Annual Monitoring Report

For
Hastings Wastewater Discharge
Resource Consent No. CD130214W

July 2021 – June 2022

Revision Schedule

Rev.	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
A	01/09/2022	For HDC Review	CW, DC	JB	JB	SK
B	12/09/2022	For Independent Review	CW, DC	JB	DM (HDC)	SK
C	23/09/2022	Independent Review Comments Incorporated	CW, DC	JB	JB, DM (HDC)	SK
D	30/09/2022	Final for Submission to HBRC	CW, DC	JB	JB, DM (HDC)	SK

Quality Statement

This document has been prepared for the benefit of Hastings District Council (HDC). No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to HDC and other persons for an application for permission or approval to fulfil a legal requirement.

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Shannon Kendall	**Chunlong Wang**

PREPARED BY

Chunlong Wang *(excl. environmental assessment part)*		30/09/2022
David Cameron *(environmental assessment part)*		12/09/2022

CHECKED BY

Jim Bradley		30/09/2022

REVIEWED BY

Jim Bradley		30/09/2022

APPROVED FOR ISSUE BY

Shannon Kendall		30/09/2022

Level 3, 111 Carlton Gore Road, Newmarket, Auckland 1023
PO Box 13-052, Armagh, Christchurch 8141

Executive Summary

Hastings District's East Clive Wastewater Treatment Plant and Offshore Ocean Outfall Scheme are governed by the Resource Consent (No. CD130214W). This Consent was granted on 25 June 2014 and expires on 31 May 2049.

The Consent includes 32 comprehensive Conditions covering:

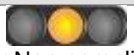
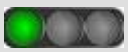
- How should the wastewater be treated to ensure a sound reduction of waste matters
- How and where to discharge the treated wastewater to minimise adverse environmental effects while providing a culturally acceptable solution
- What, when, where, and how to monitor the performance of the treatment and discharge infrastructure
- Administrative and reporting responsibilities of Hastings District Council, including maintaining a Tangata Whenua Wastewater Joint Committee.

The Consent requires an Annual Monitoring Report to be submitted to Regional Council and available to the public. This Report is prepared to meet this requirement. It demonstrates Hastings District Council has been operating and maintaining the wastewater infrastructure as expected. It also provides the public with an opportunity to understand and comment on what has happened and participate in future wastewater and environment management practices.

The highlights for this reporting period are:

- The Domestic and Non-Separable Industry (DNSI) treatment system's Biological Trickling Filter (BTF) continues to operate well and meet treatment expectations.
- The Final Combined Wastewater (FCW) that is being discharged complies with the consent and the ANZEEC 2000 & ANZG 2018 guidelines for fresh and marine quality water. The Final Combined Wastewater is of low toxicological risk when discharged into the marine environment of Hawke Bay.
- The receiving water within the mixing zone shows some adverse effects from the outfall discharge. However, these effects are only minor. Outside of the mixing zone, the receiving waters' characteristics are very similar to those of the surrounding marine waters.
- The sediments show minor effects in the vicinity of the outfall, which is reflected in higher concentrations close to the outfall diffuser. There is no indication of significant accumulation of metals around the outfall.
- The current treatment and discharge through the long ocean outfall are compliant with the Consent Conditions and provides a culturally and environmentally acceptable solution for Hastings District's East Clive Wastewater Treatment Plant and Offshore Ocean Outfall Scheme.
- There was a non-compliance with Condition 5b on 23 June 2022. While resolving a wastewater overflow on SH51 near Whakatu, approximately 140m^3 of domestic wastewater passed through the industrial wastewater treatment process bypassing the domestic treatment process at the WWTP.

The compliance assessment in accordance with the Consent Conditions is summarised in the table below.

Condition Categories	Condition No.	Summary of Requirements	Resource Consent Compliance Status *
	1 – 4	• Authorised discharge • Discharge flow rate and location • Minimum dilution ratio on slack water	 Total Compliance
Wastewater Treatment and Standards	5 – 11	• Treatment and discharge infrastructure and maintenance • Treated wastewater quality • Environmental effects	 Minor Non-compliance *(One non-compliance with Condition 5b)*
Monitoring	12 – 21	• Quantitive and qualitative sampling • Routine monitoring and inspection • What, where, and how often	 Total Compliance
Administrative	22 – 23	• Signage • Day-to-day operation and contact person	 Total Compliance
Reporting	24 – 32	• Annual reporting and emerging event reporting • 9th, 18th and 27th-year survey and review report • Involvement of Tangata Whenua	 Total Compliance

**** Note:***

 *indicates Total Compliance*

 *indicates Minor Non-compliance*

 *indicates Significant Non-compliance*

This report has been peer-reviewed in accordance with Condition 24 by eCoast Marine Consulting and Research. The Peer Review Report (Appendix G) states "…*the reporting satisfies all of the requirements of the consent conditions*…".

Contents

List of Tables

List of Figures

Abbreviations

ANZECC (2000)	Australia and New Zealand Environment and Conservation Council
ANZG (2018)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
AS	Acid Soluble
Avg	Average (or Mean)
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BTF	Biological Trickling Filter (or Biological Trickling Filter treated)
$cBOD_5$	5-day Carbonaceous Biochemical Oxygen Demand
CFU	Colony Forming Units (of Microorganisms)
COD	Chemical Oxygen Demand
DGV	Default Guideline Value
DNSI	Domestic and Non-Separable Industry
DRP	Dissolved Reactive Phosphorous
FCW	Final Combined Wastewater (same as Total Combined Discharge)
HBRC	Hawke Bay Regional Council
HDC	Hastings District Council
ID	Industrial Discharge
ISQG	Interim Sediment Quality Guideline
g/m^3	Grams per Cubic Meter (same as mg/l)
L/s	Litres per Second
LOEC	Lowest Observable Effect Concentration
MCC	Motor Control Centre
m	Meter
m^3	Cubic Meters
mg/L	Milligrams per Litre (same as g/m^3)
MOU	Memorandum of Understanding
NH_3	Ammonia
NH_3N or NH_4N	Ammoniacal Nitrogen
NH_4^+	Ammonium Ion
NIWA	National Institute of Water and Atmospheric Research
NOEC	No observed Effect Concentration
NT	Not Tested – The sample was not tested for that particular parameter
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
TCD	Total Combined Discharge (same as Final Combined Wastewater)
TEC	Threshold Effect Concentration (Geometric mean of NOEC and LOEC)
TN	Total Nitrogen
TOG	Total Oil and Grease
TP	Total Phosphorous
TSS	Total Suspended Solids
UPS	Uninterruptible Power Supply

1 Overview

The East Clive Wastewater Treatment Plant (WWTP) treats wastewater from the Hastings District and discharges treated wastewater into Hawke Bay via an offshore ocean outfall. This scheme is governed by the Resource Consent No. CD130214W. This Consent was granted on 25 June 2014 and expires on 31 May 2049.

The Consent includes 32 Conditions covering requirements for:

- How, how much, and where to discharge the final combined treated wastewater
- Wastewater treatment and standards
- Monitoring
- Administration
- Reporting

This report is prepared and submitted per Condition 24, which states that:

- Before 1 October each year, the Consent Holder shall provide the Regional Council with an Annual Monitoring Report, covering the preceding 12 months ending 30 June.

1.1 Preparation of this Report

Hastings District Council and Stantec jointly prepare this report. The report is then independently reviewed by eCoast Consulting and Research. Table 1 summarises the roles of the three organisations.

Table 1: Organisations Involved and Their Roles in Preparation of This Report

Organisation Name	Roles/Responsibility in Preparation of This Report
Hastings District Council (HDC)	• Provide all the tabulated sampling results, monitoring/testing information and reports • Provide operational and event records • Provide maintenance records and improvement action records • Clarify information, and answer queries throughout the Report preparation • Assure accountability of preparing and submitting this Report as the Consent Holder
Stantec Consulting (Stantec)	• Review all the monitoring/testing information, records and reports provided • Analyse and summarise the monitoring information provided • Ensure the completeness of information and records necessary for this Report • Physically compile this Report • Consult HDC for comments, and incorporate the review comments in the Report
eCoast Consulting and Research (eCoast)	• Conduct an independent review of this report by referring to the Consent • Compile the Peer Review Report (Appendix G)

1.2 Structure of this Report

- The reporting per Condition 24 and its directly associated Conditions is grouped in Section 2.
- The reporting per other Conditions is grouped in Section 3.
- All the laboratory testing results, field measurement results, and online monitoring results are tabulated and included in Section 4, except for the toxicity test results, which are included in Appendix D .
- The supporting reports prepared by relevant service providers are included as Appendices.

Two checklists are provided on page 4 and page 5, respectively, to help locate the information associated with each Condition. One is for Condition 24, and the other one is for the other Conditions.

1.3 Treatment and Ocean Outfall Scheme

The East Clive Wastewater Treatment Plant (WWTP) treats wastewater from the Hastings District urban area, Clive, and other areas along the conveyance route to the East Clive WWTP, and discharges treated wastewater into Hawke Bay via an offshore ocean outfall (Figure 1).

The wastewater treatment processes comprise fine screening (milli-screening), screenings washings and compaction; grit removal and grit washing; wastewater pumping of the screened and grit removed flow; Biological Trickling Filters (BTF) to treat and transform the human waste component (kūparu) to something environmentally acceptable and culturally non-offensive (which comprise a motorised rotary distributor to control the application of wastewater to the filter, polypropylene randomly packed plastic media within the filter structure, support decking which the plastic media sits on, and a number

of fans to provide controlled ventilation of the filter); the Rakahore channel (rock channel) to restore the mauri of the treated wastewater before discharge through the offshore ocean outfall; and a bark bed biofilter which the captured air discharge from the ancillary structures (milli-screen and pumping chambers) passes through to remove odour.

There are two distinct wastewater influent streams, the Domestic and Non-Separable Industry (DNSI) wastewater influent and the Separated Industrial wastewater influent. Some of the industries discharging into the DNSI network must have an Approval to Discharge Controlled Wastewater (Trade Waste), while others are considered a permitted discharge because they comply with all requirements of the Wastewater Schedule of council's Consolidated Bylaw. The DNSI wastewater influent is treated through the Biological Trickling Filters (BTF), as a biological treatment process, to remove the wastewater's cultural offensiveness linked to the human waste component (kūparu). Industrial wastewater is primarily organic and does not contain human waste (kūparu); hence, it was not determined to be culturally offensive when this consent was granted. The Separated Industrial wastewater is typically treated by industry onsite following HDC's Approval to Discharge Controlled Wastewater before the discharge into HDC's Separate Industrial wastewater collection network. The Separated Industrial wastewater influent is then further treated through a milli-screen at the East Clive WWTP and combined with BTF treated wastewater before being discharged into Hawke Bay via the long ocean outfall and diffuser (2.75km).

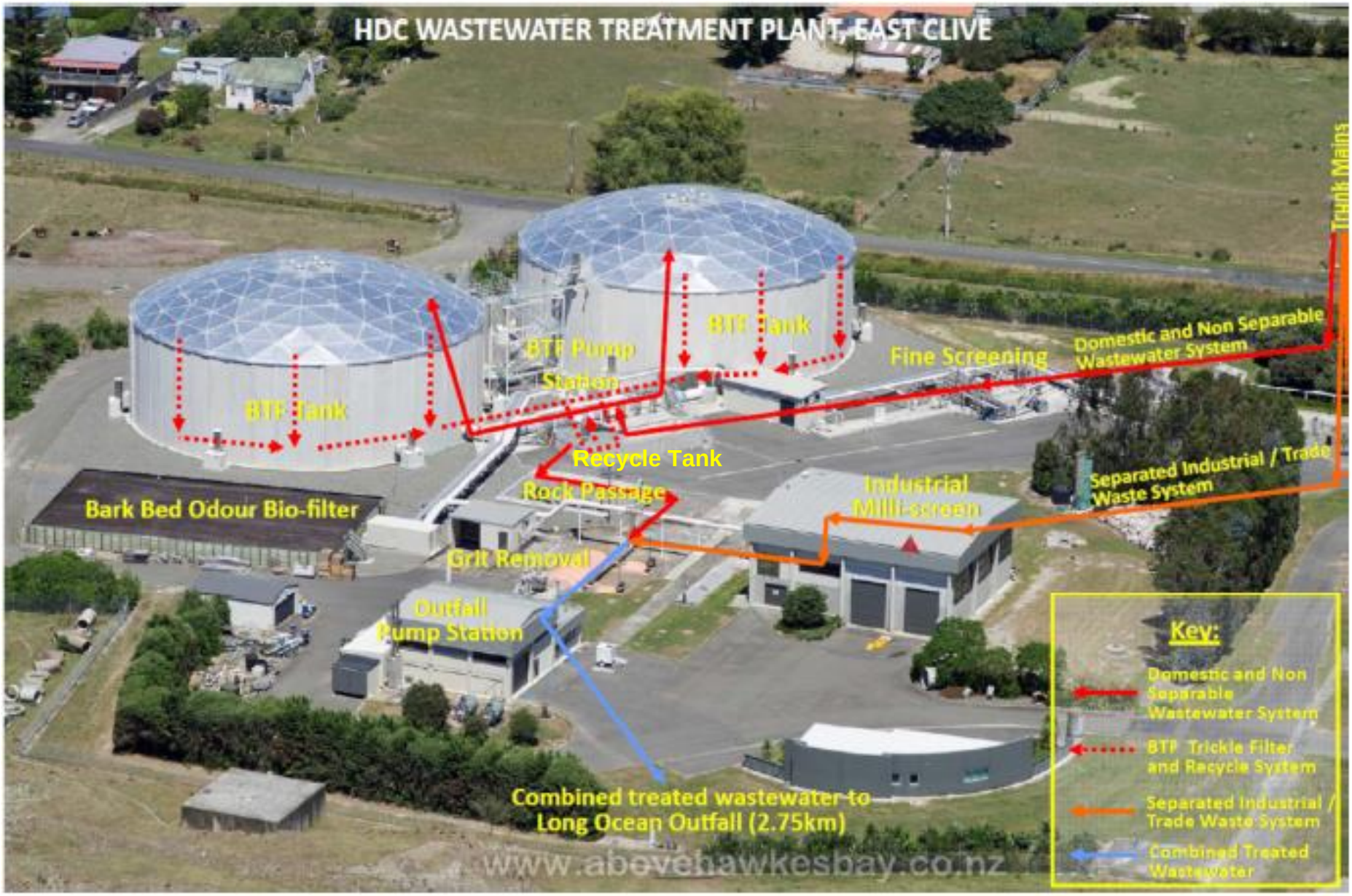


Figure 1: HDC Wastewater Treatment and Flow Paths

1.4 Checklists for This Annual Monitoring Report

Two (2) checklists, Table 2 and Table 3, are provided to help locate the relevant reporting information for each condition. Table 2 is for Condition 24, and Table 3 is for the other Conditions.

