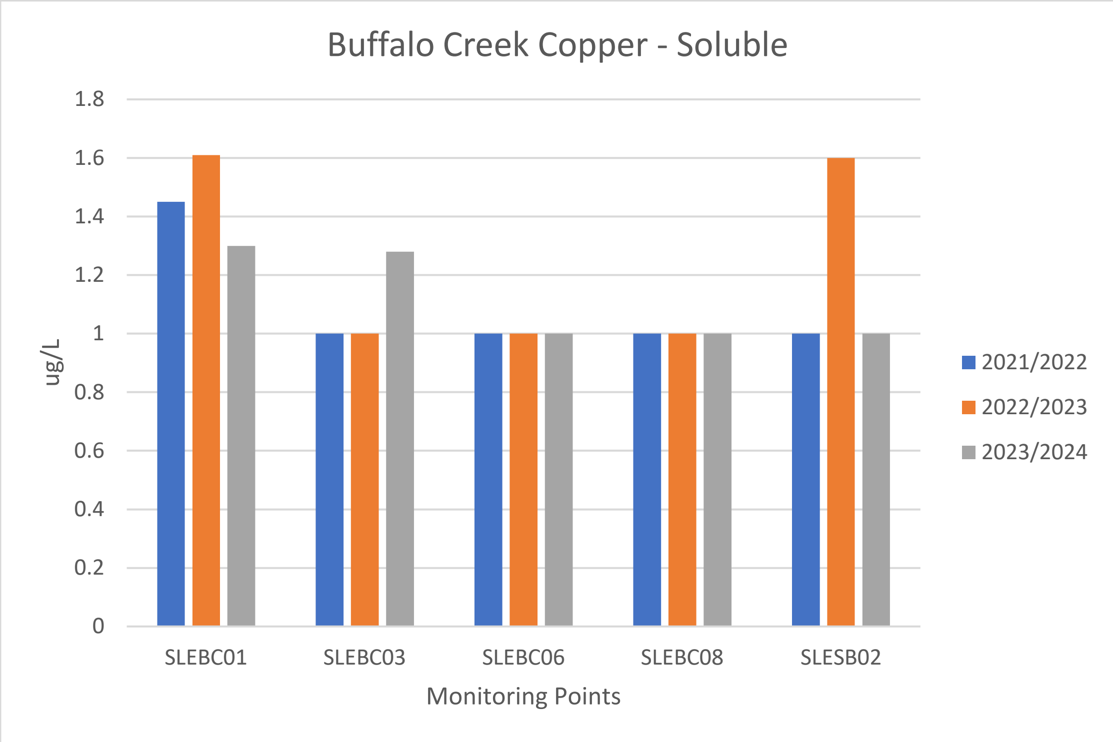

Figure 8. Buffalo Creek Copper Soluble (95th Percentile).

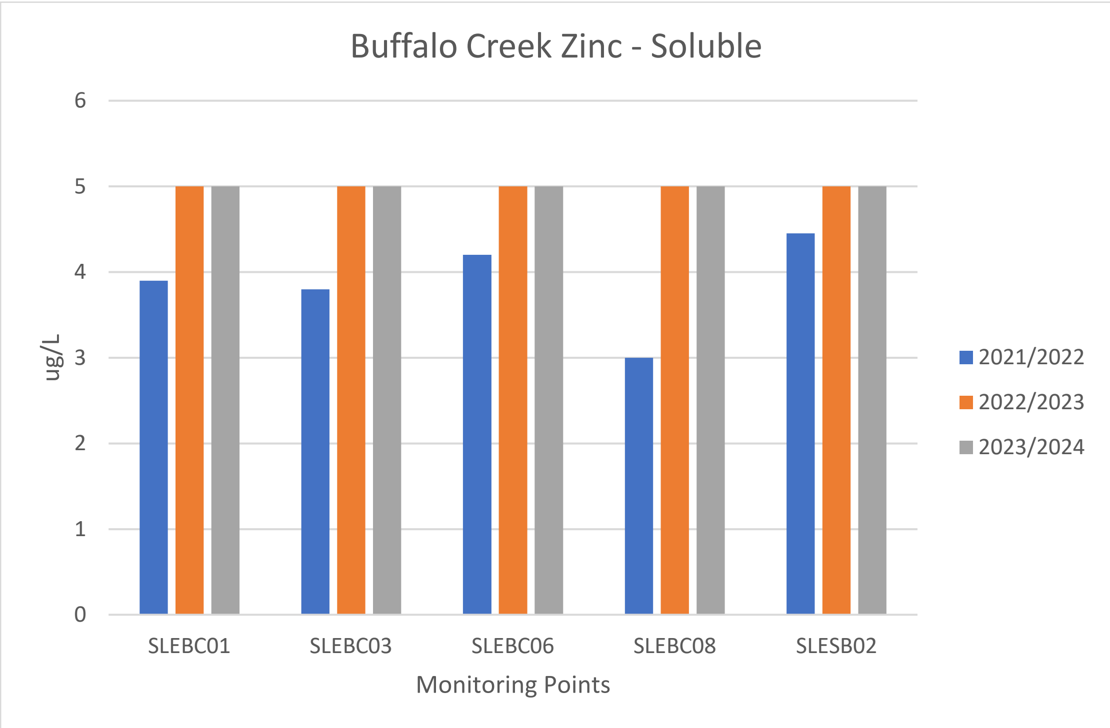

Figure 9. Buffalo Creek Zinc Soluble (95th Percentile).

