Palmerston WwTP WDL 148 Monitoring Report

2022

PowerWater

Contents

Executive Summary

This report summarises the monitoring results and analysis of sampling undertaken in accordance with Waste Discharge Licence 148-08 and fulfils the reporting requirements to the Department of Environment, Parks and Water Security under WDL 148-08 for the period of October 2021 – August 2022.

Analysis of Palmerston WWTP effluent and receiving water monitoring data indicates the following:

- Surface water parameters at all monitoring sites met the physico-chemical trigger values required for the protection of the Beneficial Uses declared for Darwin Harbour zone of influence (ZOI) and slightly to moderately disturbed (SMD) ecosystems with the exception of two exceedances of Dissolved Oxygen at SPAMY05 and SPAMY07.
- Some surface water monitoring sites exceeded total phosphorus, a secondary nutrient indicator, objectives; however, none of the sites exceeded the primary indicator chlorophyll-a.
- Pathogen indicator levels were found to be in exceedance of declared Beneficial Use guideline values and of low to moderate risk at sites SPAMY01 and SPAMY02.
- Sediment monitoring demonstrated that nutrient and toxicant indicators were below trigger values and sediment quality guidelines (SQG) for all parameters at all sites with the exception of slightly elevated chlorophyll-a concentrations at SPAMY01 and Aluminium Normalised Copper concentrations at SPAMY01, SPAMY02 and SPAMY06.
- Surface water analysis at WDL sites indicate little change from previous years. Overall, the ecological health of Myrmidon Creek is considered largely intact with limited - to no indications of secondary responses such as dissolved oxygen suppression; in-situ biomass stimulation; impacts on nutrient cycling and benthic fluxes; or significant accumulation of contaminants.

1 Report Scope

This report presents the results of the October 2021 to August 2022 data collection and assessment required for Waste Discharge Licence (WDL) 148-08 for surface water, sediment and biological monitoring.

This report is prepared in accordance with conditions in WDL 148-08 issued to Power and Water Corporation, pursuant to section 74 of the *Water Act* 1992. WDL 148-08 commenced on 1st November 2021. The licence can be accessed via the NT EPA website through; https://ntepa.nt.gov.au/your-business/public-registers/licences-and-approvals-register/waste-discharge-licences/sewerage/power-and-water-ludmilla

Specific Licence conditions in WDL 148-08 that govern the requirements of this report are:

39 The licensee must complete and provide to the Administering Agency a Monitoring Report, not less than 30 business days prior to the anniversary date of this licence, for each year of this licence, by emailing waste@nt.gov.com.

40 The licensee must ensure that each Monitoring Report:

40.1. is prepared in accordance with the requirements of the NT EPA 'Guideline for Reporting on Environmental Monitoring';

40.2. includes a tabulation of all monitoring data required as a condition of this licence and any additional data used as part of the analysis undertaken in the report, to be submitted in electronic Microsoft Excel format.

40.3. includes long-term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licenced activity over a minimum period of six years (where the data is available);

40.4. Includes an assessment of Surface Water Quality in accordance with Appendix 1, Table 1-3 and sediment quality in accordance with Appendix 2, Table 2-1.

40.5 Reports on the progress of the Palmerston Waste Stabilisation Pond Improvement Plan

40.6 Includes and assessment of environmental impacts from the Activity

40.6 contains a summary of the licence limit (site specific trigger value) exceedances that have occurred during the reporting period

40.7 Reports on the following parameters associated with wastewater discharge:

Total discharge (ML/year)

Total biochemical oxygen demand (tonnes/year)

Total Phosphorus (tonnes/year)

Total Nitrogen (tonnes/year)

2 Monitoring Objectives and Methods

The monitoring conducted in this reporting period including Licence Limits, Site Specific Threshold Values (SSTVs) and site locations is specified in the approved monitoring plans under WDL 148-08 in Appendixes 1, 2, 3, and 4 of the licence. All site maps and other pertinent information can be found in the licence document.

Specific licence conditions related to monitoring in WDL 148-08 include:

25 *The Licensee must conduct water monitoring in accordance with Appendix 1 table 1.1*

26 *The Licensee must conduct sediment monitoring in accordance with Appendix 2, table 2.1*

27 *The licensee must ensure that all samples and field environmental data are representative of the conditions at the time of sampling.*

28 *The licensee must ensure that all samples and field environmental data are collected in accordance with recognised Australian Standards and guidelines (such as AS/NZS 5667, ANZG 2018).*

29 *The licensee must ensure that all monitoring samples are analysed at a laboratory with current NATA accreditation or equivalent, for the parameters to be measured.*

30 *The licensee must for all land based monitoring points specified in this licence*

30.1. Install, maintain and provide appropriate identification signage so that they are easily identifiable at all times; and

30.2. Maintain safe access and egress, as is reasonably practicable

31 *The licensee must ensure any samples collected in accordance with Appendix 1, 2 and 3 of this licence or in connection with the Licenced activity or this licence, are obtained by, or under the supervision of, a qualified sampler*

32 *The licensee must ensure that, for each sample collected in accordance with this licence or in connection with the activity or this licence, the following information must be recorded and retained:*

32.1. the date on which the sample was collected;

32.2. the time at which the sample was collected;

32.3. the location at which the sample was collected;

32.4. the name of the person who collected the sample;

32.5. the chain of custody forms relating to the sample;

32.6. the field measurements (if any) and analytical results relating to the sample; and

32.7. laboratory quality assurance and quality control documentation.

3 Overview of Assessed data

All collected data associated with WDL 148-08 and referred to in this report is contained, summarised and presented in an Excel spreadsheet, stored in Power and Water's document storage system (Content Manager), entitled Palmerston WDL data 2021-2022, with a document reference number D2022/385019. This document contains a detailed analysis and presentation of all collected data and is available on request.

Table 1 below displays a summary of the data assessed in this report.

Table 1: Summary of data assessed in 2021-2022

Data Type	Document Location
Influent and Effluent (Flow)	4.1 Influent and Effluent (Flow) 4.1.2 Mass Loading
Surface water and discharge	4.2.1 Surface Water and Discharge Summary Data

Data Type	Document Location
	4.2.2 Pathogen Analysis 4.2.3 Nutrient Analysis 4.2.4 Physicochemical Analysis 4.2.5 Toxicant Analysis 4.2.6 All Surface Parameters Analysis
Sediment Monitoring	4.3 Sediment

3.3 Assessment criteria

The WDL 148 compliance monitoring assessed results against SSTVs relevant to the protection of the declared Beneficial Uses under the *Water Act* (NT) and the Darwin Harbour Water Quality Objectives (DHWQO) (NRTEAS 2010). These SSTV values have been developed and refined from previous versions of WDL 148 in partnership between the NT EPA and the Power and Water Corporation.

3.3.1 Surface Water

Assessment for the reporting period for each of the parameters is against either a guideline standard or an SSTV as required in Appendixes 1, 2 and 3 of WDL 148-08. The 2021 - 2022 data set was assessed against the DHWQO guidelines for the Outer or Mid Estuary, the ANZG 95% level of species protection (ANZG 2018), and for enterococci, the NHMRC (2008) Guidelines for Recreational Water.

For this assessment, where percentiles were the required reporting statistic, the most recent 24 monthly results were used to calculate the percentile value. For parameters where percentiles were not the required reporting statistic, medians calculated from the most recent 24 monthly samples were used for assessment. For exceedance reporting, individual spot values were compared to guideline values. For exceedance reporting, for parameters where a percentile was the required reporting statistic, rolling 24 monthly percentiles, or six monthly percentiles where specified in the WDL, were used for assessing compliance.