Table 2: Checklist for Reporting per Condition 24

Condition No.	Condition Summary	Coverage in this Report	Resource Consent Compliance Status *
24	Peer-reviewed Annual Monitoring Report	This Report, and Appendix G	 Total Compliance
24 a)	Summary of all monitoring undertaken	Section 2.1 on page 8	 Total Compliance
24 b)	Critical analysis of sampling results - required by condition 14	Section 2.2 on page 8	 Total Compliance
24 c)	Critical analysis of monitoring information - compliance and adverse environmental effects	Section 2.3 on page 10	 Total Compliance
24 d)	Compliance assessment against Trigger Levels - $cBOD_5$ and TSS load, total daily discharge volume	Section 2.4 on page 16	 Total Compliance
24 e)	Comment on non-compliances, operational issues, and actions undertaken	Section 2.5 on page 16	 Total Compliance
24 f)	Details of improvement works undertaken	Section 2.6 on page 16	 Total Compliance
24 g)	Identification and analysis of trends	Section 2.7 on page 17	 Total Compliance
24 h)	Recommendations for changes in monitoring	Section 2.8 on page 17	 Total Compliance
24 i)	Details of any proposed changes to conditions	Section 2.9 on page 17	 Total Compliance
24 j)	Details of wastewater treatment plant open day	Section 2.10 on page 18	 Total Compliance
24 k)	Tabulated results of the laboratory tests	Section 4 from page 22 to page 49	 Total Compliance

**** Note:***

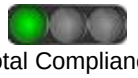
 *indicates Total Compliance*

 *indicates Minor Non-compliance*

 *indicates Significant Non-compliance*

These indicators are also used in the individual assessment sections and tables to visualise the compliance status.

Table 3: Checklist for Reporting per Other Consent Conditions

Condition No.	Condition Summary	Coverage in this Report	Resource Consent Compliance Status *
1	Discharge as per Resource Consent	Section 3 on page 19	 Total Compliance
2	Discharge flow rate **≤ 2,800 L/s**	Section 2.3.1.1 on page 10	 Total Compliance
3	Discharge to ~2,450m and 2,750m offshore via the existing long offshore outfall structure	Section 3 on page 19	 Total Compliance
4	Final WW discharged shall pass through an ocean outfall diffuser to achieve a minimum dilution of **100:1** on slack water	Section 3 on page 19	 Total Compliance
Wastewater Treatment and Standards			
5	a) All separable industrial water to pass through a milli-screen with aperture slot width **≤ 1mm** b) Minimum treatment processes for domestic and non-separable industrial water: **3mm** screening, biological trickling filter (**BTF**), **Rakahore channel** ○ Average annual daily **cBOD$_5$** loading to BTF media **≤ 0.4kg/m^3** ○ The specific surface area of BTF media **≥ 90m^2/m^3**	Section 3 on page 19 Section 2.3.1.2 on page 11	 Minor Non-compliance *(One non-compliance with Condition 5b on 23 June 2022. Refer to* Table 16*.)*
6	**Heavy metals and ammonia**: • Limits of concentration and loading; and • Additional sampling and investigation following an exceedance	Section 2.3.1.3 on page 11	 Total Compliance
7	**Environmental effects** - Determinants and their limits for: • Beyond **750m** from the midpoint of the outfall diffuser: a) Conspicuous suspended materials b) Conspicuous colour or visual clarity • Beyond **500m** from the midpoint of the outfall diffuser: c) Conspicuous floatable materials d) Objectionable odour e) Significant adverse effects on aquatic life f) Change of temperature > 3°C g) Dissolved Oxygen level < 80% of the saturation concentration h) Undesirable biological growths	Section 2.3.2.1 on page 12	 Total Compliance
8	**Total Oil and Grease**: • Daily average **≤ 200g/m^3** • Sampling procedure as per Conditions 13 and 14	Section 2.3.1.4 on page 11	 Total Compliance
9	Inspecting **diffuser**: • At least annually, and • When necessary Recording and reporting blocked ports if any	Section 3 on page 19 Appendix E	 Total Compliance
10	**Maintenance** of WW treatment plant and outfall structures	Section 3 on page 19 Appendix E	 Total Compliance
11	Maintenance of **sampling equipment** and records of calibration	Section 3 on page 19	 Total Compliance

Condition No.	Condition Summary	Coverage in this Report	Resource Consent Compliance Status *
Monitoring			
12	Instantaneous discharge flow rate and daily volume	Figure 2 on page 10 Figure 4 on page 22	 Total Compliance
13	This Condition is superseded by Condition 14	N/A	N/A
14	From July 2015 onwards - Quarterly for every 12 months taking 24-hour flow proportional samples for no less than seven consecutive days: • Domestic and non-separable industrial wastewater - Before and immediately after BTF: – Total suspended solids – Total oil and grease; and – $cBOD_5$ • Final combined wastewater - Quarterly and annually for parameters listed in Schedule 1 of the Consent	Table 22, Table 23, Table 24, Table 25 Section 2.2 on page 8	 Total Compliance
15	Toxicity of the final combined wastewater - Quarterly	Section 2.3.2.2 on page 13 Appendix D	 Total Compliance
16	Offshore water quality at ten sites: • Laboratory tests: – Faecal coliform and enterococci • Field measurements: – pH, salinity, turbidity, temperature, and dissolved oxygen level	Table 27 on page 35; Figure 19 to Figure 23 on page 44 to 48; Section 2.3.2.3 on page 14	 Total Compliance
17	Surface currents for ≥ 30 minutes at the diffuser centre - While sampling as per Condition 16 above	Section 3 on page 19	 Total Compliance
18	• Surveys showing the impact of the discharge on the benthic fauna - 8th, 17th and 26th years • Reporting within one month of receiving the survey results	The 8th-year benthic survey will be undertaken in Jan/Feb 2023	N/A
19	Seabed sediment grab samples - Twice a year (summer and winter): • Taken from 6 specific locations • Parameters as per Schedule 2 of the Consent • An additional survey if triggered	Table 28 on page 49 Section 2.3.1.5 on page 12	 Total Compliance
20	Quality analysis to be done by IANZ accredited or Regional Council approved laboratories	Section 3 on page 19 Appendix C	 Total Compliance
21	A Memorandum of Understanding (MOU) is in place and being followed.	Section 3 on page 19 Appendix C	 Total Compliance
Administrative			
22	Clear and visible signage including “Shellfish unfit for human consumption” on the buoys marking the diffuser ends	Section 3 on page 19 Appendix E	 Total Compliance
23	• Appointment of a person responsible for daily operation and to act as a contact person for Regional Council • Notifying Regional Council of appointment or change of the contact person	Section 3 on page 19	 Total Compliance
Reporting			
25	• Making each Annual Monitoring Report publicly available	Section 3 on page 19	 Total Compliance
26	• Organising a public ‘**open day**’ at the East Clive Wastewater Treatment Plant in November each year • Reporting it in the following Annual Monitoring Report	Table 20 on page 18 Section 3 on page 19	 Total Compliance

Condition No.	Condition Summary	Coverage in this Report	Resource Consent Compliance Status *
27	A Trends, Technology, Discharge, Environmental and Monitoring Review Report not later than 25 June 2023, 2032 and 2041, respectively	N/A. (Not due yet)	N/A
28	**Complaints** received and the actions taken	Section 3 on page 19	 Total Compliance
29	**Tangata Whenua** engagement**:** • A Council Committee, half of the members of which shall be Tangata Whenua representative • The Committee to function as set out in the condition	Section 3 on page 19	 Total Compliance
30	Immediately notifying Regional Council of any non-compliances that occurred or envisaged or unusual or extreme circumstances	Section 3 on page 19	 Total Compliance
31	Any unforeseen event led to non-compliance - Investigating and reporting within one month	Section 3 on page 19	 Total Compliance
32	Keeping records related to the Consent and making them available to Regional Council upon request	Section 3 on page 19	 Total Compliance

**** Note:***

 *indicates Total Compliance*

 *indicates Minor Non-compliance*

 *indicates Significant Non-compliance*

These indicators are also used in the individual assessment sections and tables to visualise the compliance status.

2 Compliance Assessment for Condition 24 and Its Extension

This section includes the compliance assessment for Condition 24 and its extension (i.e., specifically mentioned in Condition 24, or directly associated with Condition 24), including Conditions 2, 5(b), 6, 7, 8, 12, 14, 15 16, and 19.

2.1 Condition 24(a) – Summary of All Monitoring Undertaken

Table 4 below summarises all the monitoring undertaken by HDC during this reporting year. This table can also be used as a quick guide for locating the individual tables of the sampling results.

Table 4: Summary of All Monitoring Undertaken

Condition No.	Monitoring Requirement	Date/Period of Undertaken	Location of Records Included in this Report
Continuously			
12	Rate of discharge (instantaneous flow rate) – Final combined wastewater discharged	Continuously in SCADA; Recorded every 5 minutes	Figure 2 on page 10
12	Daily volume – Final combined wastewater discharged	Continuously in SCADA; Recorded daily at midnight	Figure 4 on page 22
Quarterly			
14(a)	TSS, TOG, $cBOD_5$ of DNSI – Before BTF	Quarterly for seven consecutive days: Q1: 25/07 – 31/07/2021 Q2: 01/11 – 07/11/2021 Q3: 17/01 – 23/01/2022 Q4: 26/04 – 02/05/2022	Table 22 on page 23
14(b)	TSS, TOG, $cBOD_5$ of DNSI – Immediately after BTF		Table 23 on page 25
14(c)	Parameters as per Schedule 1 of the Consent – Final combined wastewater		Table 24 on page 29
15	Toxicity of the final combined wastewater	Q1: 27/07 – 28/07/2021 Q2: 01/11 – 02/11/2021 Q3: 17/01 – 18/01/2022 Q4: 01/05 – 02/05/2022	Appendix D
16	**Laboratory tests**: Faecal coliform and enterococci – 10 locations as specified in Condition 16; and – 4 additional locations	Q1: 02/09/2021 Q2: 02/11/2021 Q3: 19/01/2022 Q4: 26/04/2022	Table 27 on page 35
16	**Field measurements**: pH, salinity, turbidity, temperature, and dissolved oxygen – 10 locations as specified in Condition 16; and – 4 additional locations	Q1: 29/07/2021 Q2: 02/11/2021 Q3: 19/01/2022 Q4: 26/04/2022	Figure 19 to Figure 23 on page 44 to 48; Section 2.3.2.3 on page 14
17	Surface currents	Q1: 29/07/2021 Q2: 02/11/2021 Q3: 19/01/2022 Q4: 26/04/2022	The data is not listed in this report due to the large amount. The data is available in electronic format and can be provided upon request.
Twice-yearly			
19	Parameters as per Schedule 2 of the Consent – Sediment grab samples taken from 6 locations	1st: 29/07/2021 2nd: 02/11/2021 3rd: 19/01/2022 4th: 26/04/2022 *(More frequent than specified)*	Table 28 on page 49
Annually			
9	Inspection of the diffuser	17/11 – 2/12/2021	Appendix E
14(c)	Parameters as per Schedule 1 of the Consent – Final combined wastewater	01/05/2022 – 02/05/2022	Table 25 on page 30
The 8th, 17th, and 26th-years after the Commencement of the Resource Consent			
18	Surveys to show the impact of the discharge on the benthic fauna	The 8th-year benthic survey is scheduled for Jan/Feb 2023	N/A

2.2 Condition 24(b) – Critical Analysis of Sampling Required by Condition 14

2.2.1 Conditions 14(a) and (b) – Quarterly Sampling Results – BTF Influent and BTF Treated Wastewater

Table 5 below summarises the analysis of laboratory testing results required by Condition 14(a) and (b).

- The BTF's TOG, cBOD5, and TSS removal performance were reasonably good and generally consistent with previous years.
- The BTF also achieved ammonia removal and total nitrogen removal, which benefits the marine receiving environment.
- The corresponding performance indicators are highlighted in Table 5.