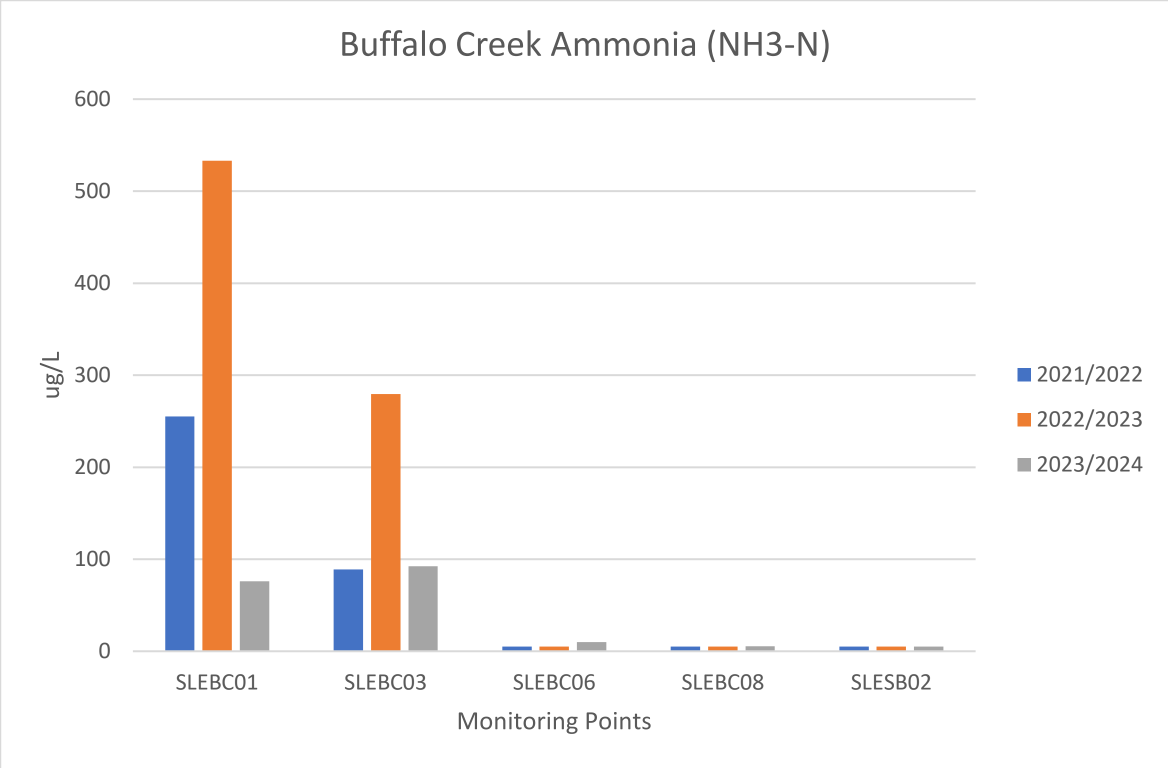

Figure 10. Buffalo Creek Ammonia (NH_3-N) (Median).

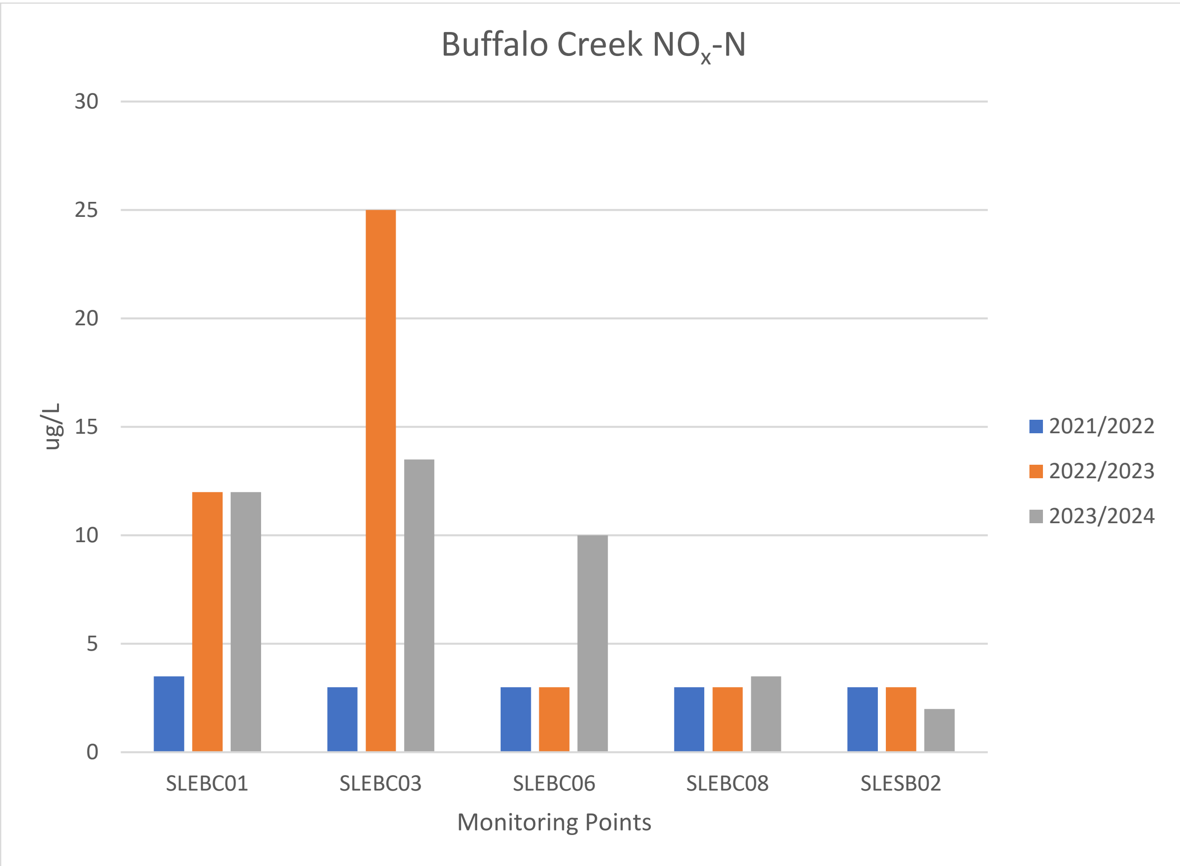

Figure 11. Buffalo Creek (NO_x-N) (Median).