3.3.2 Sediment

As specified in the WDL sediment monitoring plan, sediment quality was assessed against either Sediment Quality Guideline (SQG) ANZG (2018) values, water quality SSTVs for the relevant zone or against 2 x 80th percentile of reference site data from Short Creek, which was considered an appropriate reference as it is unaffected by waste discharge.

3.3.3 Sampling artefacts

All data assessments should be considered in the context of relevant operational history and other factors that may temporarily influence water quality. A summary is given below:

- Seasonally changing discharge volumes (section 4.1).
- Palmerston Pond 1 offline for desludging– 2012 dry season (May to October);
- Palmerston Pond 1 offline for manhole works – 2013 dry season (July to October);
- Palmerston Pond 2 offline for desludging – 2014 dry season (May – September);
- Palmerston Pond 1 offline briefly for manhole works – 2016 (10 days in October);

- Palmerston Ponds 3 and 4 offline for desludging – 2017 dry season (May – September);
- Palmerston Pond 5 offline for desludging – 2020 dry season (July – October)

Changes like desludging, which take ponds offline can reduce treatment efficacy across the short-term but are important components of ensuring long-term capacity and optimal treatment outcomes.

4 Results and Assessment

4.1 Influent and Effluent (Flow)

Table 2 provides a summary of monthly inflows into Palmerston WwTP and discharges from the WwTP to Myrmidon Creek. Figure 1 displays these flows from 2019 – 2022.

Table 2: Seasonal Inflow and Outflow for July 2021 to June 2022 (Monthly total kL)

Month	Days	Inflow to Palmerston WwTP (KL)	Discharge to Myrmidon Creek (KL)
Jul-21	31	277661	187032
Aug-21	31	390891	211917
Sep-21	30	379811	201208
Oct-21	31	391238	234417
Nov-21	30	379732	235102
Dec-21	31	460473	366091
Jan-22	31	616756	492871
Feb-22	28	416737	402038
Mar-22	31	487240	495903
April-22	30	467429	434421
May-22	31	434130	377566
June-22	30	382880	315394
Totals	365	5084980	3953960
% of Total Inflow			77.8 %
% Change from previous year		+ 4.7%	+7.0%

Month	Days	Inflow to Palmerston WwTP (KL)	Discharge to Myrmidon Creek (KL)
Seasonal Totals			
Wet Season	181	2828369	2426426
% Total		55.6	61.4
Dry Season	185	2256612	1527534
% total		44.4	38.6
WDL Total	365	5084980	3953960

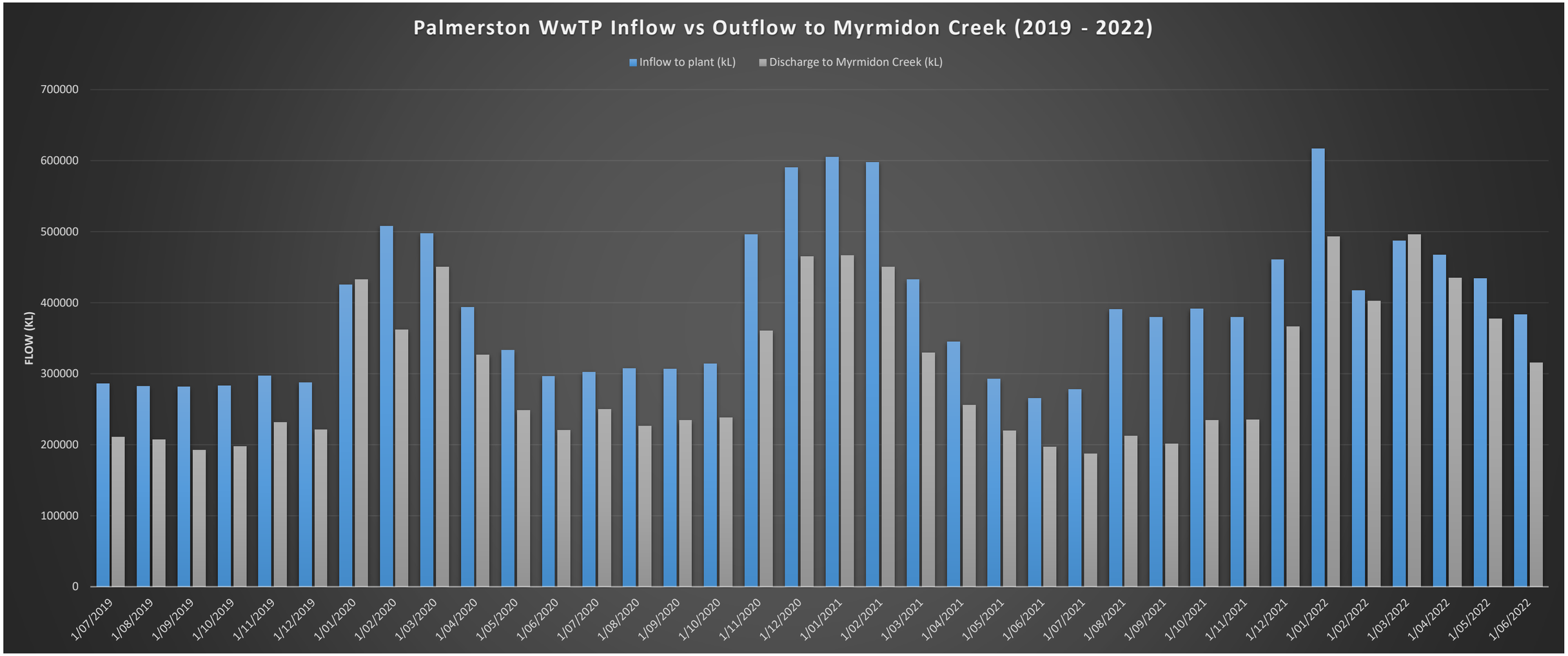

Figure 1: Monthly inflow and outflow at Palmerston Wastewater Treatment Plant 2019 to 2022

4.1.2 Loading

Mass load estimates are provided using data from inflow and discharge points. It should be noted that reported values are subject to uncertainty due to laboratory analysis reporting limits. The method for calculating discharge loads was to multiply the reported analyte concentrations by inflow and discharge volumes. In the event that reported analyte concentrations were below the limits of reporting (LOR), half the LOR value was used for the calculation. Table 3 below presents mass loads for selected parameters for the 2021 – 2022 financial year.

Table 3 Mass loading estimates summary for selected parameters

Parameter	Inflow to Palmerston Ponds (tonnes/y)	Discharge to Myrmidon Creek (tonnes/y)	% Change in creek discharge from previous year	% Removal (this year)	Change in % removal from previous year
BOD	530	132	- 3.76	80.4%	- 2.6%
COD	2,041	690	+ 4.74	74.3%	- 0.03%
NH3-unionised	210	93	+ 3.1	67.3%	+ 0.2%
NH3 Organic	55.24	44.70	+ 2.1	33.3%	+ 0.4%
NOX	0.33	0.21	0	45.8%	- 10.4%
TN	266	137	+ 2.2	60.4%	+12.4%
FRP	23	5	+ 47.9	88.5%	+1.5%
TP	34	21	+6.8	52.1%	+10.3%

Table 3 confirms that the treatment at Palmerston WwTP is reducing the loads of contaminants that would otherwise enter Darwin Harbour by between 33 and 80 percent depending on the contaminant type. The load of contaminants entering Ludmilla Creek has increased slightly for most parameters between 2020/21 and 2021/22. This is related to the higher inflow (+4.7%) into the plant and discharge (+7%) volumes, discharged from the plant to Myrmidon Creek during the year. Treatment efficiency (% Removal) remains steady for most parameters from the previous year.