Table 5: Conditions 14(a) and (b) – Analysis of BTF Performance

	Data Analysis	TSS (g/m^3)	TOG (g/m^3)	$cBOD_5$ ($g\ O_2/m^3$)	NH_3-N (g/m^3)	Inorganic-N (g/m^3)
Before BTF (DNSI Influent)	Annual Maximum	380	260	360	131	131.09
	Annual Median	158.0	45.0	167.0	27.0	27.1
	Annual Average	175.8	84.8	167.3	46.9	47.0
	Annual Minimum	42	13	20	15.1	15.19
	Standard Deviation	85	82	79	41	41
After BTF (Treated DNSI Wastewater)	Annual Maximum	240	280	230	61	61.09
	Annual Median	**67.5**	**10.0**	**27.5**	**15.6**	**19.1**
	Annual Average	**81.5**	**62.4**	**58.2**	**19.3**	**21.5**
	Annual Minimum	26	4	11	9.7	11.61
	Standard Deviation	48	98	66	11.0	10.2
BTF Performance (Contaminant Removal %)	Annual Maximum	93%	92%	95%	85%	84%
	Annual Median	**55%**	**68%**	**82%**	**44%**	**34%**
	Annual Average	**44%**	**53%**	**57%**	**45%**	**36%**

2.2.2 Condition 14(c) – Quarterly Sampling Results – Final Combined Wastewater

The analysis of the **quarterly** sampling results for the final combined wastewater in accordance with condition 14(c) is provided in Table 6. The tabulated quarterly sampling results are provided in Table 24 on page 29.

Table 6: Condition 14(c) – Analysis of Quarterly Sampling Results – Final Combined Wastewater

Test / Analyte	Annual Minimum	Annual Average	Annual Median	Annual Maximum	Standard Deviation
pH	5.7	6.5	6.5	7.5	0.4
Conductivity (mS/m)	97.2	154.7	141.5	214.0	34.1
Total Oil and Grease (g/m^3)	24	74	66	161	35
TSS (g/m^3)	102	374	330	1160	248
NH_4-N (g/m^3)	9.80	19.13	19.20	25.00	3.75
$cBOD_5$ ($g\ O_2/m^3$)	33	365	360	580	139
COD ($g\ O_2/m^3$)	250	923	980	1800	344
Zn (acid sol) (g/m^3)	0.041	0.137	0.094	0.700	0.127
Sulphide (g/m^3)	0.19	1.50	1.26	4.60	1.17
DRP (g/m^3)	0.5	3.3	3.2	7.2	1.5
As (acid sol) (g/m^3)	0.0014	0.0082	0.0021	0.1090	0.0205
Cr III (acid sol) (g/m^3)	0.005	0.046	0.021	0.400	0.077
Cr VI (g/m^3)	0.009	0.009	0.009	0.009	0.000
Cu (acid sol) (g/m^3)	0.0005	0.0071	0.0036	0.0380	0.0083
Ni (acid sol) (g/m^3)	0.0019	0.0047	0.0042	0.0093	0.0019
Pb (acid sol) (g/m^3)	0.00029	0.00183	0.00160	0.00610	0.00120
Hg (acid sol) (g/m^3)	0.000079	0.000079	0.000079	0.000079	0.000000
Cd (acid sol) (g/m^3)	0.000049	0.000150	0.000090	0.000900	0.000214

2.2.3 Condition 14(c) – Annual Sampling Results – Final Combined Wastewater

HDC took samples for seven consecutive days from 26/04/2022. However, due to a sample labelling error the lab did not analyse the annual testing parameters for the first five days. This does not have an impact on compliance as the annual testing parameters are for reference.

HDC has initiated a process change to ensure future samples are correctly labelled. The **annual** sampling results for the final combined wastewater is provided in Table 25.

2.3 Condition 24(c) – Critical Analysis of Monitoring Information

2.3.1 Assessment of Compliance

Table 7 below summarises the conclusion in terms of compliance following the analysis of the monitoring information. Sections 2.3.1.1 to 2.3.1.5 below present the detailed analysis.

Table 7: Summary of Compliance Status – Conditions 2, 5(b), 6, 8 and 19

Condition No.	Condition Summary	Coverage in this Report	Resource Consent Compliance Status *
2	Discharge Rate of Final Combined Wastewater	Section 2.3.1.1 on page 10	 Total Compliance
5(b)	Annual Average Daily $cBOD_5$ Load to BTF Media	Section 2.3.1.2 on page 11	 Total Compliance
6	Final Combined Wastewater Discharged – Heavy Metal and Ammonia	Section 2.3.1.3 on page 11	 Total Compliance
8	Final Combined Wastewater Discharged – Total Oil and Grease	Section 2.3.1.4 on page 11	 Total Compliance
19	Sediment Quality (as per Schedule 2) at 6 Locations	Section 2.3.1.5 on page 12	 Total Compliance

**** Note:***

 *indicates Total Compliance*

 *indicates Minor Non-compliance*

 *indicates Significant Non-compliance*

These indicators are also used in the individual assessment sections and tables to visualise the compliance status.

2.3.1.1 Assessment of Compliance – Condition 2 – Discharge Rate of Final Combined Wastewater

The **maximum** discharge rate of final combined wastewater was **1,992 L/s**, well below the consented limit of 2,800 L/s.

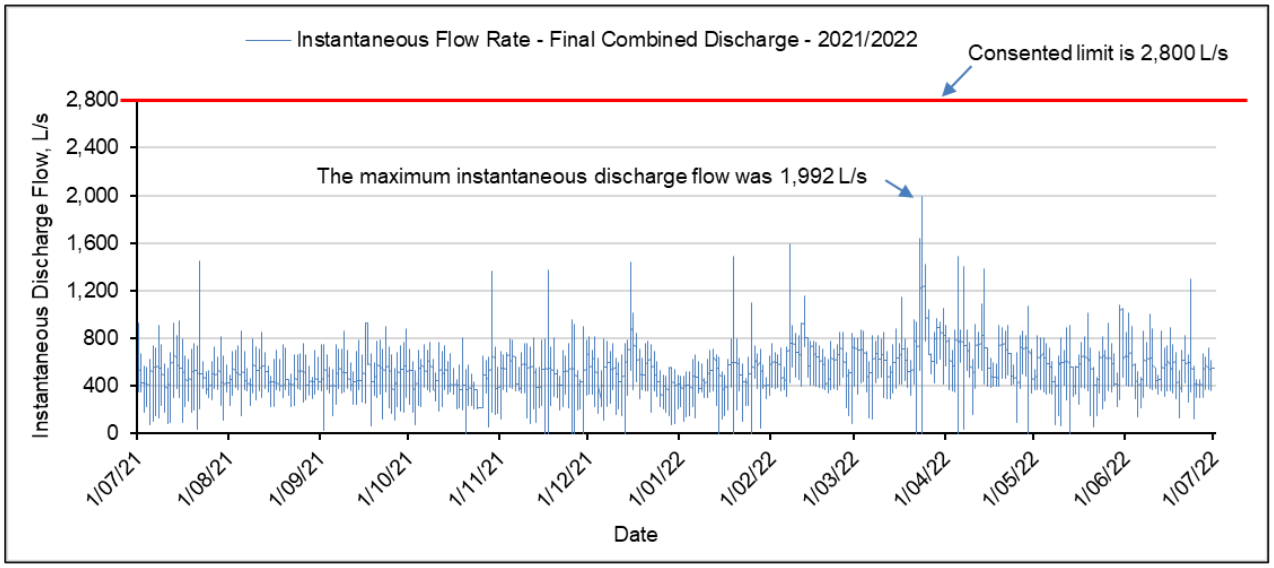


Figure 2: Assessment of Compliance – Condition 2 – Discharge Rate of Final Combined Wastewater
Note: Due to the large quantity of the data, they are presented in the graph. The data can be provided upon request.

2.3.1.2 Assessment of Compliance – Condition 5(b) – Annual Average Daily $cBOD_5$ Loading to BTF Media

The actual annual average daily $cBOD_5$ loading to the BTF media was **0.19 kg/m³**, complying with Condition 5(b).

Table 8: Assessment of Compliance – Condition 5(b) – Annual Average Daily $cBOD_5$ Loading to BTF Media

Analyte	Assessment/Comparison			Compliance Status
	Actual	vs	Consented Limit	
Annual average daily $cBOD_5$ loading to BTF media, kg/m³	0.19	<	0.4	Total Compliance

Summary of the BTF loading data is provided in the figures and table below. The detailed calculated data is provided in Table 22 on page 23.

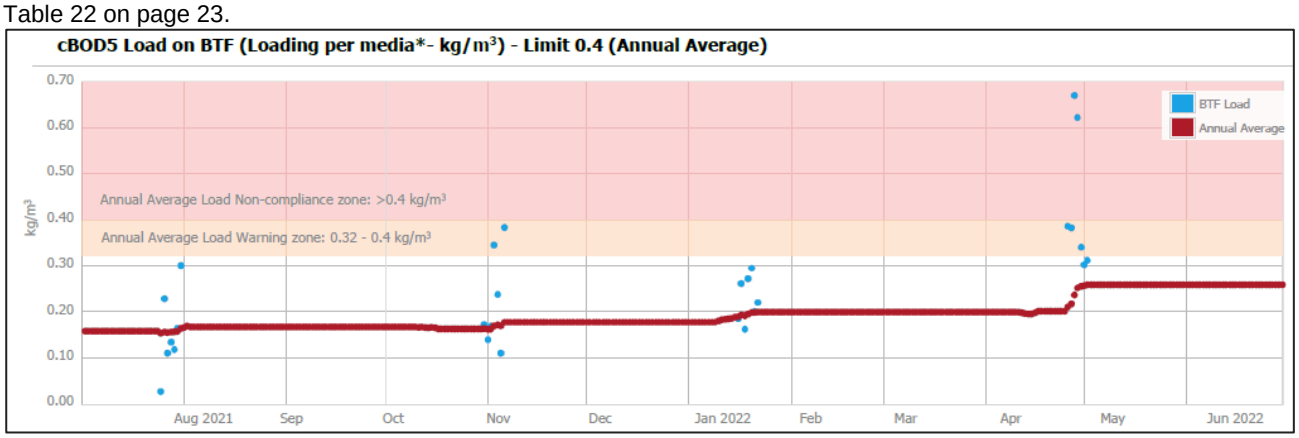


Figure 3: Annual Average $cBOD_5$ Load on BTF

2.3.1.3 Assessment of Compliance – Condition 6 – Final Combined Wastewater – Heavy Metals, and Ammonia

The actual discharged heavy metals and ammonia of the final combined wastewater were well below the Consent Limits and complying with Condition 6. Table 9 below summarises the analysis of the sampling results and assessment of the compliance.

Table 9: Assessment of Compliance – Condition 6 – Final Combined Wastewater – Heavy Metals, and Ammonia

Analyte	Concentration			Daily Loading			Resource Consent Compliance Status
	Max. Discharge (g/m³)	vs	Consent Limit (g/m³)	Max. Discharge (Kg/day)	vs	Consent Limit (Kg/day)	
Chromium III	0.4	<	2.74	17.5	<	143	
Chromium VI	0.009	<	0.44	0.52	<	22.9	
Copper	0.038	<	0.13	1.28	<	6.8	
Zinc	0.7	<	1.5	26.6	<	78	Total Compliance
Cadmium	0.0009	<	0.07	0.0425	<	3.6	
Mercury	Not detected	<	0.01	0.0046	<	0.5	
Lead	0.0061	<	0.44	0.215	<	23	
Nickel	0.0093	<	0.7	0.5	<	36	
Ammonia	25	<	91	1,388	<	4,738	

The analysis of concentration results is provided in Table 6 on page 9, and the full tabulated concentration results are provided in Table 24 on page 29. The tabulated daily loading results (calculated) are provided in Table 26 on page 34.

2.3.1.4 Assessment of Compliance – Condition 8 – Final Combined Wastewater – Total Oil and Grease

The **maximum** TOG concentration in the final combined wastewater discharged was **161 g/m³**, complying with the consented limit of 200 g/m³.

Table 10: Assessment of Compliance – Condition 8 – Final Combined Wastewater – Total Oil and Grease

Analyte	Concentration			Resource Consent Compliance Status
	Max. Discharge g/m³	vs	Consent Limit g/m³	
Total Oil and Grease of Final Combined Wastewater	161	<	200	Total Compliance

The analysis of concentration results is provided in Table 6 on page 9, and the full tabulated concentration results are provided in Table 24 on page 29.

2.3.1.5 Assessment of Compliance – Condition 19 – Sediment Quality (as per Schedule 2) at Six Locations

HDC undertook quarterly sampling for the sediments, which was more frequent than the twice-yearly required by the Consent. Table 11 below summarises the analysis of the sampling results and assessment of compliance.

- The sampling results are compared against the ISQG-Low values of ANZECC (2000) and the DGV of ANZG (2018):
    - All the heavy metal concentrations were below the limit values, except for the total recoverable Mercury measured on 02/11/2021, which was 0.18 mg/kg, over the limit of 0.15 mg/kg. *The concentration of total recoverable Mercury dropped below 0.15 mg/kg in the two following samples.)*
    - Condition 19 requires ***no more than two*** *exceedances of ANZECC 2000 (ISQG – Low) sediment guidelines on* ***one occasion*** *of sampling".* The exceedance (one) is below the Condition 19 threshold (two) and does not breach the Condition. Please refer to Table 28 for the full set of sampling results.