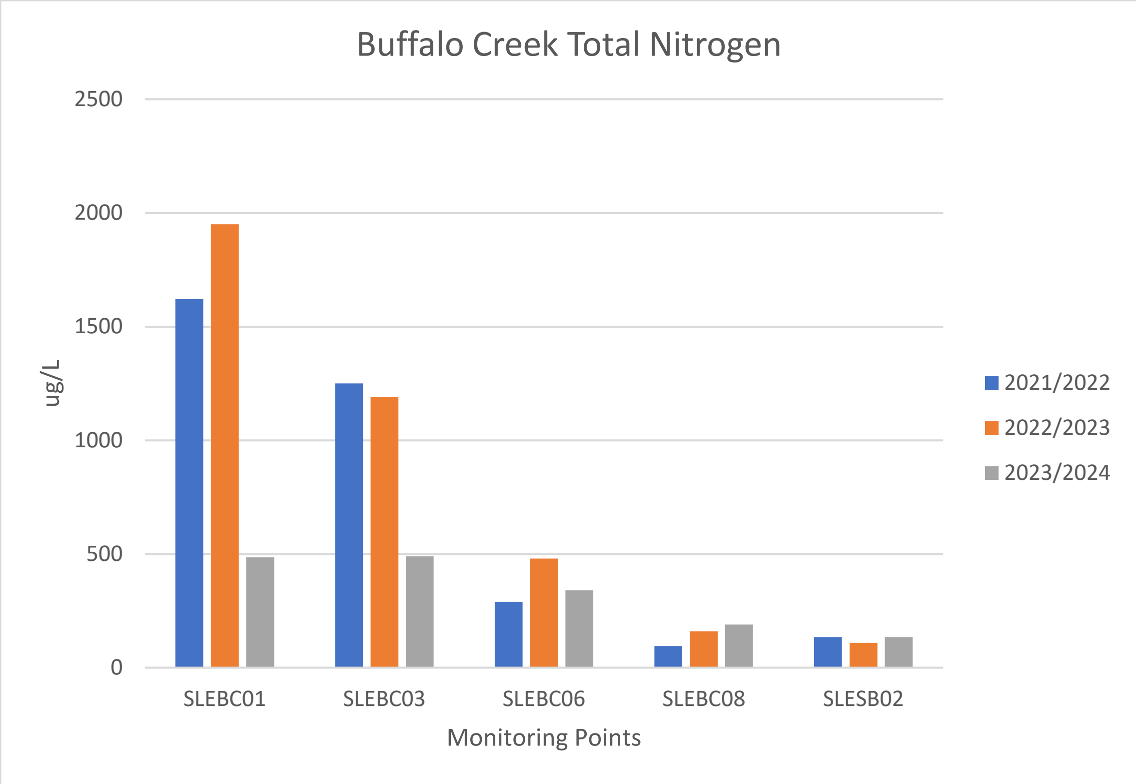

Figure 12. Buffalo Creek Total Nitrogen (Median).

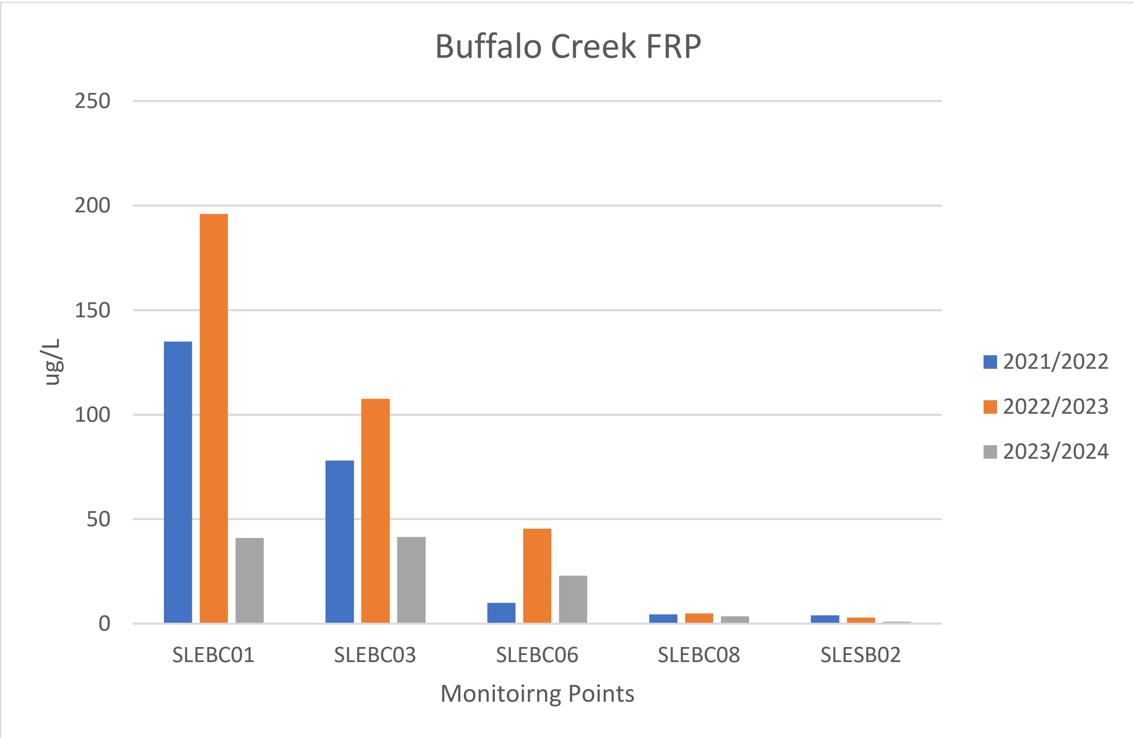

Figure 13. Buffalo Creek Filterable Reactive Phosphorus (Median).