4.2 Surface Water and Discharge

4.2.1 Surface water and discharge summary data analysis

All data was collected at the frequencies defined in the Surface Water and Discharge Monitoring schedule of the WDL 148-08. The QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) were met for water quality monitoring (ANZG 2018).

Table 4 below, includes a summary of the monitoring data for each site. Table 5 characterises the risk associated with each monitoring parameter using hazard ratios based on relevant trigger values. All surface water, sediment and sediment pore water data for the 2021/22 reporting period is located in Appendix A.

Table 4: Surface water and discharge monitoring data assessment.

Water Quality Monitoring Assessment: Palmerston WwTP Discharge and Receiving Waters - Myrmodon Creek - Comparison against Guidelines to 3/8/22																			
Indicator type	Pathogen indicators			Physico-chemical indicators						Nutrient Indicators						Toxicant Indicators		
parameter	*E. coli*		Enterococci	pH	EC	DO		Turbidity	TSS	BOD	Chl-a	FRP	TP	NH3-N	TN	NOx	NH3-N	Cu (D)	Zn (D)
Unit	cfu/100 mL			pH units	µS/cm	% sat		Ntu	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L
DHWQO	14	43	50	7.0 - 8.5[1]		80	100						0.02	0.02	0.27	0.17	0.91	Natural estuary range	Natural estuary range 0.39-3.8
SMD							110				2	0.01	0.03		0.3	0.02		0.06-1.3	
ZOI				6.5 - 8.5[2]		50	110				4						1.2		
ANZECC level of species protection	**Not applicable**		**40 (NHMRC)**	**7.0 – 8.5**		**80-**	**120**			**<2[3]**	**2**	**0.005**	**0.02**	**0.015**	**0.25**	**0.03**	**0.91**	**1.3 – SMD**	**15**
																		3.0 - D	
																		8.0- HD	
Assessment criteria	Aquatic food: [h]		Primary Contact Rec[n]	50th	50th	Low	High	50th	50th	95th	50th	50th	50th	50th	50th	50th	95th	95th	95th
percentile	50[t]	90[t]	95th			20th	80th												
Trigger Values, Section 8 of ANZG 2018 Guidelines for Fresh and Marine Waters.																			
Colour code: (Green) - Meets National and Darwin Harbour Water Quality Objectives (DHWQO) ≤ guideline; (Orange) exceeds DHWQO, Exceeds national (ANZECC/NHMRC) trigger or control stat exceeded; (red) exceeds all objectives and disturbed (D) triggers by 3x.																			
Assessment - No SSTV's for this site. Discharge effluent within the treatment plant. Discharges to Myrmidon Creek																			
SPAMYDP	275	705	74000	7.55	558	8.72	37.78	155.50	91.50	65.15	275.00	1.82	6.01	27.00	34.53	0.02	1.05	0.021	0.011
Assessment against SSTVs: ZOI within Darwin Harbour receiving waters - Myrmidon Creek																			
SPAMY01	57	310	2348	7.70	51000	63.12	83.42	8.86	4.00	2	6.79	0.005	0.135	0.068	0.76	0.012	0.005	0.001	0.003
SPAMY03	18	66	39	7.80	52100	71.16	85.7	6.32	1.00	2	2.18	0.004	0.043	0.005	0.08	0.003	0.005	0.001	0.003
Assessment against SSTVs: SMD Catchment Inflow to Darwin Harbour receiving waters: via Myrmidon Creek																			
SPAMY05	6	27	13	7.80	52150	68.84	87.38	7.03	1.00	2	1.85	0.003	0.036	0.005	0.08	0.003	0.005	0.001	0.003
SPAMY06	3	9	4	7.80	52050	77.1	89.96	4.96	1.00	2	1.73	0.003	0.031	0.005	0.08	0.003	0.005	0.001	0.003
SPAMY07	4	15	8	7.70	51300	66.02	80.64	5.48	2.00	2	2.71	0.003	0.038	0.005	0.08	0.003	0.005	0.001	0.003

Table 5: Risk characterisation of monitoring data

Water Quality Monitoring Assessment: Palmerston WwTP Discharge and Receiving Waters - Myrmidon Creek - Comparison against Guidelines to 3/8/22																			
Indicator type	Pathogen indicators			Physico-chemical indicators						Nutrient Indicators						Toxicant Indicators		
parameter	*E. coli*		Enterococci	pH	EC	DO		Turbidity	TSS	BOD	Chl-a	FRP	TP	NH3-N	TN	NOx	NH3-N	Cu (D)	Zn (D)
Unit	cfu/100 mL			pH units	µS/cm	% sat		Ntu	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L
DHWQO	14	43	50	7.0 - 8.5[1]		80	100						0.02	0.02	0.27	0.17	0.91	Natural estuary range	Natural estuary range 0.39-3.8
SMD							110				2	0.01	0.03		0.3	0.02		0.06-1.3	
ZOI				6.5 - 8.5[2]		50	110				4						1.2		
ANZECC level of species protection	**Not applicable**		**40 (NHMRC)**	**7.0 – 8.5**		**80-**	**120**			**<2[3]**	**2**	**0.005**	**0.02**	**0.015**	**0.25**	**0.03**	**0.91**	**1.3 – SMD**	**15**
																		3.0 - D	
																		8.0- HD	
Assessment criteria	Aquatic food: [h]		Primary Contact Rec[n]	50th	50th	Low	High	50th	50th	95th	50th	50th	50th	50th	50th	50th	95th	95th	95th
percentile	50t	90t	95th			20th	80th												
Discharge point and treated effluent (receiving water quality guidelines is not directly applicable); [3] PER approved treatment plant design criteria, no guideline values for receiving waters <2 is desirable for rivers and marine waters, no guidance available for estuaries due to natural dissolved organic matter availability; [4]ANZECC Low Reliability																			
Trigger Values, Section 8 of ANZECC/ARMCANZ Guidelines for Fresh and Marine Waters.																			
Colour code: (Green) - Meets National and Darwin Harbour Water Quality Objectives (DHWQO) ≤ guideline; (Orange) exceeds DHWQO, Exceeds national (ANZECC/NHMRC) trigger or control stat exceeded; (red) exceeds all objectives and disturbed (D) triggers by 3x.																			
Assessment - No SSTV's for this site. Discharge effluent within the treatment plant. Discharges to Myrmidon Creek																			
SPAMYDP	275	705	74000	7.55	558	8.72	37.78	155.50	91.50	65.15	275.00	1.82	6.01	27.00	34.53	0.02	1.05	0.021	0.011
Assessment against SSTVs: ZOI within Darwin Harbour receiving waters - Myrmidon Creek																			
SPAMY01	57	310	2348	7.70	51000	63.12	83.42	8.86	4.00	2	6.79	0.005	0.135	0.068	0.76	0.012	0.005	0.001	0.003
SPAMY03	18	66	39	7.80	52100	71.16	85.7	6.32	1.00	2	2.18	0.004	0.043	0.005	0.08	0.003	0.005	0.001	0.003
Assessment against SSTVs: SMD Catchment Inflow to Darwin Harbour receiving waters: via Myrmidon Creek																			
SPAMY05	6	27	13	7.80	52150	68.84	87.38	7.03	1.00	2	1.85	0.003	0.036	0.005	0.08	0.003	0.005	0.001	0.003
SPAMY06	3	9	4	7.80	52050	77.1	89.96	4.96	1.00	2	1.73	0.003	0.031	0.005	0.08	0.003	0.005	0.001	0.003
SPAMY07	4	15	8	7.70	51300	66.02	80.64	5.48	2.00	2	2.71	0.003	0.038	0.005	0.08	0.003	0.005	0.001	0.003

4.2.2 Pathogens Analysis

Site SPAMY01, in close proximity to the discharge, displays elevated levels of enterococci that would be considered high risk to the recreational declared beneficial use of Darwin Harbour. But this site is not used by the community for recreational purposes and as such there is no risk of human exposure through recreational activities. At SPAMY02, the next closest monitoring site, enterococci concentrations return to within guideline values and SSTV's. At both SPAMY01 and SPAMY02, e-coli is present at levels that present a moderate risk to the aquatic foods declared beneficial use for Darwin Harbour. In January 2017, Power and Water Corporation installed warning signage within Myrmidon Creek to advise of the location of the discharge and to warn the public regarding potential risks to aquatic food safety.