Table 11: Assessment of Compliance – Condition 19 – Sediments – Heavy Metals

	Annual Maximum Value of the Quarterly Sampling Results	ANZECC (2000) * ISQG-Low	ANZG (2018) * DGV	Number of Exceedance	Resource Consent Compliance Status
Total Recoverable Zinc (mg/kg dry wt)	75	200	200	**0**	 Total Compliance
Total Recoverable Arsenic (mg/kg dry wt)	7.3	20	20	**0**	
Total Recoverable Cadmium (mg/kg dry wt)	0.062	1.5	1.5	**0**	
Total Recoverable Chromium (mg/kg dry wt)	38	80	80	**0**	
Total Recoverable Copper (mg/kg dry wt)	13.3	65	65	**0**	
Total Recoverable Tin (mg/kg dry wt)	1.84	5	9	**0**	
Total Recoverable Nickel (mg/kg dry wt)	13.7	21	21	**0**	
Total Recoverable Lead (mg/kg dry wt)	14.6	50	50	**0**	
Total Recoverable Mercury (mg/kg dry wt)	0.18	0.15	0.15	**1**	

** Note: The ANZECC (2000) was superseded by ANZG (2018). The DGV (Default Guide Value) in ANZG (2018) is therefore also listed here for assessment/comparison.*

2.3.2 Assessment of Adverse Environmental Effects

2.3.2.1 Assessment of Environmental Effects – Condition 7 – Beyond 750m, 500m from Midpoint of Diffuser

Table 12 below summarises the outcomes of the assessment of adverse environmental effects per Consent Condition 7.

Table 12: Assessment of Environmental Effects – Condition 7 – Beyond 750m, 500m from Midpoint of Diffuser

Indicator/Parameter	Result/Answer	Supporting Information	Resource Consent Compliance Status
Beyond 750m from the midpoint of the outfall diffuser:			
a) Any production of any conspicuous suspended materials?	No	Observation records *	
b) Any conspicuous change in the colour or visual clarity?	No	Observation records *	
Beyond 500m from the midpoint of the outfall diffuser:			
c) Production of any conspicuous oil or grease films, scums or foams, or floatable materials?	No	Observation records *	
d) Any emission of objectionable odour?	No	Observation records * Zero public complaints	 Total Compliance
e) Any significant adverse effects on aquatic life?	No	NIWA toxicity (Appendix D) Data analysis on receiving water quality (Section 4.4) and sediments (Section 4.5)	
f) A change of the natural temperature of the receiving water by more than 3°C?	No. The maximum change was -2.9°C.	Monitoring records in Figure 22 on page 47	
g) The Dissolved Oxygen concentration is less than 80% of the saturation concentration?	No. The minimum was 101.6%	Field measurement records in Figure 23 on page 48	
h) Undesirable biological growths?	No	Observation records * Diffuser Inspection Report in Appendix E	

** Notes:*

- *Visual observations were made and recorded for locations 500m south, 500m north, 750m south, and 750 north from the centre of the diffuser and directly over the diffuser.*
- *The observation records (29/07/2021, 02/11/2021, 19/01/2022, 26/04/2022) are available and can be provided upon request.*

2.3.2.2 Assessment of Environmental Effects – Condition 15 – Toxicity of Final Combined Wastewater

HDC contracted NIWA (National Institute of Water and Atmospheric Research) to undertake the quarterly toxicity testing for the final combined wastewater discharged from the East Clive Wastewater Treatment Plant.

Table 13 below summarises the key findings and conclusions of the NIWA reports. The reports confirmed the compliance with Condition 15. The complete NIWA reports are provided in Appendix D .

Table 13: Assessment of Environmental Effects – Condition 15 – Toxicity of Final Combined Wastewater

Sampling Date	Summary of Key Findings and Conclusions*	Resource Consent Compliance Status
27/07/2021 – 28/07/2021	The algae, wedge shell and blue mussel tests did not show statistically significant toxicity at a 200-fold dilution (0.5% effluent). After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species. Based on the algae, wedge shell and blue mussel test results for the supplied sample (27-28 July 2021), the wastewater complies with the HBRC consent compliance criteria for no toxicity at the prescribed 200-fold dilution. Ammoniacal-N and hydrogen sulfide concentrations at a 200-fold dilution were 9-fold and 10-fold less than the respective ANZG (2018) default guideline values to protect from chronic toxicity.	 Total Compliance

Sampling Date	Summary of Key Findings and Conclusions*	Resource Consent Compliance Status
01/11/2021 – 02/11/2021	The algae test had an anomalous concentration response curve at the lower concentrations and a no-toxicity dilution could not be calculated. The wedge shell tests showed statistically significant toxicity at 5% effluent and higher but did not show statistically significant toxicity at a 200-fold dilution (0.5% effluent). Normal blue mussel embryo development was significantly affected at the lowest test concentration (0.25% effluent) resulting in a no toxicity dilution of >400-fold. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species. For the effluent sample tested in this quarter, one species had a TEC > 0.5% effluent, one species had a TEC < 0.5% effluent and for the third species a TEC could not be calculated. As no species has had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC10 (acute) or EC20 (chronic) greater than 0.5% effluent, **no further action is required.**	
17/01/2022 – 18/01/2022	The algae, wedge shell and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 71-fold from both the blue mussel and algae tests. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species. For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC10 (acute) or EC20 (chronic) greater than 0.5% effluent, **no further action is required.**	
01/05/2022 – 02/05/2022	The algae, wedge shell, and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 141-fold from both the blue mussel test. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species. For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC10 (acute) or EC20 (chronic) greater than 0.5% effluent **so no further action is required.**	

2.3.2.3 Assessment of Environmental Effects – Conditions 16 – Receiving Water

HDC conducted quarterly sampling of the receiving water as required under condition 16.

Table 14 below summarises the laboratory and field measurements of the receiving water quality. Section 4.4 includes the full data record and analysis of temporal and spatial variations.

Faecal coliform concentration recorded within 500m of the outfall diffuser on 2 September 2021 (refer to **Table 27**) was significantly higher compared with sites beyond 500m, but no difference was observed during the other three sampling rounds. Total suspended solid concentration recorded within 500m of the outfall diffuser on 2nd November 2021 (refer to **Table 27**) was significantly higher compared with sites beyond 500m, but no difference was observed during the other three sampling rounds. For all other variables including nutrients, ammonia, pH, salinity, temperature, dissolved oxygen, and enterococci there was no difference on any sampling round between sites within or beyond 500m from the diffuser.

The nutrients (dissolved inorganic nitrogen and dissolved reactive phosphorus) showed seasonal variation, being slightly elevated at all sites during winter and very low at all sites during the algae growth period of summer/autumn.

Overall, the results indicate that the discharge of wastewater did not significantly influence the water quality at the discharge point. It is unlikely that there were significant adverse effects on aquatic life beyond 500m from the diffuser due to water quality changes (as per conditions 7).

Table 14: Assessment of Environmental Effects – Condition 16 – Receiving Water

Test / Analyte	Distance from the centre of the diffuser (m) *2	Annual Minimum	Annual Average	Annual Maximum	Standard Deviation
Total Suspended Solids *1 (g/m^3)	100-500	2.9	5.3	18.0	3.7
	750-2000	2.9	3.8	8.0	1.3
Total Nitrogen *1 (g/m^3)	100-500	0.1150	0.1769	0.2800	0.0549
	750-2000	0.1070	0.1755	0.2900	0.0541
Total Ammoniacal-N *1 (g/m^3)	100-500	0.0049	0.0069	0.0130	0.0028
	750-2000	0.0049	0.0084	0.0280	0.0053

Test / Analyte	Distance from the centre of the diffuser (m) *2	Annual Minimum	Annual Average	Annual Maximum	Standard Deviation
Nitrate-N + Nitrite-N *1 (g/m^3)	100-500	0.0009	0.0196	0.0560	0.0166
	750-2000	0.0009	0.0176	0.0690	0.0223
Dissolved Reactive Phosphorus *1 (g/m^3)	100-500	0.0014	0.0048	0.0080	0.0023
	750-2000	0.0016	0.0046	0.0087	0.0023
Total Phosphorus *1 (g/m^3)	100-500	0.0050	0.0092	0.0140	0.0026
	750-2000	0.0050	0.0092	0.0150	0.0028
Faecal Coliforms (CFU/100mL)	100-500	0.9	208.2	2100	511.0
	750-2000	0.9	16.4	80.0	25.9
Enterococci (CFU/100mL)	100-500	0.9	9.8	36.0	12.8
	750-2000	0.9	8.0	52.0	13.9
pH	100-500	7.9	8.1	8.2	0.1
	750-2000	7.4	8.1	8.3	0.3
Salinity (psu)	100-500	31.3	32.2	33.29	0.8
	750-2000	30.35	32.0	33.27	0.9
Turbidity (FNU)	100-500	1.36	1.9	3.12	0.6
	750-2000	0.56	2.8	7.93	1.9
Temperature (°C)	100-500	12.1	15.5	21.5	3.8
	750-2000	11.6	15.2	21.6	3.9
Dissolved Oxygen (% Saturation)	100-500	101.3	105.9	111.8	3.7
	750-2000	94.9	105.8	117.4	4.8

** Notes:*

1. *These parameters are not required in the Resource Consent. HDC monitors these extra parameters for more visibility of the impact on the receiving water.*
2. *The resource consent requires monitoring at 10 points up to 1000m from the centre of the diffuser. HDC monitored the quality at additional points at 2000m from the centre of the diffuser.*

2.3.2.4 Assessment of Environmental Effects – Condition 18 – Impact on Benthic Fauna

The first benthic survey should be undertaken during 26th June 2022 and 25th June 2023 which is outside of this reporting year. The survey is currently programmed to be undertaken in January/February 2023 (summer) to be consistent with the previous surveys.

2.3.2.5 Assessment of Environmental Effects – Condition 19 – Sediments

HDC conducted quarterly sampling of the receiving sediments, double the frequency required under condition 19.

Section 4.5 includes the full data record and analysis of temporal and spatial variations.

The results showed minor elevated heavy metal concentrations 250m away from the midpoint of the diffuser compared with concentrations at 500m and 750m away from the diffuser. However, nearly all results complied with the ANZECC (2000) and ANZG (2018) guideline values for heavy metals. A single elevated measurement of mercury, above the guidelines, was observed during the spring sampling round (02 November 2021) 250m north of the diffuser. However, the other three quarterly measurements, including the first and second quarters of 2022 complied with the mercury guideline. Pursuant to condition 19 of the consent, in the event the two or more exceedances of ANZECC (2000) sediment guidelines on one occasion of sampling, then an additional benthic survey is required to be undertaken within one year of the exceedance occurring. In this case, the trigger has not been exceeded, and no further action is required.

Overall, the sediment monitoring undertaken during the reporting year indicates that it is unlikely that there were significant adverse effects on aquatic life beyond 500m from the diffuser due to water benthic heavy metal concentrations (as per conditions 7).

2.4 Condition 24(d) – Annual Average Loads of TSS, $cBOD_5$ and Volume Discharged

Table 15 below summarises the compliance assessment for Condition 24(d) – annual average load of TSS, cBOD5 and daily volume discharged. All the loads were well below their corresponding Consent Trigger Values.

Table 15: Assessment of Compliance – Condition 24(d) – Annual Average Mass Loads of TSS, $cBOD_5$, and Daily Volume Discharged

Analyte	Assessment / Comparison			Resource Consent Compliance Status
	Average Load *3 July 2021 to June 2022	vs	Consent Trigger Value	
$cBOD_5$ Annual Average Mass Load *1 kg/day	16,295	<	48,000	 Total Compliance
TSS Annual Average Mass Load *1 kg/day	16,553	<	39,000	
Total Daily (Annual Average) Volume *2 m^3/day	44,159	<	66,000	

** Notes:*

1. *The annual average mass loads of $cBOD_5$ and TSS are calculated with:*
   - *The results of quarterly quality sampling, and the actual daily volumes of the final combined wastewater discharged on the sampling days; and then*
   - *Averaged over the entire reporting period.*
2. *The annual average daily volume is calculated with:*
   - *The actual daily volume of final combined wastewater discharged is available for the entire reporting period (Figure 4).*
3. *The tabulated daily loading results (calculated) are provided in* Table 24 *on page 29.*

2.5 Condition 24(e) – Non-compliance, Issues and Actions Undertaken

There was one non-compliance event (considered a minor) that occurred during this reporting period, as explained in item 2 in Table 16.

The issues that appeared, the actions that have been undertaken, planned and underway are summarised in Table 16.

Table 16: Condition 24(e) – Summary of Issues and Actions Undertaken, Planned or Underway

No.	Summary of the Issue Occurred	Actions Undertaken, Planned, or Underway
1	A minor leak at the wye connection (diffuser connection) has occurred at the same location as identified in 2020. The leak's location is in the vicinity of the diffuser, and the rate of the leak is comparable to the diffuser ports, and hence does not represent non-compliance.	– The prefabricated WYE piece sealing rings, gasket clamps and gasket, were successfully installed. – There was also no longer any visible surface plume on the surface after the repair.
2	On 23 June 2022, while resolving a wastewater overflow at a manhole on SH51 near Whakatu, approximately 140m^3 of domestic wastewater passed through the industrial wastewater treatment process via the industrial sewer Inland Trunk #2, bypassing the domestic treatment process at the WWTP. This resulted in a non-compliance with Condition 5b.	– Root causes have been identified. – Samples were taken and analysed to understand the impact. – A non-compliance report (Appendix F) was submitted to HBRC on 22 July 2022.

2.6 Condition 24(f) – Improvement Works Undertaken

The significant improvement works that have been undertaken are summarised in Table 17.