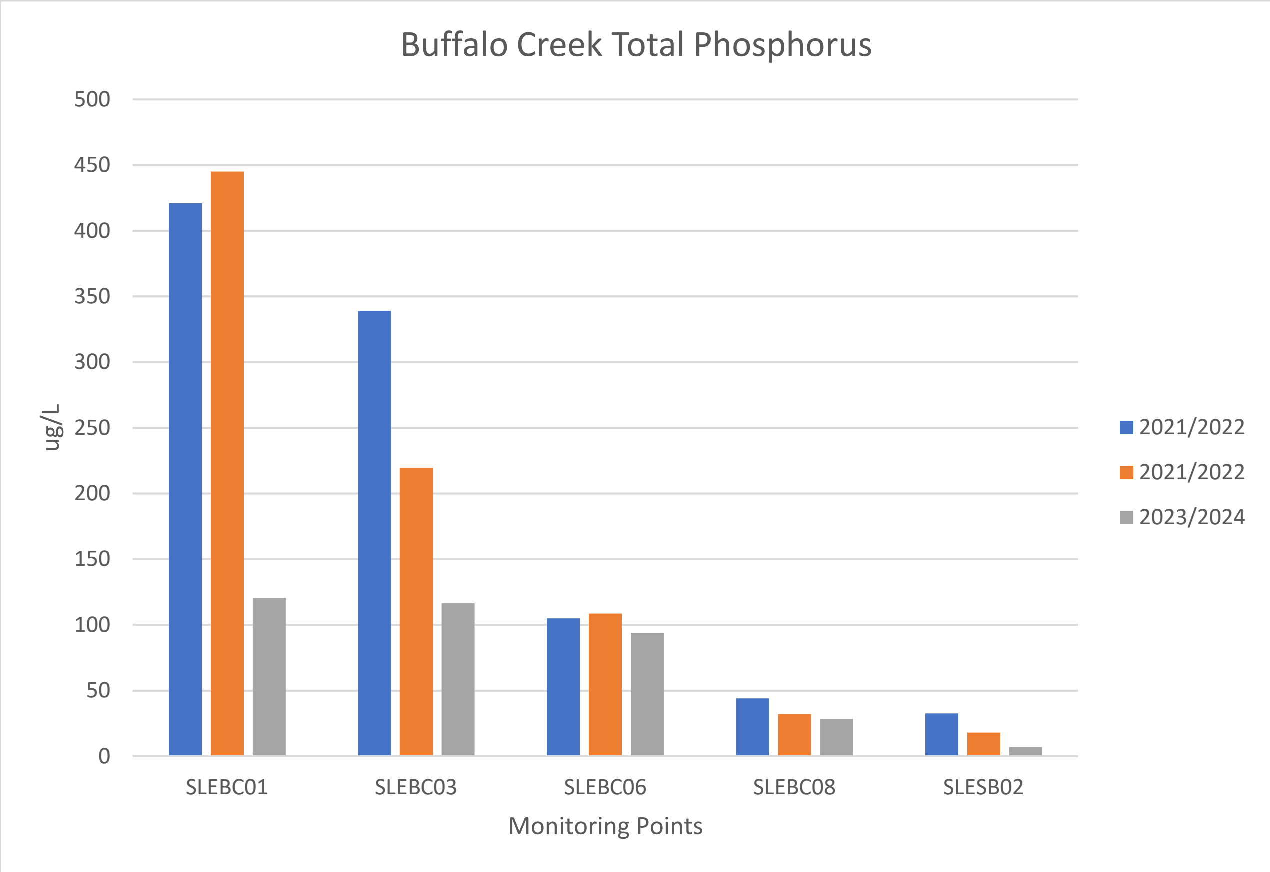

Figure 14. Buffalo Creek Total Phosphorus (Median).

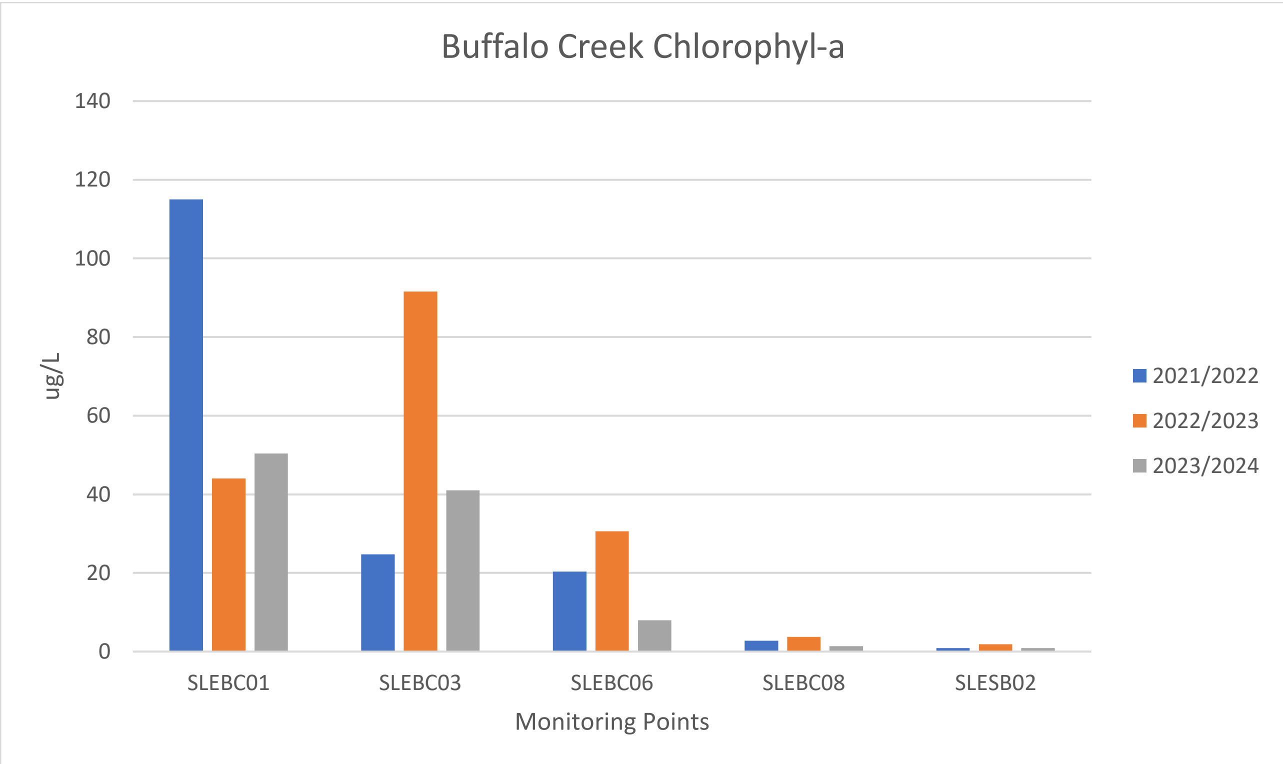

Figure 15. Buffalo Creek Chlorophyll-a (80th Percentile).

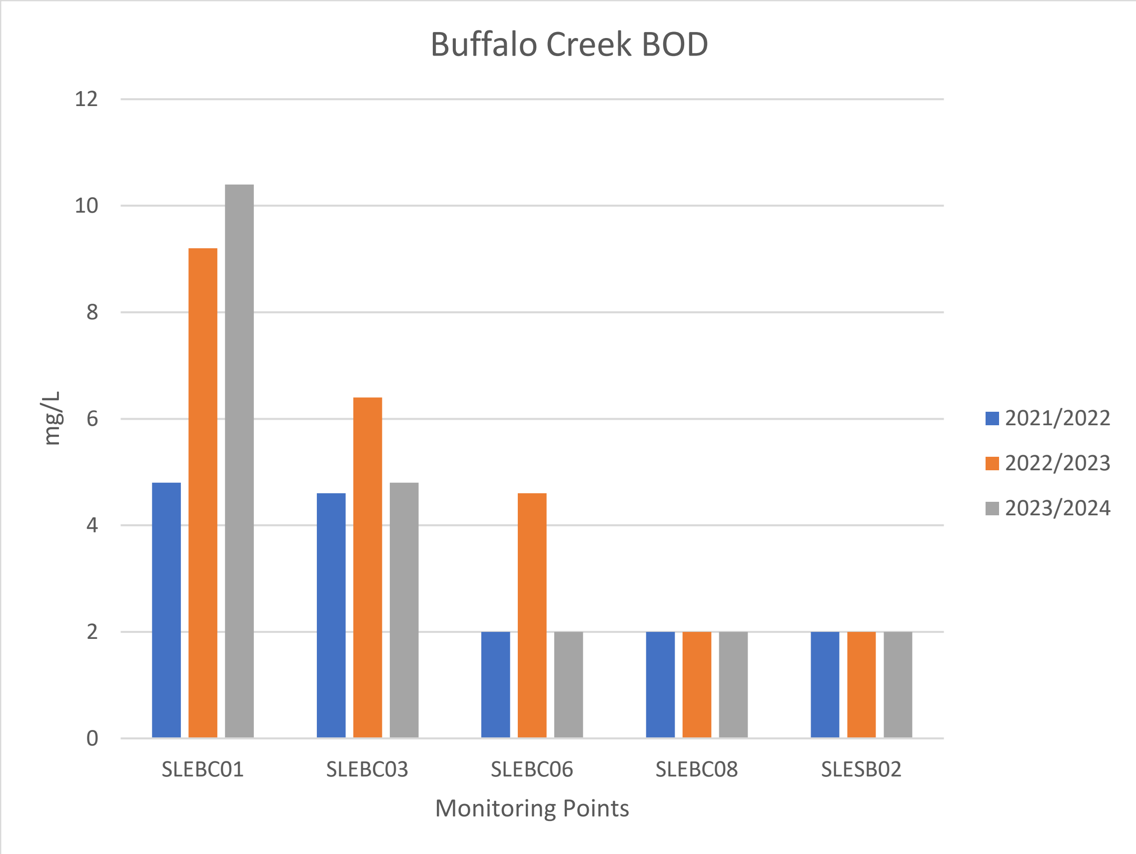

Figure 16. Buffalo Creek Biochemical Oxygen Demand (Median).