At the remaining downstream sites, further from the discharge, pathogen concentrations are within both DHWQO guideline values and SSTV's.

4.2.3 Nutrient Analysis

No exceedances of guideline values at sites were recorded for any nutrient parameters in the assessment period. While some total phosphorus (TP) values and Total Nitrogen (TN) values are greater than SSTV values, the corresponding Chlorophyll-a values were below the SSTV value, hence those TP values are not considered to be exceedances. Chlorophyll-a is considered the primary indicator of the environmental effect of nutrient loads providing a measure of algal abundance and eutrophication. Chlorophyll-a concentrations, while not exceeding the SSTV values, are slightly elevated at some sights, exceeding the DHWQO guideline values. This indicates the potential for eutrophication although the risk remains low.

The risk of the nutrient component of the discharge adversely impacting the environment is considered to be low.

4.2.4 Physicochemical Analysis

There were two exceedances of Dissolved Oxygen (DO) SSTV's during the reporting period both occurring on the 9/3/2022. SPAMY05 displayed DO levels of 64.1 and DO levels at SPAMY07 were recorded as 64.1, both slightly below the SSTV of 65. These levels returned to within SSTV limits on the next sample run. There were no other exceedances of Physicochemical parameters during the reporting period. The risk to the receiving environment from the discharge for these parameters is considered low.

4.2.5 Toxicant Analysis

No exceedances of toxicant parameters were identified during the reporting period. Toxicant concentrations were below guideline values for all sites with the exception of the discharge which slightly exceeded the DHWQO value for unionised ammonia. Toxicant parameters in the discharge are considered to pose a low risk of adverse impacts to the receiving environment.

4.2.6 All Surface Water Parameters Analysis

The results indicated that the effluent discharged from Palmerston Ponds to Myrmidon Creek posed a low risk to the declared Beneficial Uses of the receiving waters including Darwin Harbour and Myrmidon Creek.

4.3 Sediment

4.3.1 Sediment Summary Analysis

All data was collected at the frequencies defined in the sediment monitoring schedule of WDL 148-08. The QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) as described in ANZG (2018) were met for sediment monitoring. Table 6 below provides values for the sediment data collected in the 2022 dry season.

Table 6: Sediment and Pore Water Assessment

2022	Sediment												Pore Water					
Indicator type	Nutrient Indicators						Toxicant Indicators						Nutrient Indicators			Toxicant Indicators		
Parameter	Chl-a	Chl-a : Phaeophytin	TP	TN	TOC	TN : TOC	Cu (D)	Bioavailable Cu	Al Normalised Cu	Zn (D)	Bioavailable Zn	Al Normalised Zn	TP	FRP	TN	NH3 unionised	Cu (D)	Zn (D)
Unit	mg/kg	none	mg/kg	mg/kg	mg/kg	none	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SQG Lower							65	65		210	210						65	210
SQG Upper							270	270		400	400						270	400
ANZG (2018) SMD							1.3			15							1.3	15
ANZG (2018) ZOI							3			15							3	15
Assessment criteria	> 2 x Reference site 80th Percentile	<1 OR >1	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile		<1 OR >1	SQG	SQG	> 2 x Reference site 80th Percentile	SQG	SQG	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	> 2 x Reference site 80th Percentile	SQG	> 2 x Reference site 80th Percentile
> 2 x Reference site 80th Percentile	12.52	1	1039.6	3572	74520	1	270	270	10.48	400	400	37.36	0.632	0.04	8.96	6.26	0.002	0.01
Impact zone - ZOI																		
SLPAMY01	13.1	1.8	694	2510	37000	0.07	16.8	6.1	12.4	38.7	17.9	28.5	0.23	0.01	6.4	5.51	0.001	0.005
SPAMY03	4.21	1.79	480	1940	28700	0.07	10.1	3.3	10.5	29.3	14.1	30.5	0.26	0.01	2.8	2.47	0.001	0.005
SMD SITES																		
SPAMY05	3.44	0.45	644	2560	26400	0.10	12.1	3.1	8.1	37.9	14.6	25.3	0.16	0.02	3.8	3.66	0.001	0.005
SPAMY06	2.11	2.34	352	1090	21000	0.05	8.5	1.8	10.9	18.6	8.9	23.9	0.19	0.01	1.2	0.98	0.001	0.005
SPAMY07	3.89	0.6	549	1820	29500	0.06	11.2	5.6	7.6	35.5	17.6	24.1	0.16	0.01	2.1	1.67	0.001	0.005
Short Creek reference siteS where site 01 is most upper estuary in series - Total concentration in sediment (mg/kg) or concentration in sediment porewater (mg/L)																		
SPASC01	6.16	0.86	521	1810	28100	0.06	9.8	4.8	5.00	35.4	16.9	18.00	0.17	0.01	3.4	2.55	0.001	0.005
SPASC02	4.52	0.86	419	1630	29000	0.06	9	4.3	5.20	33.4	15.1	19.40	0.26	0.01	5.5	3.88	0.001	0.005
SPASC03	6.41	1.10	519	1750	33100	0.05	9.4	5.1	5.30	32.5	17	18.20	0.4	0.01	3.8	2.63	0.001	0.005
SPASC04	0.1	0.47	424	1770	43500	0.04	7.1	2.6	4.40	25.8	11.9	16.10	0.22	0.01	2.1	1.48	0.001	0.005

4.3.2 All Sediment and Pore water Parameters Analysis

Compared to the reference sites in Short Creek, there were slightly elevated concentrations of Aluminium normalised copper at SPAMY01, SPAMY03 and SPAMY06. Considering surface water concentrations of copper for the discharge were below the laboratory LOR, this might indicate some accumulation of copper in the sediment proximal to the discharge although the levels are low, below Sediment Quality Guidelines (SQG) and considered low risk.

At SPAMY01, SPAMY03 and SPAMY06, the chlorophyll-a to phaeophytin ratio is slightly higher than 1 but still considered low risk. There appears to be no evidence of eutrophication caused by the discharge in the sediments as chlorophyll-a values remain either below or close to reference creek values. All pore water parameters were within SQG values or reference creek comparator values.

The discharge poses low risk to the sediment quality and benthic infauna of the receiving environment.

5 Exceedance summary

Table 8: Summary of exceedances and non-compliances with the licence during the reporting period

Date	Site	Zone	Parameter	Value	WDL	WDL condition	Reporting Statistic	Exceedance / Non-compliance	Comment / Significance	EPA Notified ?	CM Reference
9/03/2022	SPAMY07	SMD	Dissolved oxygen (field)	56.5	148-08		Individual result	Exceedance	Less than 3x SSTV value, 1st Occasion	No, not required	
9/03/2022	SPAMY05	SMD	Dissolved oxygen (field)	64.1	148-08		Individual result	Exceedance	Less than 3x SSTV value, 1st Occasion	No, not required	

6 Conclusion

This report summarises monitoring and results of sampling undertaken in accordance with WDL 148 - 08 and fulfils the reporting requirements to the DEPaWS under the licence. A detailed summary of all results, from both this and previous years, is contained in a document entitled “Palmerston WDL data” (D2022/385019) and is available on request.