Table 17: Condition 24(f) – Summary of Significant Improvement Works Undertaken, Underway, or Planned

No.	Summary of the Improvement Work	Timeframe
1	Replenishment of groyne rock structure (revetment) that protects the outfall structures	Completed
2	Outfall diffuser maintenance with necessary replacement	Completed
3	Outfall pump station steel manifold renewal	2025

2.7 Condition 24(g) – Identification and Analysis of Trends

The trends identified and the comments on them are provided in Table 18. The following symbols are used to reflect the trends to visualise the interpretation:

———	Stable, or generally stable with negligible fluctuation
∿∿∿	Noticeable fluctuation but considered normal (e.g., seasonal changes)
↑	Generally increased (see comments)
↓	Generally decreased (see comments)

Table 18: Summary of Trends Identified and the Comments on Them

Analyte	Trend Over the Reporting Period	Trend vs Previous Years	Comments
FCW – Loads: Annual Average Daily Volume	N/A (annual average; see below for daily volume trend)	———	The Annual Average daily volume last year is slightly higher than 2020/2021, however, it is lower than 2019/2020 and 2018/2019.
FCW – Loads: Daily Volume	∿∿∿	↑	The peak daily discharge volume has increased considerably compared to the last two years, however, it is lower than year 2018/2019.
FCW – Loads: Chromium-III, Chromium-VI, Zinc, Copper, Lead, Nickel	∿∿∿	↓	The loads this year are generally lower than the previous three years, which represents reduced load to environment
FCW – Loads: Mercury, Cadmium	———	———	Most of the concentrations were under the detection limits, and so were the loads.
FCW – Loads: Ammonia, $cBOD_5$, TSS, TOG	∿∿∿	↓	Generally lower than the previous three years, which represents reduced load to environment
FCW – Loads: VOC, SVOC, ON & OP Pesticides, PCP	———	———	Consistently low with most concentrations below detection limits, and so were the loads.
Receiving Water Contaminants: Faecal Coliforms, Enterococci	∿∿∿	———	The quality has been significantly improved compared to the previous years. There was a spike during the 1st quarterly sampling but returned to low for the last three quarterly sampling days.
Sediments: Heavy metals	———	———	No susceptible trends or changes observed.
FCW – Toxicity	∿∿∿	———	The NIWA report advised no further test was required.

2.8 Condition 24(h) – Recommendation for Changes in Monitoring

No changes or additions are recommended to the current consent monitoring programme.

2.9 Condition 24(i) – Details of Any Proposed Changes to Consent Conditions

The proposed changes to Consent Conditions and the reasons behind them are listed in Table 19.

Table 19: Condition 24(i) – Proposed Changes to Consent Conditions

Condition No.	Proposed Change(s)	Reason(s)
19	Use ANZG 2018 (DGV) instead of ANZECC 2000 (ISQG) – Low values for assessing the sediments.	ANZECC (2000) has been superseded by ANZG (2018).

2.10 Condition 24(j) – Details of Wastewater Treatment Plant Open Day

An open day at the East Clive Wastewater Treatment Plant was held on 27 November 2021 in accordance with Consent Condition 26. The details of the open day are summarised in Table 20.

The invitation links and the visitor register can be provided upon request.

Table 20: Condition 24(j) – Summary of the Open Day Details

Condition Requirements	Response
Date and time	27 November 2021, 10am to 1pm
Number of participants from the community	51 (more than doubled compared to last year)
Advance notification/invitation to the community?	Yes. Via Hastings District Council's official website and Facebook page
Attendance by Hastings District Council staff?	Yes
Attendance by Regional Council Compliance Officer?	No
Written questions received?	None
Overall feedback from the community?	Positive

2.11 Condition 24(k) – Tabulated Results of Laboratory Tests

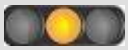
All the laboratory test results are tabulated and provided in Section 4. The original laboratory test reports are available and can be provided upon request.

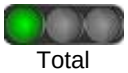
Note: Table 4 on page 8 can be used as a quick guide for locating the individual tables of results for the required tests.

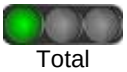
3 Compliance Assessment for Other Conditions

The compliance assessment for other Conditions (i.e., excluding Condition 24 and its extensions) is reported below.

Table 21: Assessment of Compliance – for Conditions Except No. 24 and Its Extensions

Condition No.	Condition Summary	Justification for Compliance Assessment	Resource Consent Compliance Status *
1	Discharge as per Resource Consent	The final combined wastewater was discharged pursuant to the Consent Conditions.	 Total Compliance
3	Discharge to ~2,450m and 2,750m offshore via the existing long offshore outfall structure	The current diffuser is located in the seabed as specified in the Consent.	 Total Compliance
4	Final combined wastewater discharged shall pass through an ocean outfall diffuser to achieve a minimum dilution of 100:1 on slack water	The diffuser was designed and constructed to meet this Condition.	 Total Compliance
Wastewater Treatment and Standards			
5	a) All separable industrial wastewater to pass through a milli-screen with aperture slot width **≤ 1mm** b) Minimum treatment processes for domestic and non-separable industrial water: **3mm** screening → biological trickling filter (**BTF**) → **Rakahore channel** • Average annual daily **$cBOD_5$** loading to BTF media **≤ 0.4kg/m³** • The specific surface area of BTF media **≥ 90m²/m³**	• 5(a) A 1mm ContraShear Subo screen was installed for screening all the separable industrial wastewater. • 5(b) A 3mm Escamax screen and a 3mm centre flow band screen are installed for screening the domestic and non-separable industrial wastewater. For the DNSI, the annual average daily $cBOD_5$ loading to the BTF media was 0.19 kg/m³, complying with Condition 5, and i) The media in the BTF has a specified surface area of 100m²/m³, > 90m²/m³ as defined in the Condition. ii) All the treated wastewater passed through the Rakahore channel before reaching the discharge outfall. • **Minor non-compliance**: On 23 June 2022, while resolving the overflow at a manhole on SH51 near Whakatu, approximately 140m³ of domestic wastewater bypassing the domestic treatment process at the WWTP, via the industrial sewer Inland Trunk #2, instead passing through the industrial wastewater treatment process.	 Minor Non-compliance
9	Inspecting diffuser: • At least annually, and • When necessary Recording and reporting blocked ports, if any	The annual inspection and maintenance was conducted 17/11/2021 – 02/12/2021. • All diffusers were seen good flows except the blanked diffusers #1, #2, and #3. • The Diffuser Inspection and Maintenance Report is provided in Appendix E .	 Total Compliance
10	Maintenance of WW treatment plant and outfall structures	Both preventative and responsive maintenance has been undertaken to maintain and improve the serviceability and reliability of the WWTP and discharge outfall components. The serviced components including but are not limited to: • Inlet screens, pumps, grit removal unit, valves, instruments, compactors, BTF equipment, etc. • Automation control components, including hardware and software • Electrical components The maintenance and service records and logs are available and can be provided upon request.	 Total Compliance

Condition No.	Condition Summary	Justification for Compliance Assessment	Resource Consent Compliance Status *
11	Maintenance of sampling equipment and records of calibration	The instruments are regularly calibrated, verified, and serviced as per their manufacturers' guidance. They included: • Electric Conductivity monitor • Dissolved Oxygen monitor • pH monitor • Turbidity monitor The calibration and verification records are available and can be provided upon request.	 Total Compliance
Monitoring			
17	Surface currents for ≥ 30 minutes at the diffuser centre while sampling as per Condition 16	HDC confirms that the surface currents have been measured and recorded per Condition 17 on: • Q1: 29/07/2021 • Q2: 02/11/2021 • Q3: 19/01/2022 • Q4: 26/04/2022 The data is not listed in this report due to the large amount. The data is available in electronic format and can be provided upon request.	 Total Compliance
20	Quality analysis to be done by IANZ accredited or Regional Council approved laboratories	As described in the Memorandum of Understanding (Appendix C): • All the laboratory analyses were carried out by Hill Laboratories who have the appropriate accreditation • The toxicity tests were carried out by NIWA	 Total Compliance
21	A Memorandum of Understanding (MOU) is in place and being followed	The latest version was updated on 05/11/2020. It was submitted to and approved by the Regional Council. A copy is provided in Appendix C for reference.	 Total Compliance
Administrative			
22	Clear and visible signage including "Shellfish unfit for human consumption" on the buoys marking the diffuser ends	The signage is in place and in accordance with Condition 22. Photos taken during the diffuser inspection are included in Appendix E .	 Total Compliance
23	• Appointment of a person responsible for daily operation and to act as a contact person for Regional Council • Notifying Regional Council of appointment or change of the contact person	This Condition was well followed by HDC. • The day-to-day contact person from HDC side during the reporting period was Kumar Sevaratnam and then David Mackenzie.	 Total Compliance
Reporting			
25	Making each Annual Monitoring Report publicly available	HDC has not received formal notification from HBRC regarding the 2020/2021 Annual Monitoring Report, however, the report has been made available to public as of September 2022. https://www.hastingsdc.govt.nz/documents-and-forms/reports/	 Total Compliance

Condition No.	Condition Summary	Justification for Compliance Assessment	Resource Consent Compliance Status *
26	• Organising a public **open day** at the East Clive Wastewater Treatment Plant in November each year • Reporting it in the next Annual Monitoring Report	• The notification was provided in advance, and an Open Day was held on **27/11/2021**, as summarised in Table 20 per Condition 24(j). Although, • The Compliance Officer was not available for the Open Day.	 Total Compliance
28	**Complaints** received and the actions taken	HDC has a complaint logging system in place. • No complaints were raised regarding the East Clive Wastewater Treatment Plant, the Outfall Structures, the FCW discharge, or their associated environment.	 Total Compliance
29	**Tangata Whenua** engagement**:** • A Council Committee, half of the members of which shall be Tangata Whenua representative • The Committee to function as set out in the condition	The Tangata Whenua Wastewater Joint Committee (constituted as a sub-committee of Council under the Local Government Act 2002) has been functioning well since it was established and complying with the Consent Condition. • The last committee meeting was held on **26/11/2021**. • The meeting agenda and minutes are available and can be provided upon request.	 Total Compliance
30	Immediately notifying Regional Council of any non-compliances that occurred or envisaged or unusual or extreme circumstances	HDC has been alert and proactive regarding issues that may cause non-compliance in accordance with this Condition. • There was no material issue arisen. • The correspondence records between HDC and the Regional Council are available and can be provided upon request.	 Total Compliance
31	Any unforeseen event led to non-compliance - Investigating and reporting within one month	There was one minor non-compliance occurred on 23 June 2022. A non-compliance report (Appendix F) was formally submitted to HBRC.	 Total Compliance
32	Keeping records related to the Consent and making them available to Regional Council upon request	HDC confirms that all the records are kept in order and can be provided to Regional Council upon request.	 Total Compliance

** Note:*

 *indicates Total Compliance*

 *indicates Minor Non-compliance*

 *indicates Significant Non-compliance*

4 Monitoring and Sampling Results

4.1 Actual Daily Volume of Total Combined Discharge (TCD) for Condition 12

Due to the large quantity of the data, the actual daily volumes of final combined wastewater are presented in the graph below. The tabulated data per Condition 12 are available and can be provided upon request.

	Average	Maximum	Minimum	Standard Deviation	Sum
TCD (m^3/day)	44933.60	129367.00	28455.00	10219.30	16176095.0
TCD-Annual Average (m^3/day)	44159.38	45574.18	43186.30	689.44	16074013.0

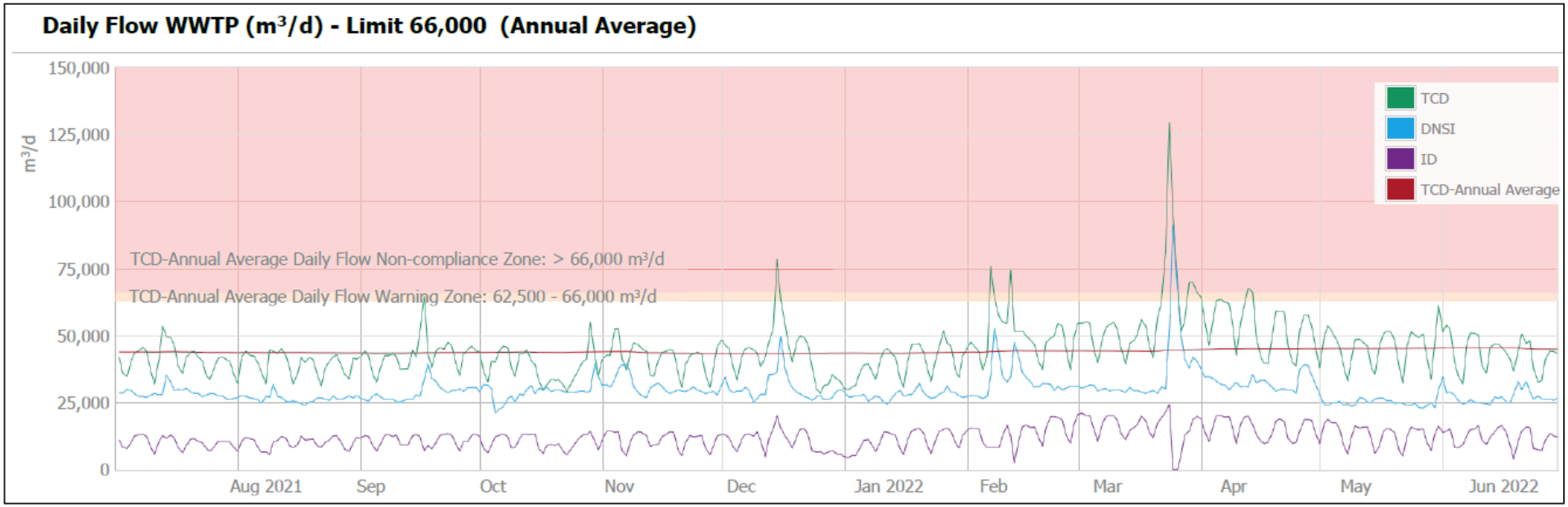


Figure 4: Condition 12 – Actual Daily Volume of Total Combined Discharge (TCD) – SCADA Records

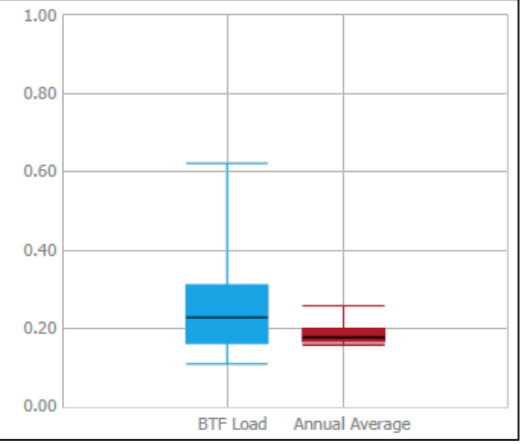
4.2 Tabulated Sampling Results for Condition 14(a) and14(b)

The sampling results per Condition 14(a) and 14(b) are provided in Table 22 and Table 23, respectively. Table 22 and Table 23 include the sampling results of the additional parameters (in addition to the Consent required) obtained by HDC. Figure 5 shows the calculated daily $cBOD_5$ loading to the BTF media.