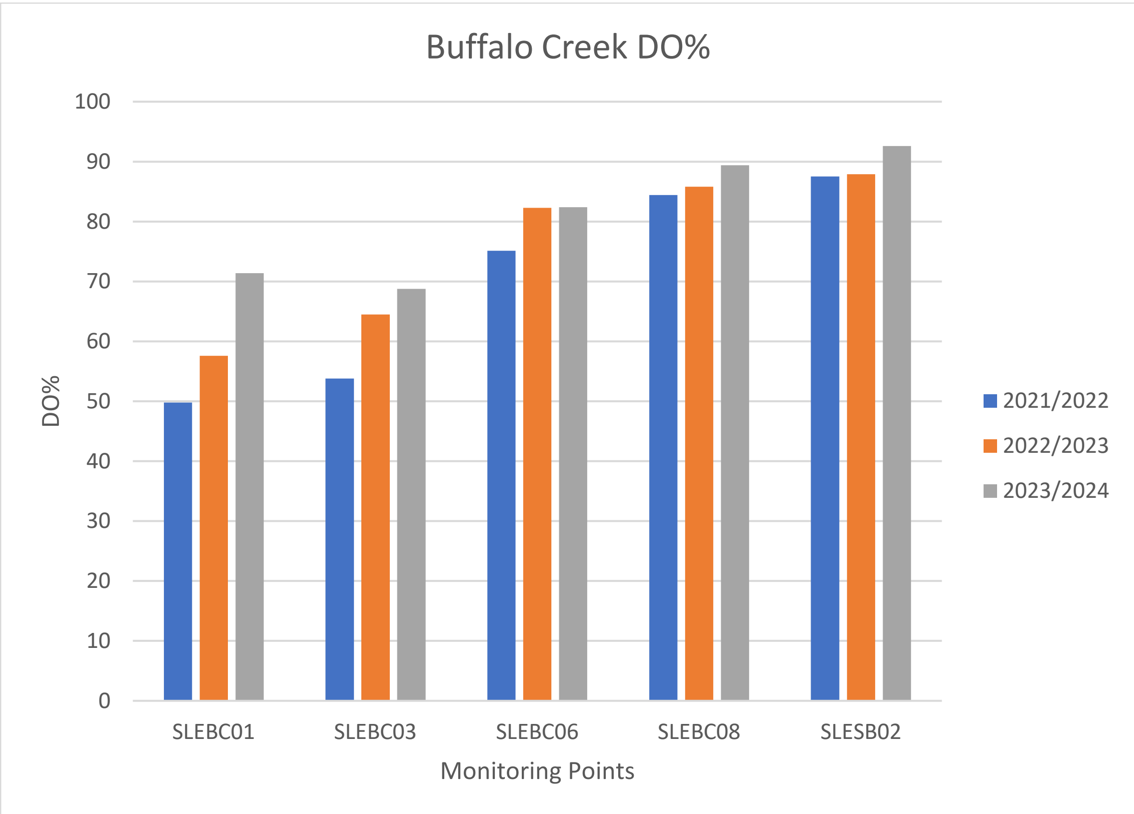

Figure 17. Buffalo Creek Dissolved Oxygen Saturation (Median).

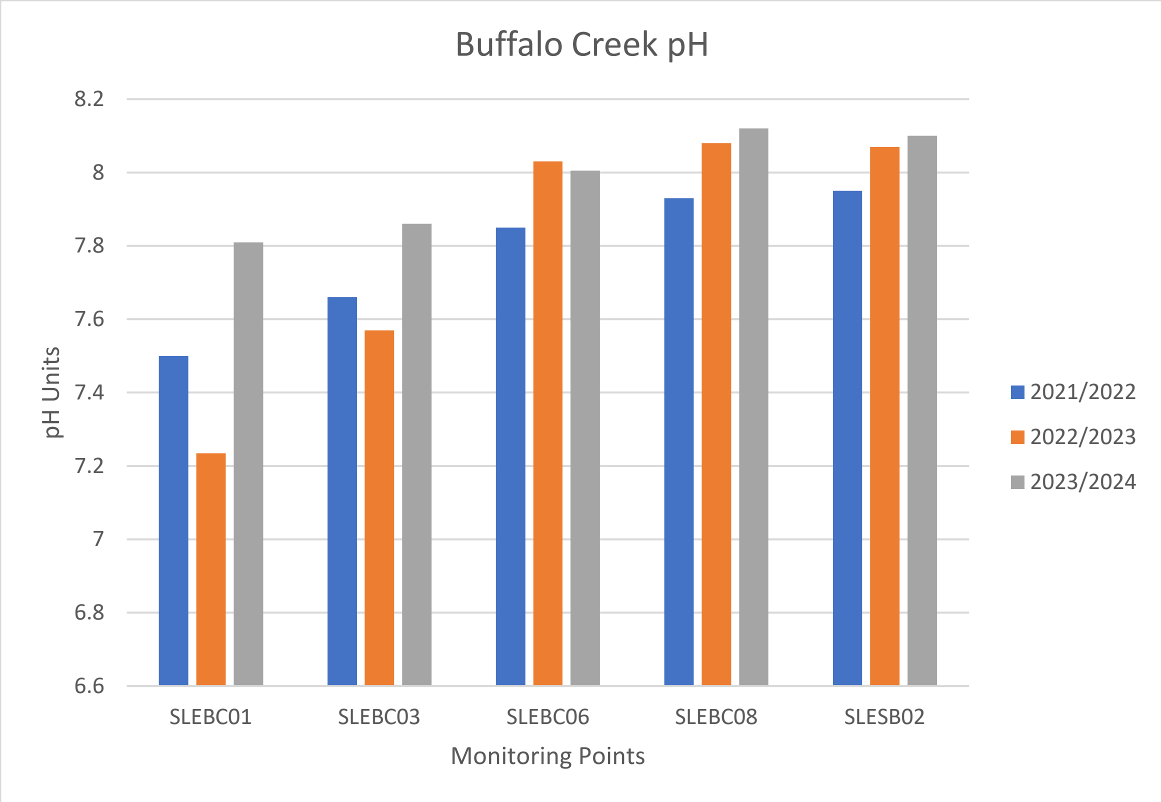

Figure 18. Buffalo Creek pH (Median).