Surface water analysis at WDL sites indicate little change from previous years. Overall, the ecological health of Myrmidon Creek is considered largely intact with limited - to no indications of secondary responses such as dissolved oxygen suppression; in-situ biomass stimulation; impacts on nutrient cycling and benthic fluxes; or significant accumulation of contaminants.

A moderate risk to human exposure was found at SPAMY01 but this site is not a known bathing or swimming site and public warning signs are in place.

Based on chlorophyll-a concentrations, elevated levels of some nutrients at some surface water sites does not appear to be translating to eutrophication.

There were two non-reportable exceedances of DO concentrations below SSTV’s at SPAMY05 and SPAMY07.

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Appendix A – Data

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Lab Sampling		Algae	Bacteriological		Metals				Nutrients and Organics										Physical and General Chemical						Field Sampling		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci- (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
13/10/2021	SPAMYDP	303.0	1,100.0	140.0	0.0208	0.0109	0.694	32.0	< 0.06	3.08	6.44	44.16	26.0	663.0	122.0	22.4	7.7	13/10/2021	SPAMYDP	8.3	171
13/10/2021	SPAMY07	5.35	4.0	5.0	< 0.001	< 0.003	< 0.005	< 0.005	0.003	< 0.003	0.058	0.43	< 2.0	53,800.0	4.0	22.4	7.8	13/10/2021	SPAMY07	76.8	5.05
13/10/2021	SPAMY01	12.2	57.0	36.0	< 0.001	< 0.003	0.006	0.201	0.029	0.004	0.156	1.0	< 2.0	53,500.0	4.0	22.4	7.8	13/10/2021	SPAMY01	66.7	8.11
13/10/2021	SPAMY03	6.69	42.0	23.0	< 0.001	< 0.003	0.009	0.278	0.014	0.004	0.158	1.12	< 2.0	52,500.0	< 1.0	22.4	7.8	13/10/2021	SPAMY03	86.2	3.74
13/10/2021	SPAMY05	2.79	11.0	1.0	< 0.001	< 0.003	< 0.005	< 0.005	0.006	0.004	0.027	0.66	< 2.0	54,100.0	2.0	22.1	7.9	13/10/2021	SPAMY05	83.6	3.39
13/10/2021	SPAMY06	2.09	0.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	0.008	< 0.003	0.025	0.19	< 2.0	54,000.0	1.0	22.1	8.0	13/10/2021	SPAMY06	89	2.67
10/11/2021	SPAMY07	1.86	2.0	3.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.057	0.08	< 2.0	52,900.0	4.0	22.3	7.9	10/11/2021	SPAMY07	69.5	6.04
10/11/2021	SPAMY01	2.08	29.0	97.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.111	0.15	< 2.0	52,700.0	6.0	22.3	7.8	10/11/2021	SPAMY01	71.3	6.68
10/11/2021	SPAMY03	1.65	8.0	12.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.046	0.1	< 2.0	53,500.0	4.0	22.6	7.8	10/11/2021	SPAMY03	73.5	6.83
10/11/2021	SPAMY05	1.77	5.0	5.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.035	0.08	< 2.0	53,500.0	< 1.0	22.6	7.8	10/11/2021	SPAMY05	82.1	6.22
10/11/2021	SPAMY06	1.89	0.0	0.0	< 0.001	< 0.003	< 0.005	0.006	< 0.003	0.005	0.034	0.08	< 2.0	53,200.0	< 1.0	22.7	7.8	10/11/2021	SPAMY06	84.4	5.29
10/11/2021	SPAMYDP	294.0	1,200.0	56,000.0	0.0295	0.0143	0.597	30.8	0.018	3.32	11.7	30.42	35.0	641.0	106.0	22.5	7.6	10/11/2021	SPAMYDP	8.6	164
8/12/2021	SPAMY07	5.56	39.0	8.0	< 0.001	< 0.003	< 0.005	< 0.5	< 0.003	< 0.003	0.038	0.26	< 2.0	52,800.0	< 1.0	22.3	7.8	8/12/2021	SPAMY07	79.8	8.76
8/12/2021	SPAMY01	7.18	57.0	49.0	< 0.001	< 0.003	< 0.005	0.049	0.02	0.006	0.154	1.15	< 2.0	52,100.0	7.0	22.5	7.7	8/12/2021	SPAMY01	72.3	11.9
8/12/2021	SPAMY03	6.21	3.0	7.0	< 0.001	< 0.003	< 0.005	0.007	< 0.003	< 0.003	0.034	0.08	< 2.0	53,000.0	< 1.0	22.5	7.8	8/12/2021	SPAMY03	81	11.5
8/12/2021	SPAMY05	5.53	3.0	7.0	< 0.001	< 0.003	< 0.005	0.008	< 0.003	< 0.003	0.036	0.05	< 2.0	53,000.0	3.0	22.4	7.8	8/12/2021	SPAMY05	77.4	10.9
8/12/2021	SPAMY06	5.63	4.0	3.0	< 0.001	< 0.003	< 0.005	0.007	< 0.003	< 0.003	0.036	0.31	< 2.0	53,000.0	< 1.0	22.5	7.8	8/12/2021	SPAMY06	85.8	8.51
8/12/2021	SPAMYDP	497.0	780.0	74.0	0.0219	0.0071	0.609	28.1	0.024	2.5	7.38	43.22	62.0	581.0	102.0	22.4	7.7	8/12/2021	SPAMYDP	19.2	209
11/01/2022	SPAMYDP	254.0	210.0	6.0	0.0248	0.0242	0.269	18.2	0.021	1.94	3.89	25.22	46.0	452.0	74.0	22.4	7.5	11/01/2022	SPAMYDP	29.9	113
11/01/2022	SPAMY07	5.47	3.0	1.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.074	0.08	4.0	48,700.0	2.0	22.5	7.7	11/01/2022	SPAMY07	66.5	8.78
11/01/2022	SPAMY01	8.06	9.0	10.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.105	0.09	< 2.0	48,100.0	6.0	22.4	7.7	11/01/2022	SPAMY01	82.7	11.6