Table 22: Condition 14(a) – DNSI Influent (Before BTF and after Screening) – Quarterly Sampling Results

Quarter No.	Sampling Date	TSS (g/m^3)	TOG (g/m^3)	$cBOD_5$ ($g\ O_2/m^3$)	COD ($g\ O_2/m^3$)	Ash (g/m^3)	Nitrate-N (g/m^3)	Nitrate-N + Nitrite-N (g/m^3)	Nitrite-N (g/m^3)	Total NH_3-N (g/m^3)	Total Inorganic-N (g/m^3)	Total Solids (TS) (g/m^3)	Volatile Total Solids (g/m^3)
1	25/07/2021	100	21	20	250	260	0.09	0.09	0.09	26	26.09	440	177
	26/07/2021	220	46	165	410	310	0.09	0.09	0.09	27	27.09	590	280
	27/07/2021	86	15	82	240	260	0.09	0.09	0.09	18.9	18.99	440	173
	28/07/2021	87	23	100	300	250	0.09	0.09	0.09	28	28.09	420	171
	29/07/2021	105	16	91	230	260	0.09	0.09	0.09	16.3	16.39	440	177
	30/07/2021	123	32	127	330	310	0.09	0.09	0.09	28	28.09	460	460
	31/07/2021	300	48	230	560	220	0.09	0.09	0.09	25	25.09	590	590
2	1/11/2021	150	36	112	400	280	0.09	0.09	0.09	26	26.09	530	240
	2/11/2021	139	24	90	270	260	0.09	0.09	0.09	18.9	18.99	470	210
	3/11/2021	110	17	112	340	194	0.09	0.09	0.09	21	21.09	500	310
	4/11/2021	360	88	210	620	270	0.09	0.09	0.09	19.9	19.99	680	420
	5/11/2021	380	83	129	500	250	0.09	0.09	0.09	15.1	15.19	500	250
	6/11/2021	42	13	58	146	240	0.09	0.09	0.09	17.2	17.29	350	116
	7/11/2021	360	44	200	600	280	0.09	0.09	0.09	19.9	19.99	670	400
3	17/01/2022	192	42	136	390	260	0.09	0.09	0.09	32	32.09	510	250
	18/01/2022	182	41	190	480	270	0.09	0.09	0.09	27	27.09	540	270
	19/01/2022	156	42	111	340	260	0.09	0.09	0.09	26	26.09	460	200
	20/01/2022	210	77	172	540	270	0.09	0.09	0.09	29	29.09	560	290
	21/01/2022	230	62	210	410	260	0.09	0.09	0.09	28	28.09	570	300
	22/01/2022	173	38	150	400	250	0.09	0.09	0.09	26	26.09	500	250
	23/01/2022	171	48	169	410	240	0.09	0.09	0.09	27	27.09	490	250
4	26/04/2022	109	260	210	470	24	0.09	0.09	0.09	116	116.09	380	25
	27/04/2022	160	240	200	440	24	0.09	0.09	0.09	122	122.09	320	34
	28/04/2022	161	157	350	510	24	0.09	0.09	0.09	131	131.09	330	31
	29/04/2022	210	210	360	560	24	0.09	0.09	0.09	123	123.09	400	39
	30/04/2022	115	172	220	390	24	0.09	0.09	0.09	107	107.09	320	32
	1/05/2022	140	250	220	470	16.8	0.09	0.09	0.09	97	97.09	320	27
	2/05/2022	152	230	260	490	28	0.09	0.09	0.09	114	114.09	360	31
Analysis of Data Above	Annual Maximum	380	260	360	620	310	0.09	0.09	0.09	131	131.09	680	590
	Annual Median	158	45	167	410	255	0.1	0.1	0.1	27	27.1	465	225
	Annual Average	175.8	84.8	167.3	410.6	200.7	0.1	0.1	0.1	46.9	47	469.3	214.4
	Annual Minimum	42	13	20	146	16.8	0.09	0.09	0.09	15.1	15.19	320	25
	Standard Deviation	85	82	79	119	106	0.0	0.0	0.0	41	41	101	145

	Minimum	Average	Maximum	Standard Deviation
BTF Load kg/m³	0.03	0.26	0.67	0.14
Annual Average BTF Load kg/m³	0.15	0.19	0.26	0.03



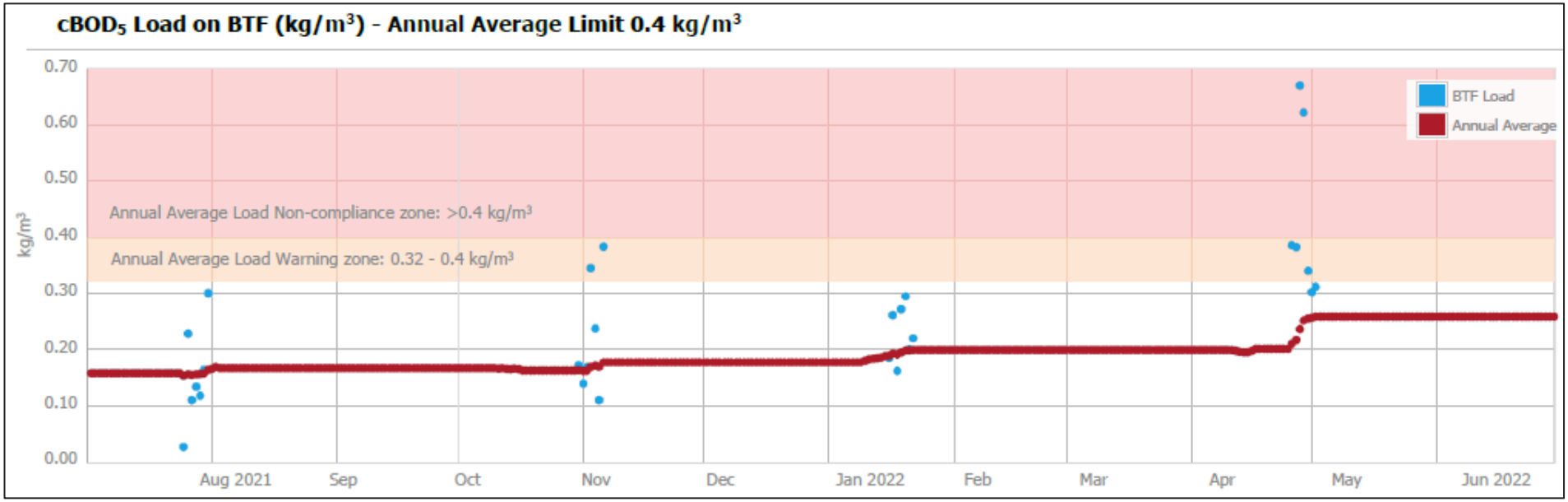


Figure 5: Condition 5 – Daily cBOD5 Loading to BTF Media

** Note: The daily $cBOD_5$ loading rates to the BTF media are calculated based on: the total BTF media volume (m^3); the daily DNSI influent flow rates (m^3/day); and the corresponding daily $cBOD_5$ concentration (g/m^3) for that day.*

Table 23: Condition 14(b) – BTF Treated Wastewater – Quarterly Sampling Results

Quarter No.	Sampling Date	TSS (g/m^3)	TOG (g/m^3)	$cBOD_5$ ($g\ O_2/m^3$)	COD ($g\ O_2/m^3$)	Ash (g/m^3)	Nitrate-N (g/m^3)	Nitrate-N + Nitrite-N (g/m^3)	Nitrite-N (g/m^3)	Total NH_3-N (g/m^3)	Total Inorganic-N (g/m^3)	Total Solids (TS) (g/m^3)	Volatile Total Solids (g/m^3)
1	25/07/2021	96	10	80	172	290	4.2	5	0.79	16.1	21.1	450	167
	26/07/2021	62	7	16	130	270	3.5	4.1	0.62	15.3	19.4	410	137
	27/07/2021	86	8	33	148	290	3.3	3.9	0.61	15.3	19.2	460	163
	28/07/2021	50	4	16	138	260	2.8	3.5	0.62	15.5	19	410	155
	29/07/2021	52	5	24	111	260	2.9	3.5	0.69	16.2	19.7	400	141
	30/07/2021	29	4	11	93	89	3.4	4.1	0.64	16.6	20.7	240	240
	31/07/2021	240	16	34	270	310	3.1	3.8	0.67	15.7	19.5	430	430
2	1/11/2021	110	4.9	18	184	290	1.76	2.2	0.47	16.4	18.6	430	142
	2/11/2021	130	10	35	136	280	2.6	3.1	0.56	20	23.1	460	179
	3/11/2021	69	10	14	149	250	2.5	3.1	0.6	17.5	20.6	370	125
	4/11/2021	41	7	11	105	159	2.4	2.8	0.44	13.6	16.4	360	200
	5/11/2021	58	15	29	138	250	1.56	2.2	0.6	10.6	12.8	350	106
	6/11/2021	61	11	15	136	250	2	2.7	0.67	12	14.7	360	103
	7/11/2021	26	5	12	69	240	2.5	3.2	0.67	12.4	15.6	340	96
3	17/01/2022	67	8	21	144	250	2.2	2.9	0.78	14.9	17.8	410	158
	18/01/2022	74	9	27	150	280	2.1	2.8	0.65	14.4	17.2	410	131
	19/01/2022	68	11	13	132	240	1.38	1.91	0.53	9.7	11.61	360	124
	20/01/2022	88	11	31	164	240	1.24	1.89	0.66	12.9	14.79	370	124
	21/01/2022	60	9	23	169	260	0.56	1.11	0.55	15.7	16.81	390	130
	22/01/2022	177	16	28	280	280	0.99	1.49	0.51	12.9	14.39	480	198
	23/01/2022	57	8	13	132	177	1.39	2.2	0.83	12.1	14.3	300	123
4	26/04/2022	114	220	210	430	21	0.09	0.16	0.2	27	27.16	210	20
	27/04/2022	86	210	197	410	18	0.09	0.09	0.11	42	42.09	157	20
	28/04/2022	39	99	134	230	19.1	0.09	0.09	0.09	30	30.09	115	8
	29/04/2022	99	270	141	410	19.8	0.09	0.09	0.09	33	33.09	176	17
	30/04/2022	46	240	105	350	22	0.09	0.09	0.09	27	27.09	166	9
	1/05/2022	36	240	108	350	21	0.09	0.09	0.09	15	15.09	136	7
	2/05/2022	162	280	230	510	22	0.09	0.09	0.09	61	61.09	280	27
Analysis of Data Above	Annual Maximum	240	280	230	510	310	4.2	5	0.83	61	61.09	480	430
	Annual Median	67.5	10	27.5	149.5	250	1.9	2.5	0.6	15.6	19.1	365	127.5
	Annual Average	81.5	62.4	58.2	208.6	191.4	1.8	2.2	0.5	19.3	21.5	336.8	124.3
	Annual Minimum	26	4	11	69	18	0.09	0.09	0.09	9.7	11.61	115	7
	Standard Deviation	60	7	70	98	58	0.8	0.9	0.2	2.5	2.4	69	75

Figure 6 to Figure 10 present the analysis of BTF's $cBOD_5$, TSS, TOG, NH_3/NH_4^+, and total inorganic Nitrogen removal performance. The analysis is based on the data included in Table 22 and Table 23 above. The key findings are summarised in Section 2.2.1 on page 8. Note that the treated wastewater $cBOD_5$, TSS, TOG, NH_3/NH_4^+ were low despite a few low removal % were seen during the period. The low or negative removal % appeared when the influent concentrations of the parameters were low.