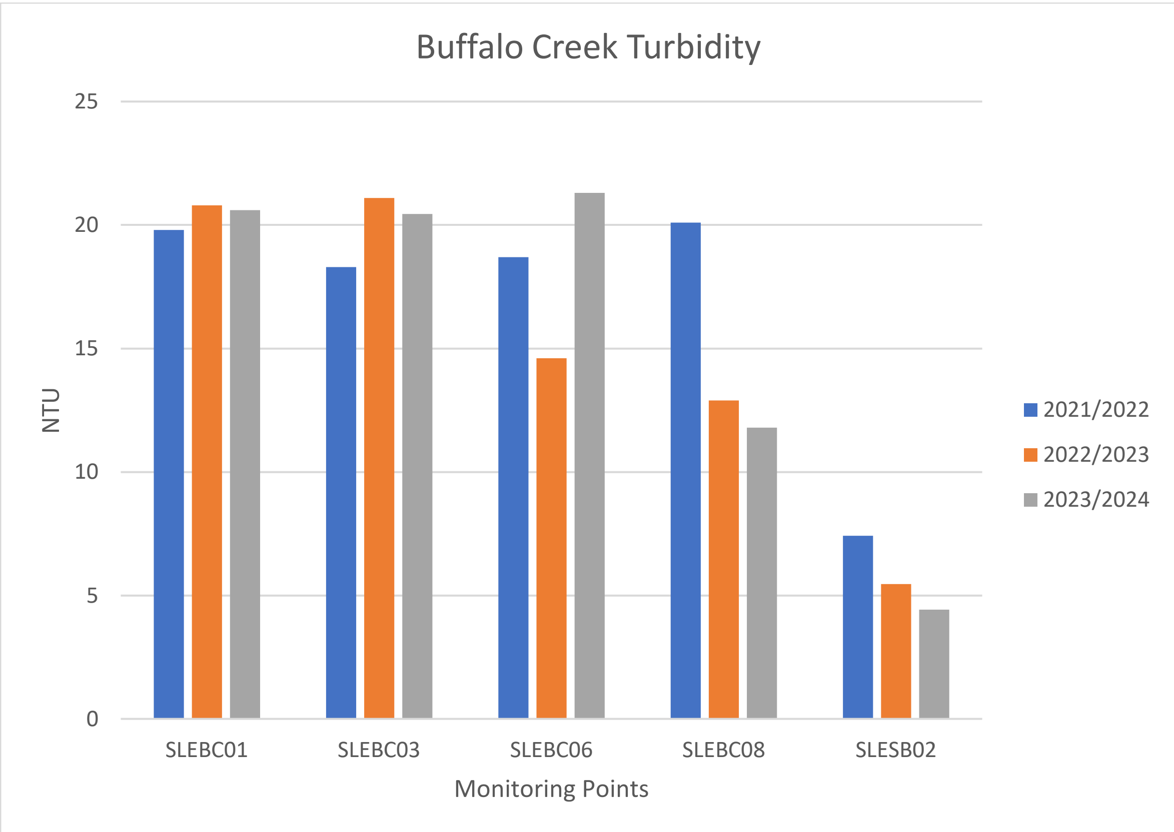

Figure 19. Buffalo Creek Turbidity (Median).

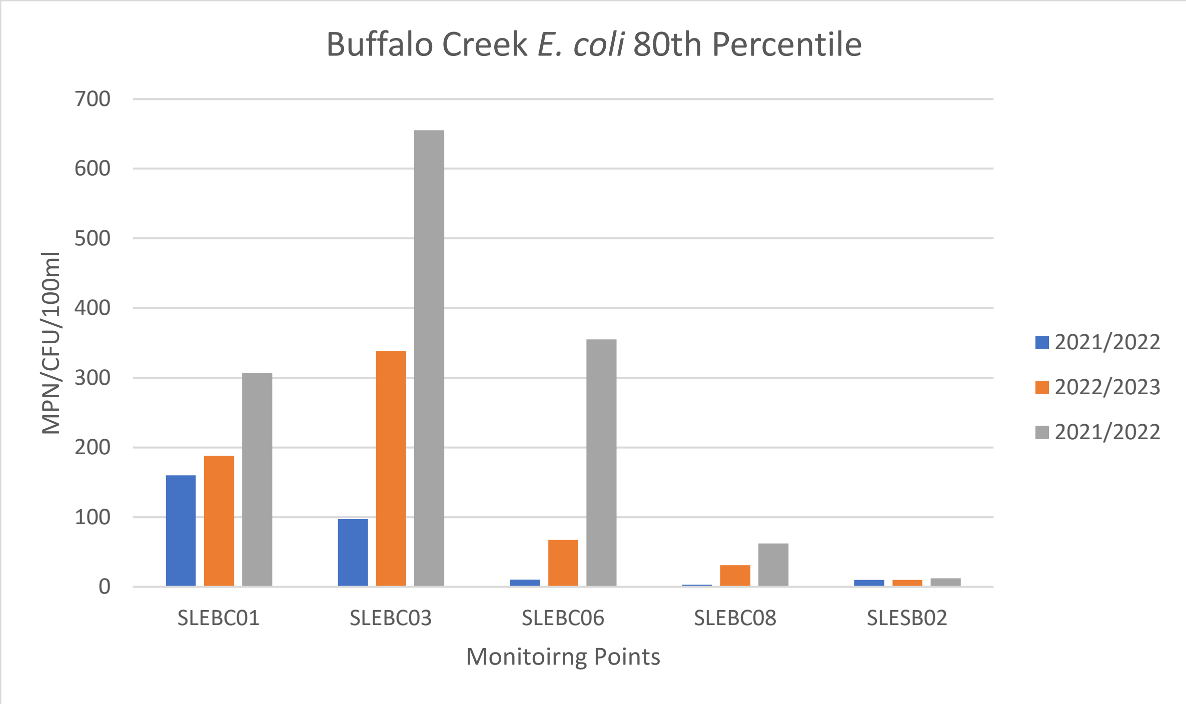

Figure 20. Buffalo Creek E.coli (80th Percentile).