Lab Sampling		Algae	Bacteriological		Metals			Nutrients and Organics							Physical and General Chemical					Field Sampling		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci- (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
11/01/2022	SPAMY03	2.39	0.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.042	0.08	< 2.0	49,200.0	2.0	22.5	7.9	11/01/2022	SPAMY03	90.6	7.4
11/01/2022	SPAMY05	1.51	0.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.037	0.08	< 2.0	49,500.0	4.0	22.4	7.9	11/01/2022	SPAMY05	95	11.8
11/01/2022	SPAMY06	1.57	1.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.042	0.08	< 2.0	49,500.0	< 1.0	22.4	7.9	9/02/2022	SPAMYDP	94.5	78.7
9/02/2022	SPAMYDP	728.0	2.0	0.0	0.0166	0.0153	0.089	11.1	0.019	1.12	2.36	19.32	32.0	329.0	22.0	22.2	7.2	9/02/2022	SPAMY07	63.4	5.79
9/02/2022	SPAMY07	4.15	15.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.069	0.48	2.0	36,100.0	< 1.0	23.1	7.6	9/02/2022	SPAMY01	61.6	13.6
9/02/2022	SPAMY01	40.0	33.0	33.0	< 0.001	< 0.003	< 0.005	0.161	0.057	0.012	0.289	2.28	3.0	35,500.0	< 1.0	23.0	7.4	9/02/2022	SPAMY03	81.8	5.8
9/02/2022	SPAMY03	11.7	36.0	9.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.069	0.45	< 2.0	39,700.0	< 1.0	23.1	7.7	9/02/2022	SPAMY05	86.9	7.97
9/02/2022	SPAMY05	9.56	32.0	3.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.072	0.61	< 2.0	35,400.0	< 1.0	23.0	7.6	9/02/2022	SPAMY06	93.9	4.63
9/02/2022	SPAMY06	6.01	9.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.062	0.33	< 2.0	39,700.0	4.0	23.1	7.8	9/03/2022	SPAMYDP	96.7	87.8
9/03/2022	SPAMYDP	20.9	14.0	2.0	0.0232	0.0128	0.226	12.2	0.044	1.69	2.48	25.44	36.0	351.0	46.0	23.0	7.6	9/03/2022	SPAMY07	56.5	5.48
9/03/2022	SPAMY07	3.84	5.0	6.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.03	0.45	< 2.0	45,000.0	< 1.0	23.0	7.6	9/03/2022	SPAMY01	93.9	9.45
9/03/2022	SPAMY01	8.82	220.0	90.0	< 0.001	< 0.003	< 0.005	0.012	< 0.003	0.014	0.121	1.15	< 2.0	43,400.0	< 1.0	23.0	7.4	9/03/2022	SPAMY03	53	10
9/03/2022	SPAMY03	4.69	73.0	40.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.005	0.036	0.38	< 2.0	44,500.0	< 1.0	23.0	7.5	9/03/2022	SPAMY05	64.1	7.26
9/03/2022	SPAMY05	4.19	16.0	13.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.029	0.53	< 2.0	45,400.0	< 1.0	23.0	7.7	9/03/2022	SPAMY06	75.1	6.18
9/03/2022	SPAMY06	3.81	6.0	5.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.029	0.62	< 2.0	45,800.0	< 1.0	23.0	7.7	6/04/2022	SPAMYDP	27	105
6/04/2022	SPAMYDP	256.0	120.0	44.0	0.0303	0.0093	0.244	16.9	0.07	1.01	4.19	24.67	43.0	413.0	70.0	23.0	7.5	6/04/2022	SPAMY07	65.7	6.77
6/04/2022	SPAMY07	1.39	2.0	8.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.02	0.043	0.08	< 2.0	48,500.0	< 1.0	22.8	7.7	6/04/2022	SPAMY01	58.9	9.26
6/04/2022	SPAMY01	6.4	430.0	33.0	< 0.001	< 0.003	< 0.005	0.029	< 0.003	0.018	0.154	0.39	< 2.0	46,900.0	< 1.0	22.4	7.5	6/04/2022	SPAMY03	66	6.93
6/04/2022	SPAMY03	2.17	69.0	38.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.012	0.044	0.08	< 2.0	48,300.0	< 1.0	22.4	7.7	6/04/2022	SPAMY05	65.8	7.86
6/04/2022	SPAMY05	1.84	9.0	13.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.041	0.16	< 2.0	48,300.0	< 1.0	22.4	7.7	6/04/2022	SPAMY06	69.3	6.79
6/04/2022	SPAMY06	1.52	7.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.017	0.031	0.08	< 2.0	48,800.0	< 1.0	22.4	7.8	5/05/2022	SPAMYDP	31.6	94.1
5/05/2022	SPAMYDP	170.0	800.0	320.0	0.0175	0.0096	0.261	20.7	0.018	2.87	4.52	30.82	29.0	475.0	82.0	22.3	7.4	5/05/2022	SPAMY07	69.6	6.64
5/05/2022	SPAMY07	1.57	6.0	3.0	< 0.001	0.005	< 0.005	0.008	< 0.003	0.006	0.036	0.08	< 2.0	49,700.0	< 1.0	22.4	7.7	5/05/2022	SPAMY01	63.6	8.23
5/05/2022	SPAMY01	4.59	130.0	50.0	< 0.001	0.004	< 0.005	0.007	< 0.003	0.008	0.105	0.66	< 2.0	48,300.0	2.0	22.4	7.6	5/05/2022	SPAMY03	71.1	7.04
5/05/2022	SPAMY03	2.18	28.0	14.0	< 0.001	< 0.003	< 0.005	0.007	< 0.003	0.008	0.046	0.08	< 2.0	49,500.0	6.0	22.4	7.7	5/05/2022	SPAMY05	66.7	7.48