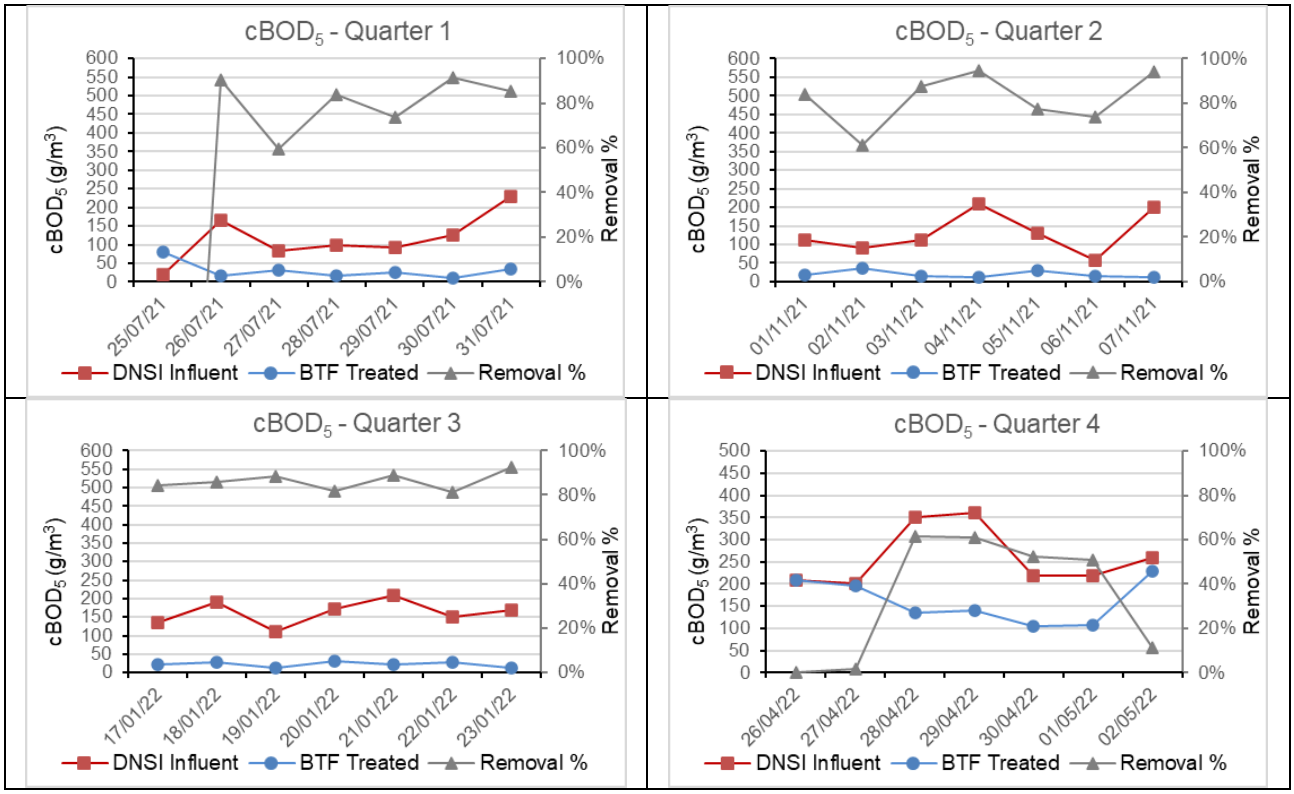


Figure 6: Analysis of BTF Performance – $cBOD_5$ Removal

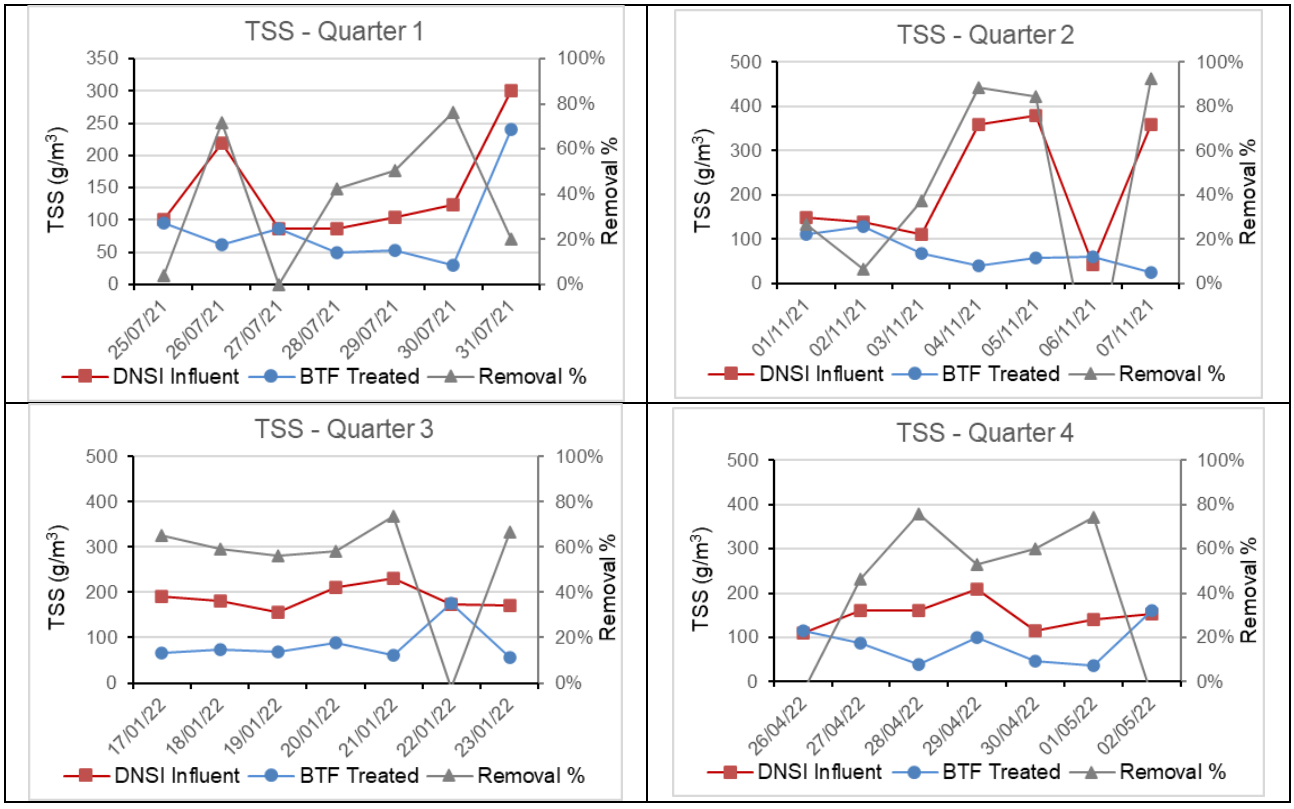


Figure 7: Analysis of BTF Performance – TSS Removal

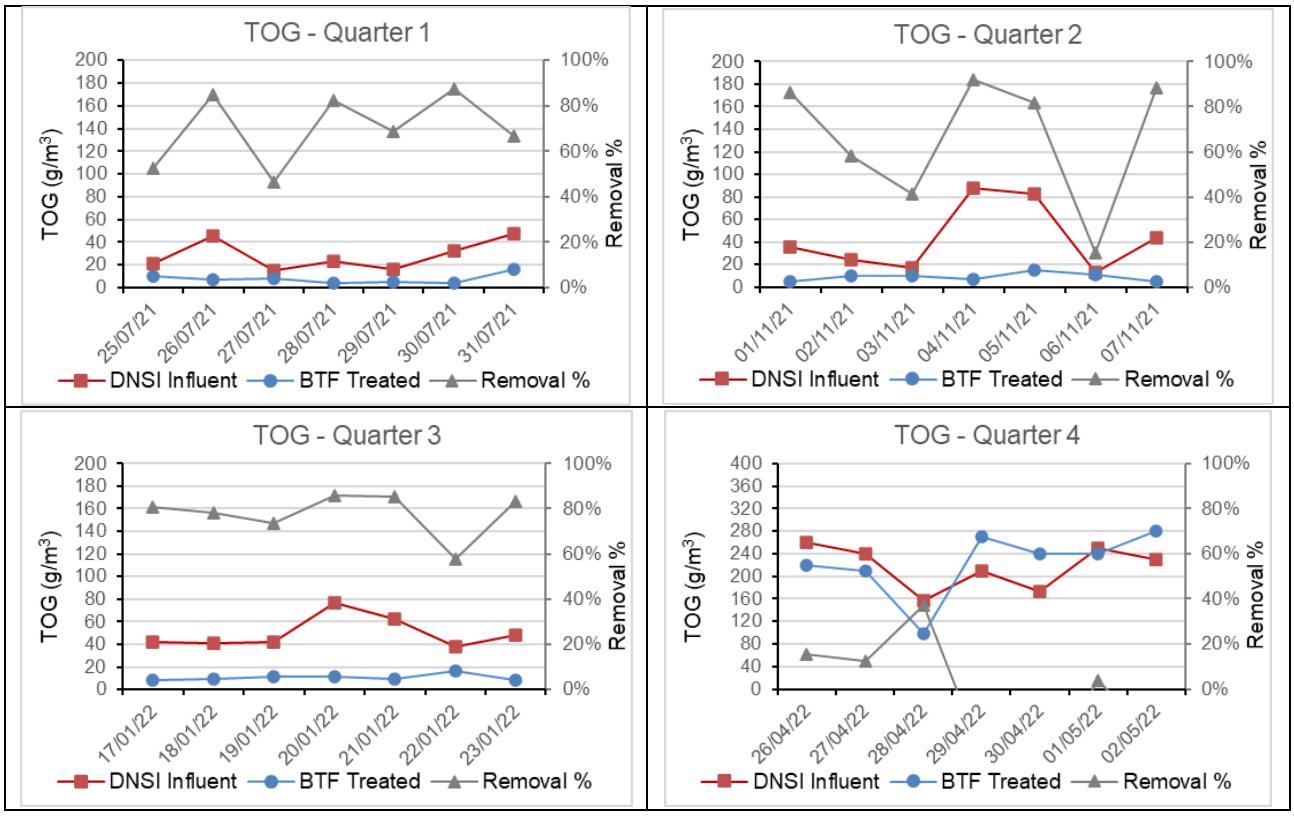


Figure 8: Analysis of BTF Performance – TOG Removal

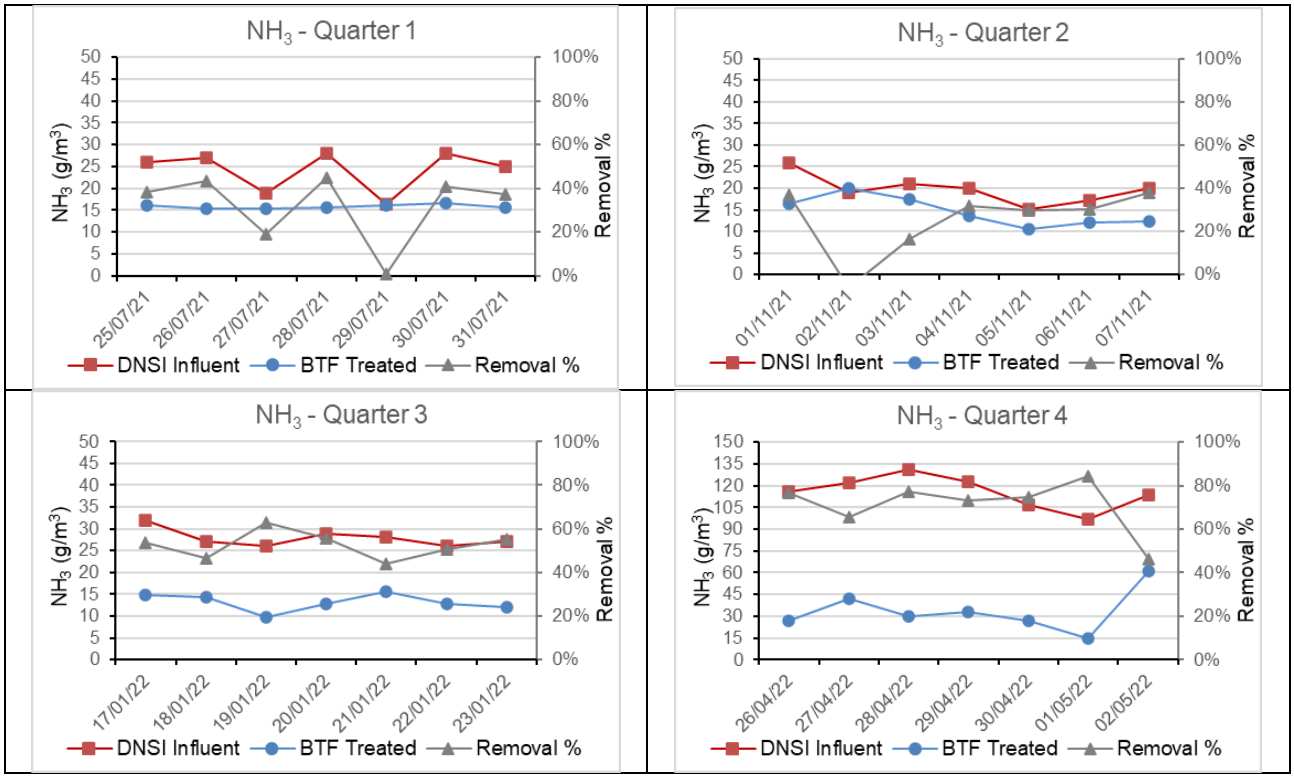


Figure 9: Analysis of BTF Performance – NH_3 Removal

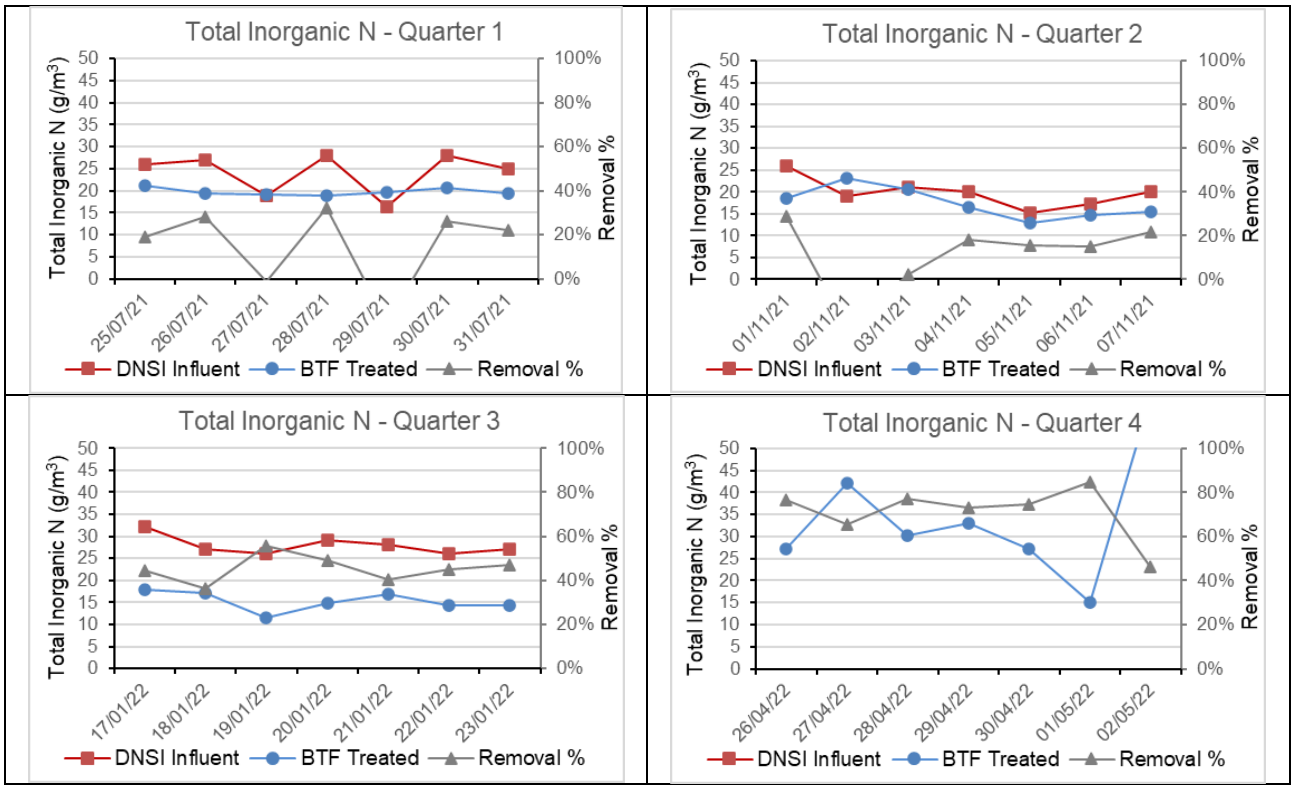


Figure 10: Analysis of BTF Performance – Total Inorganic Nitrogen Removal

4.3 Tabulated Sampling Results for Condition 14(c) and Calculated Daily Loads for Condition 6

The quarterly and annual sampling results per Condition 14(c) are provided in Table 24 and Table 25, respectively. The daily loads of heavy metals, Ammonia, TSS, and $cBOD_5$ calculated based on the quarterly sampling of the final combined wastewater per Condition 6 are provided in Table 26.

Table 24: Condition 14(c) – Final Combined Wastewater – Quarterly Sampling Results

Quarter No.	Sampling Date	pH	EC (mS/m)	TOG (g/m^3)	TSS (g/m^3)	NH4-N (g/m^3)	cBOD5 ($g\ O_2/m^3$)	Zn (acid sol) (g/m^3)	Sulphide (g/m^3)	DRP (g/m^3)	As (acid sol) (g/m^3)	Cr III (acid sol) (g/m^3)	Cr VI (g/m^3)	Cu (acid sol) (g/m^3)	Ni (acid sol) (g/m^3)	Pb (acid sol) (g/m^3)	Hg (acid sol) (g/m^3)	COD ($g\ O_2/m^3$)	Cd (acid sol) (g/m^3)
1	25/07/2021	6.0	109.5	43	260	9.8	430	0.171	0.19	1.3	0.0040	0.012	0.009	0.0380	0.0036	0.00120	0.000079	1010	0.000090
	26/07/2021	6.5	139.1	97	610	17.4	340	0.700	0.25	2.8	0.0030	0.041	0.009	0.0108	0.0042	0.00430	0.000079	1220	0.000100
	27/07/2021	6.6	142.1	46	124	16.7	450	0.092	0.41	2.7	0.0019	0.030	0.009	0.0079	0.0033	0.00090	0.000079	900	0.000090
	28/07/2021	6.3	164.1	123	310	19.5	370	0.198	1.77	3.3	0.0019	0.057	0.009	0.0048	0.0040	0.00220	0.000079	1310	0.000090
	29/07/2021	6.3	186.1	81	840	17.0	410	0.123	1.42	3.0	0.0019	0.129	0.009	0.0016	0.0041	0.00130	0.000079	960	0.000090
	30/07/2021	6.4	184.9	102	430	23.0	460	0.143	2.20	5.2	0.0019	0.022	0.009	0.0018	0.0047	0.00160	0.000079	1020	0.000090
	31/07/2021	6.7	185.8	75.4	1160	25.0	540	0.350	1.26	3.3	0.0019	0.089	0.009	0.0016	0.0062	0.00610	0.000079	1800	0.000170
2	1/11/2021	6.9	102.9	38	115	16.5	270	0.067	0.30	3.1	0.0020	0.005	0.009	0.0051	0.0042	0.00070	0.000079	620	0.000090
	2/11/2021	7.0	138.0	52	187	20.0	300	0.074	1.03	4.2	0.0020	0.019	0.009	0.0024	0.0038	0.00070	0.000079	690	0.000090
	3/11/2021	6.8	140.4	34	125	24.0	300	0.041	1.70	0.5	0.0014	0.010	0.009	0.0005	0.0029	0.00029	0.000079	730	0.000049
	4/11/2021	7.1	139.2	161	520	23.0	350	0.129	1.25	3.0	0.0025	0.032	0.009	0.0021	0.0048	0.00166	0.000079	1080	0.000090
	5/11/2021	6.8	139.2	161	520	23.0	350	0.129	1.25	3.0	0.0025	0.032	0.009	0.0021	0.0048	0.00166	0.000079	1080	0.000090
	6/11/2021	7.2	174.8	58	182	19.7	124	0.095	0.44	2.0	0.0020	0.023	0.009	0.0023	0.0031	0.00130	0.000079	440	0.000090
	7/11/2021	7.1	106.3	28	102	14.7	33	0.069	0.23	1.9	0.0018	0.005	0.009	0.0035	0.0019	0.00114	0.000079	250	0.000049
3	17/01/2022	6.2	168.2	100	380	19.1	470	0.122	1.86	4.3	0.0019	0.016	0.009	0.0036	0.0070	0.00190	0.000079	1110	0.000110
	18/01/2022	6.1	214.0	82	330	13.6	560	0.079	2.70	4.8	0.0060	0.036	0.009	0.0029	0.0040	0.00130	0.000079	1170	0.000090
	19/01/2022	6.2	207.0	98	350	17.6	330	0.070	1.33	4.7	0.0190	0.052	0.009	0.0090	0.0090	0.00189	0.000079	1000	0.000900
	20/01/2022	6.1	206.0	86	330	25.0	580	0.090	4.60	7.2	0.0190	0.023	0.009	0.0090	0.0090	0.00189	0.000079	1220	0.000900
	21/01/2022	5.9	195.4	65	350	18.5	500	0.081	3.90	5.1	0.1090	0.400	0.009	0.0260	0.0036	0.00140	0.000079	1130	0.000090
	22/01/2022	6.0	209.0	93	530	22.0	400	0.250	3.30	5.0	0.0210	0.142	0.009	0.0028	0.0056	0.00280	0.000079	910	0.000160
	23/01/2022	6.9	133.6	24	159	17.6	162	0.083	1.11	3.7	0.0070	0.013	0.009	0.0035	0.0020	0.00120	0.000079	490	0.000090