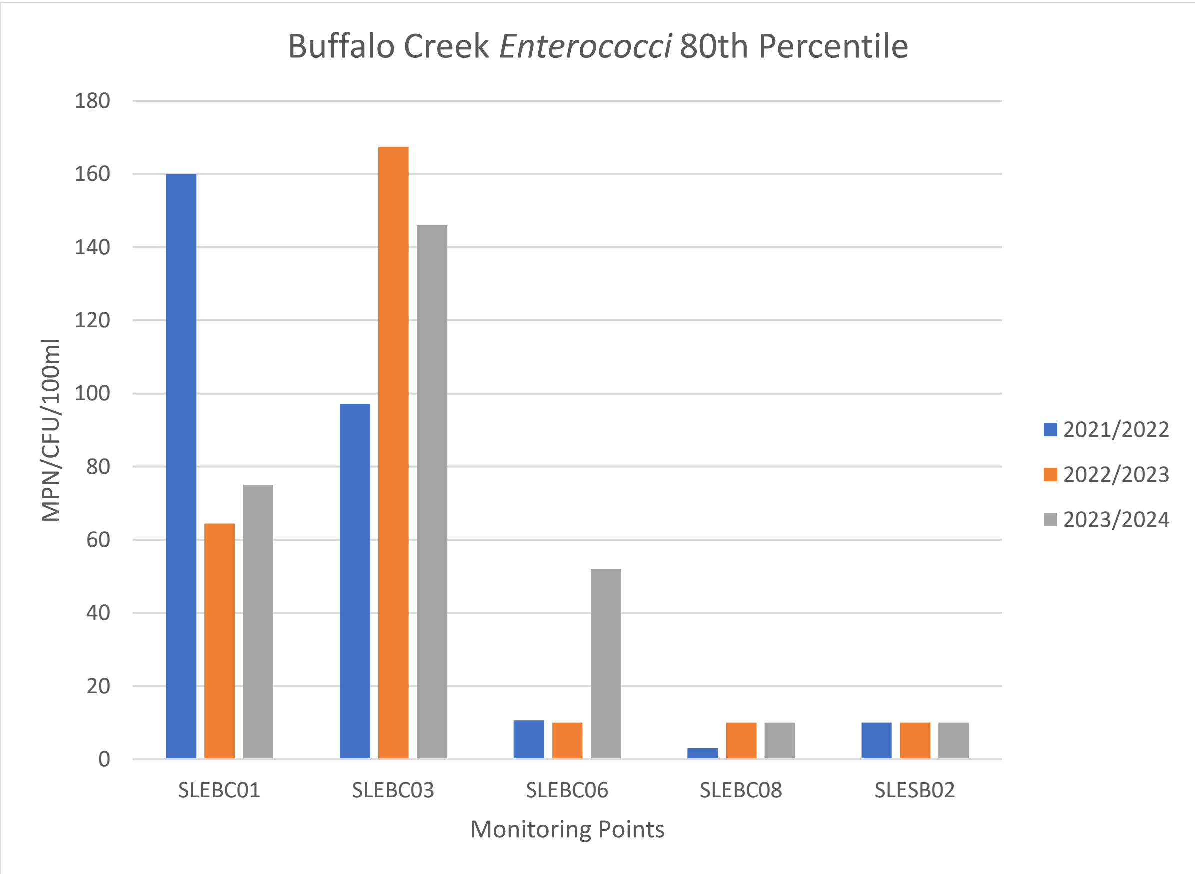

Figure 21. Buffalo Creek Enterococci (80th Percentile).

Appendix 2 - Event Based Assessment Table

	Minimum pH (field) (pH units)			
Site Code	SLEBC03	SLEBC06	SLEBC08	SLESB02
SSTV	<6			
2023/2024	7.33	7.74	7.91	7.65

	Maximum pH (field) (pH units)			
Site Code	SLEBC03	SLEBC06	SLEBC08	SLESB02
SSTV	> 8.5			
2023/2024	8.1	8.15	8.2	8.16

	Minimum Dissolved Oxygen (DO) - field (%sat)			
Site Code	SLEBC03	SLEBC06	SLEBC08	SLESB02
SSTV	<30	<50	<75	
2023/2024	18.1*	45.7*	77.9	86.2

	Maximum Ammonia Nitrogen (NH3-N) (µg/L)		
Site Code	SLEBC06	SLEBC08	SLESB02
SSTV	>1200	>910	
2023/2024	263	21	15

	Maximum Enterococci (MPN/CFU/100 mL)		
Site Code	SLEBC06	SLEBC08	SLESB02
SSTV	>200	>50	
2023/2024	63	10	10

	Maximum Copper - Soluble (ug/L)		
Site Code	SLEBC06	SLEBC08	SLESB02
SSTV	>3	>1.3	
2023/2024	1	1	1