Lab Sampling		Algae	Bacteriological		Metals		Nutrients and Organics							Physical and General Chemical					Field Sampling		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci- (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
11/01/2022	SPAMY03	2.39	0.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.042	0.08	< 2.0	49,200.0	2.0	22.5	7.9	11/01/2022	SPAMY03	90.6	7.4
11/01/2022	SPAMY05	1.51	0.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.037	0.08	< 2.0	49,500.0	4.0	22.4	7.9	11/01/2022	SPAMY05	95	11.8
11/01/2022	SPAMY06	1.57	1.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.042	0.08	< 2.0	49,500.0	< 1.0	22.4	7.9	9/02/2022	SPAMYDP	94.5	78.7
9/02/2022	SPAMYDP	728.0	2.0	0.0	0.0166	0.0153	0.089	11.1	0.019	1.12	2.36	19.32	32.0	329.0	22.0	22.2	7.2	9/02/2022	SPAMY07	63.4	5.79
9/02/2022	SPAMY07	4.15	15.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.069	0.48	2.0	36,100.0	< 1.0	23.1	7.6	9/02/2022	SPAMY01	61.6	13.6
9/02/2022	SPAMY01	40.0	33.0	33.0	< 0.001	< 0.003	< 0.005	0.161	0.057	0.012	0.289	2.28	3.0	35,500.0	< 1.0	23.0	7.4	9/02/2022	SPAMY03	81.8	5.8
9/02/2022	SPAMY03	11.7	36.0	9.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.069	0.45	< 2.0	39,700.0	< 1.0	23.1	7.7	9/02/2022	SPAMY05	86.9	7.97
9/02/2022	SPAMY05	9.56	32.0	3.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.072	0.61	< 2.0	35,400.0	< 1.0	23.0	7.6	9/02/2022	SPAMY06	93.9	4.63
9/02/2022	SPAMY06	6.01	9.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.003	0.062	0.33	< 2.0	39,700.0	4.0	23.1	7.8	9/03/2022	SPAMYDP	96.7	87.8
9/03/2022	SPAMYDP	20.9	14.0	2.0	0.0232	0.0128	0.226	12.2	0.044	1.69	2.48	25.44	36.0	351.0	46.0	23.0	7.6	9/03/2022	SPAMY07	56.5	5.48
9/03/2022	SPAMY07	3.84	5.0	6.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.03	0.45	< 2.0	45,000.0	< 1.0	23.0	7.6	9/03/2022	SPAMY01	93.9	9.45
9/03/2022	SPAMY01	8.82	220.0	90.0	< 0.001	< 0.003	< 0.005	0.012	< 0.003	0.014	0.121	1.15	< 2.0	43,400.0	< 1.0	23.0	7.4	9/03/2022	SPAMY03	53	10
9/03/2022	SPAMY03	4.69	73.0	40.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.005	0.036	0.38	< 2.0	44,500.0	< 1.0	23.0	7.5	9/03/2022	SPAMY05	64.1	7.26
9/03/2022	SPAMY05	4.19	16.0	13.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.029	0.53	< 2.0	45,400.0	< 1.0	23.0	7.7	9/03/2022	SPAMY06	75.1	6.18
9/03/2022	SPAMY06	3.81	6.0	5.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.029	0.62	< 2.0	45,800.0	< 1.0	23.0	7.7	6/04/2022	SPAMYDP	27	105
6/04/2022	SPAMYDP	256.0	120.0	44.0	0.0303	0.0093	0.244	16.9	0.07	1.01	4.19	24.67	43.0	413.0	70.0	23.0	7.5	6/04/2022	SPAMY07	65.7	6.77
6/04/2022	SPAMY07	1.39	2.0	8.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.02	0.043	0.08	< 2.0	48,500.0	< 1.0	22.8	7.7	6/04/2022	SPAMY01	58.9	9.26
6/04/2022	SPAMY01	6.4	430.0	33.0	< 0.001	< 0.003	< 0.005	0.029	< 0.003	0.018	0.154	0.39	< 2.0	46,900.0	< 1.0	22.4	7.5	6/04/2022	SPAMY03	66	6.93
6/04/2022	SPAMY03	2.17	69.0	38.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.012	0.044	0.08	< 2.0	48,300.0	< 1.0	22.4	7.7	6/04/2022	SPAMY05	65.8	7.86
6/04/2022	SPAMY05	1.84	9.0	13.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.041	0.16	< 2.0	48,300.0	< 1.0	22.4	7.7	6/04/2022	SPAMY06	69.3	6.79
6/04/2022	SPAMY06	1.52	7.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.017	0.031	0.08	< 2.0	48,800.0	< 1.0	22.4	7.8	5/05/2022	SPAMYDP	31.6	94.1
5/05/2022	SPAMYDP	170.0	800.0	320.0	0.0175	0.0096	0.261	20.7	0.018	2.87	4.52	30.82	29.0	475.0	82.0	22.3	7.4	5/05/2022	SPAMY07	69.6	6.64
5/05/2022	SPAMY07	1.57	6.0	3.0	< 0.001	0.005	< 0.005	0.008	< 0.003	0.006	0.036	0.08	< 2.0	49,700.0	< 1.0	22.4	7.7	5/05/2022	SPAMY01	63.6	8.23
5/05/2022	SPAMY01	4.59	130.0	50.0	< 0.001	0.004	< 0.005	0.007	< 0.003	0.008	0.105	0.66	< 2.0	48,300.0	2.0	22.4	7.6	5/05/2022	SPAMY03	71.1	7.04
5/05/2022	SPAMY03	2.18	28.0	14.0	< 0.001	< 0.003	< 0.005	0.007	< 0.003	0.008	0.046	0.08	< 2.0	49,500.0	6.0	22.4	7.7	5/05/2022	SPAMY05	66.7	7.48
5/05/2022	SPAMY05	2.1	28.0	10.0	< 0.001	< 0.003	< 0.005	0.006	< 0.003	0.004	0.045	0.08	< 2.0	49,900.0	< 1.0	22.4	7.7	5/05/2022	SPAMY06	76.2	7.03

Lab Sampling		Algae	Bacteriological		Metals			Nutrients and Organics								Physical and General Chemical						Field Sampling		Field Measurements	
Sample Date	Location	Chlorophyll a (ug/L)	E. Coli (CFU/100mL)	Enterococci- (CFU/100mL)	Copper - Filtered (mg/L)	Zinc - Filtered (mg/L)	Ammonia (NH3 unionised) as N (mg/L)	Ammonia Nitrogen (NH3-N) (mg/L)	Nitrate + Nitrite as N (NOx) (mg/L)	Phosphorus - Filterable Reactive as P. (mg/L)	Phosphorus - Total (mg/L)	Total Nitrogen (N-Total) (mg/L)	Biochemical Oxygen Demand (mg/L)	Electrical Conductivity (Lab) (uS/cm)	Suspended Solids (mg/L)	Temperature (lab) (deg C)	pH (lab) (pH units)	Sample Date	Location	Dissolved Oxygen (DO) - field (%sat)	Turbidity (field) (NTU)
5/05/2022	SPAMY05	2.1	28.0	10.0	< 0.001	< 0.003	< 0.005	0.006	< 0.003	0.004	0.045	0.08	< 2.0	49,900.0	< 1.0	22.4	7.7	5/05/2022	SPAMY06	76.2	7.03
5/05/2022	SPAMY06	2.07	8.0	2.0	< 0.001	0.005	< 0.005	0.008	< 0.003	0.004	0.03	0.08	< 2.0	50,100.0	2.0	22.4	7.8	8/06/2022	SPAMYDP	2.03	160
8/06/2022	SPAMYDP	169.0	1,300.0	480.0	0.0163	0.0036	0.4	25.9	0.025	0.347	5.91	38.23	33.0	535.0	98.0	22.4	7.5	8/06/2022	SPAMY07	79.7	3.76
8/06/2022	SPAMY07	2.71	3.0	0.0	< 0.001	< 0.003	< 0.005	0.064	< 0.003	< 0.003	0.027	0.08	< 2.0	51,300.0	6.0	22.3	7.7	8/06/2022	SPAMY01	99.2	8.45
8/06/2022	SPAMY01	4.1	21.0	33.0	< 0.001	< 0.003	0.006	0.249	< 0.003	0.005	0.149	0.25	< 2.0	51,200.0	4.0	22.4	7.7	8/06/2022	SPAMY03	71.4	3.94
8/06/2022	SPAMY03	2.15	0.0	0.0	< 0.001	< 0.003	< 0.005	0.033	< 0.003	< 0.003	0.016	0.08	< 2.0	51,700.0	6.0	22.3	7.8	8/06/2022	SPAMY05	80	3.2
8/06/2022	SPAMY05	1.63	1.0	1.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.005	0.014	0.08	< 2.0	51,500.0	8.0	22.3	7.8	8/06/2022	SPAMY06	81.9	3.02
8/06/2022	SPAMY06	1.11	0.0	0.0	< 0.001	< 0.003	< 0.005	0.006	< 0.003	0.004	0.022	0.08	< 2.0	51,500.0	6.0	22.3	7.8	11/06/2022	SPAMY06	97.4	8.54
6/07/2022	SPAMYDP	113.0	1,800.0	620.0	0.0178	0.005	0.469	29.7	0.01	0.017	6.1	45.21	51.0	601.0	130.0	21.7	7.5	6/07/2022	SPAMYDP	93.6	141
6/07/2022	SPAMY07	1.13	1.0	4.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.036	0.32	< 2.0	52,900.0	12.0	21.6	7.9	6/07/2022	SPAMY07	84.6	3.47
6/07/2022	SPAMY01	1.89	20.0	10.0	< 0.001	< 0.003	< 0.005	0.149	0.022	< 0.003	0.073	0.86	< 2.0	52,700.0	< 1.0	21.4	7.8	6/07/2022	SPAMY07	84.7	3.69
6/07/2022	SPAMY03	1.03	1.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.032	0.45	< 2.0	52,800.0	4.0	21.5	7.9	6/07/2022	SPAMY01	83.6	5.29
6/07/2022	SPAMY05	1.03	1.0	4.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.005	0.034	0.95	< 2.0	52,800.0	< 1.0	21.6	7.9	6/07/2022	SPAMY03	91.4	3.83
6/07/2022	SPAMY06	0.72	1.0	0.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	0.004	0.05	0.45	< 2.0	52,600.0	< 1.0	21.5	7.9	6/07/2022	SPAMY05	89.7	4.79
3/08/2022	SPAMYDP	364.0	######	140.0	0.0394	0.0415	0.903	36.4	< 0.06	4.12	6.68	48.66	61.0	678.0	85.0	22.3	7.7	6/07/2022	SPAMY06	90.2	3.72
3/08/2022	SPAMY07	0.99	4.0	1.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.019	0.08	< 2.0	53,200.0	8.0	22.2	7.9	3/08/2022	SPAMYDP	81.4	117
3/08/2022	SPAMY01	1.69	80.0	21.0	0.002	< 0.003	< 0.005	0.087	0.04	< 0.003	0.069	0.16	< 2.0	52,500.0	4.0	22.2	7.8	3/08/2022	SPAMY07	81.2	4.01
3/08/2022	SPAMY03	1.34	32.0	3.0	0.002	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.018	0.08	< 2.0	53,100.0	< 1.0	22.1	7.9	3/08/2022	SPAMY01	79.3	5.95
3/08/2022	SPAMY05	1.4	2.0	2.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.022	0.08	< 2.0	53,200.0	6.0	22.2	7.9	3/08/2022	SPAMY03	80.1	4.61
3/08/2022	SPAMY06	0.52	17.0	3.0	< 0.001	< 0.003	< 0.005	< 0.005	< 0.003	< 0.003	0.022	0.08	< 2.0	52,900.0	< 1.0	22.2	8.0	3/08/2022	SPAMY05	81.6	6.8
																		3/08/2022	SPAMY06	80.7	3.46

SEDIMENTS AND PORE WATER		Pore volume extracted (mL)	TOC (mg/kg)	TOC (%)	CHL-A (MG/KG)	PHEO-A (MG/KG)	chl-a:pheo-a calcula	NOX-N (mg/kg)	TK-N (mg/kg)	Total N (mg/kg)	TN:TOC (calc)	NH3-N (mg/L)	pH (lab)	NOX-N (mg/L)	Org N as N (TKN-NH3)	TK-N (mg/L)	Total N (mg/L)	Total P (mg/kg)	Total P (mg/L)	FRP (mg/L)	Moisture (%)	Al_T (mg/kg)	Cu_T (mg/kg)	Cu_T:Al X10000 [calc]	Cu_B (mg/kg)	Cu_F (mg/L)	Zn_T (mg/kg)	Zn_T:Al X10000 [calc]	Zn_B (mg/kg)	Zn_F (mg/L)
		SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	PORE	PORE	PORE	PORE	PORE	PORE	SED	PORE	PORE	SED	SED	SED	SED	SED	PORE	SED	SED	SED	PORE
SPAMY01	23/06/2022	290	*37,000*	3.7	13.1	7.28	*1.80*	0.7	2510	2510	*0.068*	5.51	7.65	0.1	0.5	6.4	6.4	694	0.23	<0.01	63.9	13600	16.8	12.4	6.1	<0.001	38.7	28.5	17.9	<0.005
SPAMY03	23/06/2022	338	*28,700*	2.87	4.21	2.35	*1.79*	0.2	1940	1940	*0.068*	2.47	7.74	0.02	0.5	2.8	2.8	480	0.26	<0.01	54.7	9610	10.1	10.5	3.3	<0.001	29.3	30.5	14.1	<0.005
SPAMY05	23/06/2022	514	*26,400*	2.64	3.44	7.64	*0.45*	0.4	2560	2560	*0.097*	3.66	7.76	0.03	0.5	3.8	3.8	644	0.16	0.02	66.3	15000	12.1	8.1	3.1	<0.001	37.9	25.3	14.6	<0.005
Triplicate 5A -	23/06/2022	433	*33,900*	3.39	3.91	2.51	*1.56*	0.4	2900	2900	*0.086*	1.97	7.76	0.03	0.5	2.4	2.4	730	0.17	0.02	60.1	13200	11.1	8.4	4.6	<0.001	34.8	26.4	14.2	<0.005
Triplicate 5B -	23/06/2022	220	*21,800*	2.18	3.51	2.07	*1.70*	0.3	2080	2080	*0.095*	3.99	7.76	0.01	2	6	6	563	0.19	<0.01	54.8	10900	9.7	8.9	3.9	<0.001	29.6	27.2	13.2	<0.005
SPAMY06	23/06/2022	662	*21,000*	2.1	2.11	0.9	*2.34*	0.1	1090	1090	*0.052*	0.98	7.77	0.02	0.5	1.2	1.2	352	0.19	0.01	46.7	7780	8.5	10.9	1.8	<0.001	18.6	23.9	8.9	<0.005
Triplicate 6A -	23/06/2022	390	*20,200*	2.02	1.43	1.63	*0.88*	0.2	650	650	*0.032*	1.68	7.77	0.01	0.5	2.6	2.6	498	0.2	<0.01	42.3	8260	7.7	9.3	1.2	<0.001	19.3	23.4	8.4	<0.005
Triplicate 6B -	23/06/2022	238	*15,400*	1.54	2.51	0.79	*3.18*	0.2	1270	1270	*0.082*	1.67	7.78	0.005	1.1	2.8	2.8	435	0.21	<0.01	46.4	10100	7.5	7.4	1.7	<0.001	23.8	23.6	8.5	<0.005
SPAMY07	23/06/2022	901	*29,500*	2.95	3.89	6.52	*0.60*	0.3	1820	1820	*0.062*		7.73	0.01	0.5	2.1	2.1	549	0.16	<0.01	61.4	14700	11.2	7.6	5.6	<0.001	35.5	24.1	17.6	<0.005
REFERENCE CREEK - SHORT CREEK																														
SPASC01	20/06/2022	411	*28,100*	2.81	6.16	7	*0.86*	0.6	1810	1810	*0.064*	2.55	7.65	0.05	<1	3.3	3.4	521	0.17	<0.01	58.6	19700	9.8	*5.0*	4.8	<0.001	35.4	*18.0*	16.9	<0.005
SPASC02	20/06/2022	313	*29,000*	2.90	4.52	5.19	*0.86*	0.4	1630	1630	*0.056*	3.88	7.79	0.07	1.5	5.4	5.5	419	0.26	<0.01	55.2	17200	9.0	*5.2*	4.3	<0.001	33.4	*19.4*	15.1	<0.005
SPASC03	20/06/2022	293	*33,100*	3.31	6.41	4.78	*1.10*	0.5	1750	1750	*0.053*	2.63	7.82	0.09	1.1	3.7	3.8	519	0.4	<0.01	60.5	17900	9.4	*5.3*	5.1	<0.001	32.5	*18.2*	17.0	<0.005
SPASC04	20/06/2022	451	*43,500*	4.35	<0.1	14.18	*0.47*	0.3	1770	1770	*0.041*	1.48	7.81	0.06	<1	2	2.1	424	0.22	<0.01	62.7	16000	7.1	*4.4*	2.6	<0.001	25.8	*16.1*	11.9	<0.005
Triplicate 7A -	20/06/2022	536	*20,800*	2.08	2.03	2.95	*0.80*	0.2	1480	1480	*0.071*	1.01	7.78	0.06	<1	1.3	1.4	418	0.18	<0.01	56.2	15300	8.0	*5.2*	1.6	<0.001	27	*17.6*	9.1	<0.005
Triplicate 7B -	20/06/2022	430	*39,200*	3.92	0.56	6.66	*0.58*	0.3	1120	1120	*0.029*	1.38	7.79	0.07	<1	1.9	2	211	0.16	<0.01	57.2	22400	10.7	*4.8*	2.6	<0.001	42.3	*18.9*	11.8	<0.005