	Maximum Zinc - Soluble (ug/L)	
Site Code	SLEBC08	SLESB02
SSTV	>8	
2023/2024	5	5

Table 6. Event based assessment tables (- Exceedance/Non-notifiable incident)*

Appendix 3 – Sediment and Porewater Monitoring Results Assessment Table

			Sediments													Porewater								
PWC DHSWMP 2024 - Leanyer/Sanderson WWTP		Analyte	Moisture Content	Aluminium	Copper	Zinc	Al normalisation of Total Copper	Al normalisation of Total Zinc	Nitrite + Nitrate as N (Sol.)	Total Phosphorus as P	Total Organic Carbon	C:N Ratios	Chlorophyll *a* mg/kg (dry weight)	Pheophytin *a* mg/kg (dry weight)	Ratios to Pheophytin-a	pH Value		Copper		Zinc	Ammonia as N	Ammonia as N - pH adjusted ANZG 2018 SMD Trigger Valuesa	Total Nitrogen as N	Total Phosphorus as P
		Unit	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%					pH Unit		µg/L		µg/L	mg/L	mg/L	mg/L	
		LOR	1.0	50	1.0	1.0			0.1	2	0.02					0.01		1		5	0.01	0.1	0.01	
Sample Date:	**Client sample ID (1st):**																							
Buffalo Creek																								
22/05/2024	SLEBC01		64.5	24600	18.5	58.7	0.00075	0.0024	2.1	723	3.15	16.29	1.2900	9.5500	0.1351	7.65	<	1.0	<	5.0	5.20	**0.13**	6.30	1.83
22/05/2024	SLEBC03		67.2	21200	16.6	55	0.00078	0.0026	3.4	934	3.02	16.29	2.6000	12.8100	0.2030	7.52	<	1.0	<	5.0	4.63	0.08	6.40	0.61
22/05/2024	SLEBC04		49.8	14500	8.3	29.3	0.00057	0.0020	1.2	527	1.77	25.29	1.0500	5.4900	0.1913	7.46	<	1.0	<	5.0	9.04	0.14	12.00	1.32
22/05/2024	SLEBC05		54.7	15300	7.7	28.3	0.00050	0.0018	0.3	415	1.31	21.83	0.4900	3.7200	0.1317	7.78	<	1.0	<	5.0	5.14	0.17	5.20	1.95
22/05/2024	SLEBC06		40.6	11900	3.8	20.3	0.00032	0.0017	0.2	361	1.01	31.56	0.1500	0.7800	0.1923	7.60	<	1.0	<	5.0	1.86	0.04	2.30	0.10
22/05/2024	SLEBC08		48.2	8000	2.6	15.1	0.00033	0.0019	0.5	500	0.52	11.47	0.2400	2.5700	0.0934	7.62	<	1.0	<	5.0	0.49	0.01	1.20	0.11
22/05/2024	SLEBC08/TRIPLICATE 1A		42.2	7960	3.3	17	0.00041	0.0021	0.8	495	0.54	12.09	0.4400	1.6200	0.2716	7.57	<	1.0	<	5.0	1.46	0.0299	2.40	0.13
22/05/2024	SLEBC08/TRIPLICATE 1B		43.1	6990	2.4	15.5	0.00034	0.0022	0.3	395	0.48	9.73	0.1500	0.7100	0.2113	7.65		2.0		6.0	0.99	0.0243	1.30	0.07
22/05/2024	SLEBC01/TRIPLICATE 2A		65.8	21200	15.8	52.3	0.00075	0.0025	3.8	1040	3.16	18.96	5.6700	19.0900	0.2970	7.45		3.0		10.0	6.25	0.0975	8.20	0.58
22/05/2024	SLEBC01/TRIPLICATE 2B		62.8	17300	15.6	48.4	0.00090	0.0028	2.3	841	2.95	20.30	9.9300	27.9200	0.3557	7.51	<	1.0	<	5.0	6.53	0.1167	9.60	1.57
Kings Creek																								
20/05/2024	SLEKC01		46.1	7320	2.4	13.3	0.00033	0.0018	0.5	356	0.72	23.48	0.9500	2.5500	0.3725	7.86	<	1.0	<	5.0	2.86	0.11	4.00	0.08
20/05/2024	SLEKC02		48.0	10700	3.2	17.1	0.00030	0.0016	0.3	330	1.21	22.97	0.4800	1.4800	0.3243	7.86	<	1.0	<	5.0	0.76	0.03	1.80	0.06
20/05/2024	SLEKC03		38.1	4920	1.4	10.7	0.00028	0.0022	0.3	424	0.46	9.58	0.3200	0.6300	0.5079	7.83		1.0	<	5.0	1.70	0.06	2.20	0.05
20/05/2024	SLEKC03/TRIPLICATE 4A		39.5	10800	2.6	15.2	0.00024	0.0014	0.3	410	0.49	22.97	0.0800	1.0300	0.0777	8.01	<	1.0	<	5.0	0.72	0.04	1.10	0.04
20/05/2024	SLEKC03/TRIPLICATE 4B		38.6	4640	1.4	10.2	0.00030	0.0022	0.3	308	0.39	13.30	0.3700	0.6700	0.5522	7.89	<	1.0	<	5.0	1.17	0.05	2.10	0.05
Michetts Creek																								
21/05/2024	SLEMC01		52.8	16600	5.4	24	0.00033	0.0014	0.6	508	1	14.85	1.1100	4.7700	0.2327	7.78	<	1.0	<	5.0	0.53	0.0174	1.00	0.04
21/05/2024	SLEMC02		49.1	11100	2.9	17.2	0.00026	0.0015	0.3	482	1.09	15.57	0.5600	1.6100	0.3478	7.87	<	1.0	<	5.0	0.63	0.0252	1.50	0.05
21/05/2024	SLEMC03		53.4	9010	2.8	14.4	0.00031	0.0016	0.4	461	0.67	12.11	0.4000	1.3800	0.2899	7.84	<	1.0	<	5.0	0.72	0.0270	1.80	0.10
21/05/2024	SLEMC03/TRIPLICATE 3A		32.6	6330	1	6.5	0.00016	0.0010	0.2	500	0.6	31.03	0.3200	1.0700	0.2991	7.80	<	1.0	<	5.0	1.05	0.0360	2.20	0.06
21/05/2024	SLEMC03/TRIPLICATE 3B		33.3	8140	2.2	12.2	0.00027	0.0015	0.2	434	0.35	18.10	0.3200	0.9100	0.3516	7.85	<	1.0	<	5.0	0.95	0.0364	1.60	0.07
					Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile			Reference Site 2 x 80th Percentile							Reference Site 2 x 80th Percentile		
					5.9200	34.2400	0.0006	0.0038	0.8	971.2000	2.0360	46.1508			0.7993							0.1032		
					DGV	DGV																		
					65	200																		
					GV-High	GV-High																		
					270	410																		

Above reference site
Above DGV (Default Guideline Values)
Above GV-High (Guideline Vaule High)
https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants

Table 7. Sediment and Porewater Monitoring Results Assessment Table.

Appendix 4 – Tabulation of Monitoring Results

POWER AND WATER CORPORATION WDL Monitoring Report – Leanyer Sanderson WWTP		
Leanyer Sanderson WDL Summary Data Sheet	All samples collected are in accordance with the conditions of the WDL's. Data is extracted from the PWC water quality database for assessment and filed on the PWC records management system. A tabulated summary of all year's wastewater monitoring data for Leanyer Sanderson WDL is completed and provided as Appendix 3, attached as an Excel file format to the submission of this annual monitoring report.	Internal document number D2024/329109

Table 8. Tabulation of monitoring results.

References

APHA. (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). American Public Health Association, American Water Works Association, Water Environment Federation. ISBN 978-0875532875.

ANZECC & ARMCANZ. (2000). *Australian and New Zealand guidelines for fresh and marine water quality*. National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT. Retrieved from https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants

Australian Government Department of Agriculture, Water and the Environment. (2018). *ANZG 2018 SMD Trigger Values*. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Retrieved from https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants

Australian Government Department of Agriculture, Water and the Environment. (2023). *Guideline Values for Sediment Quality*. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Retrieved from https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants

Cambridge University Press & Assessment. (n.d.). *Estuarine Deposited Sediments: Sampling and Analysis*. In *Estuarine and Coastal Hydrography and Sediment Transport*. Retrieved from Cambridge University Press.

Chapman, D. (Ed.). (1996). *Water Quality Assessments: A Guide to the Use of Biota, Sediments, and Water in Environmental Monitoring* (2nd ed.). United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), and United Nations Environment Programme (UNEP). ISBN 978-0419215905.

National Environment Protection Council (NEPC). (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013*. Retrieved from https://www.nepc.gov.au/resource/national-environment-protection-assessment-site-contamination-measure-1999-amended-2013

Northern Territory Environmental Protection Authority (NT EPA). (2021). *Waste Discharge Licence (WDL) 147 – Leanyer Sanderson Wastewater Treatment Plant*. Retrieved from https://ntepa.nt.gov.au/__data/assets/pdf_file/0017/901533/wdl147.pdf

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