4	26/04/2022	5.7	168.3	91	850	16.0	540	0.093	2.80	4.3	0.0030	0.014	0.009	0.0033	0.0042	0.00400	0.000079	1460	0.000150
	27/04/2022	6.2	144.2	64	350	13.9	330	0.063	1.23	3.2	0.0020	0.019	0.009	0.0057	0.0029	0.00160	0.000079	680	0.000090
	28/04/2022	6.4	125.8	53	320	24.0	510	0.074	2.70	3.2	0.0018	0.010	0.009	0.0020	0.0040	0.00160	0.000079	660	0.000070
	29/04/2022	6.6	140.8	60	340	22.0	340	0.144	0.82	2.1	0.0027	0.017	0.009	0.0145	0.0093	0.00220	0.000079	920	0.000090
	30/04/2022	7.0	137.0	41	191	19.6	210	0.087	0.27	1.7	0.0016	0.014	0.009	0.0159	0.0047	0.00120	0.000079	510	0.000060
	1/05/2022	7.5	97.2	44	210	18.2	150	0.110	0.23	2.0	0.0030	0.009	0.009	0.0118	0.0055	0.00170	0.000079	440	0.000060
	2/05/2022	6.4	131.5	67	310	19.3	400	0.120	1.42	1.7	0.0022	0.017	0.009	0.0050	0.0059	0.00158	0.000079	1020	0.000060
Analysis of Data Above	Annual Maximum	7.5	214.0	161	1160	25.0	580	0.700	4.60	7.2	0.1090	0.400	0.009	0.0380	0.0093	0.00610	0.000079	1800	0.000900
	Annual Median	6.5	141.5	66	330	19.2	360	0.094	1.26	3.2	0.0021	0.021	0.009	0.0036	0.0042	0.00160	0.000079	980	0.000090
	Annual Average	6.5	154.7	74	374	19.1	365	0.137	1.50	3.3	0.0082	0.046	0.009	0.0071	0.0047	0.00183	0.000079	923	0.000150
	Annual Minimum	5.7	97.2	24	102	9.8	33	0.041	0.19	0.5	0.0014	0.005	0.009	0.0005	0.0019	0.00029	0.000079	250	0.000049
	Annual Standard Deviation	0.4	34.1	35	248	3.8	139	0.127	1.17	1.5	0.0205	0.077	3.53311E-18	0.008	0.0019	0.00120	0	344	0.000214

Table 25: Condition 14(c) – Final Combined Wastewater – Annual Sampling Results
HDC took samples for seven consecutive days from 26/04/2022. However, due to a sample labelling error the lab did not analyse the annual testing parameters for the first five days. This does not impact the compliance as the annual testing parameters are for reference.

HDC has initiated a process change to ensure future samples are correctly labelled.

Date *	1/05/2022	2/05/2022
pH (pH Units)	7.5	6.4
Total Solids (TS) (g/m3)	810	1250
Dissolved Mercury (g/m3)	7.90E-05	7.90E-05
Total Mercury (g/m3)	7.90E-05	7.90E-05
Total Cyanide (g/m3)	0.019	0.019
Nitrite-N (g/m3)	0.019	0.019
Nitrate-N (g/m3)	0.019	0.019
Nitrate-N + Nitrite-N (g/m3)	0.019	0.019
Total Kjeldahl Nitrogen (TKN) (g/m3)	24	48
Total Phosphorus (g/m3)	4.4	4.4
Total Organic Carbon (TOC) (g/m3)	105	187
Total Phenols (g/m3)	0.06	0.07
Acetochlor (g/m3)	0.0019	0.0019
Alachlor (g/m3)	0.0009	0.0009
Atrazine (g/m3)	0.0019	0.0019
Atrazine-desethyl (g/m3)	0.0019	0.0019
Atrazine-desisopropyl (g/m3)	0.0039	0.0039
Azaconazole (g/m3)	0.0009	0.0009
Azinphos-methyl (g/m3)	0.0039	0.0039
Benalaxyl (g/m3)	0.0009	0.0009
Bitertanol (g/m3)	0.0039	0.0039
Bromacil (g/m3)	0.0019	0.0019
Bromopropylate (g/m3)	0.0019	0.0019
Butachlor (g/m3)	0.019	0.019
Captan (g/m3)	0.0039	0.0039
Carbaryl (g/m3)	0.0019	0.0019
Carbofuran (g/m3)	0.0019	0.0019
Chlorfluazuron (g/m3)	0.019	0.019
Chlorothalonil (g/m3)	0.0019	0.0019
Chlorpyrifos (g/m3)	0.0019	0.0019
Chlorpyrifos-methyl (g/m3)	0.0019	0.0019
Chlortoluron (g/m3)	0.0039	0.0039
Cyanazine (g/m3)	0.0019	0.0019
Cyfluthrin (g/m3)	0.0029	0.0029
Cyhalothrin (g/m3)	0.0019	0.0019
Cypermethrin (g/m3)	0.0049	0.0049
Deltamethrin (including Tralomethrin) (g/m3)	0.0019	0.0019
Diazinon (g/m3)	0.0009	0.0009
Dichlofluanid (g/m3)	0.0019	0.0019
Dichloran (g/m3)	0.0049	0.0049
Dichlorvos (g/m3)	0.0019	0.0019
Difenoconazole (g/m3)	0.0029	0.0029
Dimethoate (g/m3)	0.0039	0.0039
Diphenylamine (g/m3)	0.0039	0.0039
Diuron (g/m3)	0.0019	0.0019
Fenpropimorph (g/m3)	0.0019	0.0019
Fluazifop-butyl (g/m3)	0.0019	0.0019
Fluometuron (g/m3)	0.0019	0.0019
Flusilazole (g/m3)	0.0019	0.0019
Fluvalinate (g/m3)	0.00149	0.00149
Furalaxyl (g/m3)	0.0009	0.0009
Haloxyfop-methyl (g/m3)	0.0019	0.0019
Hexaconazole (g/m3)	0.0019	0.0019
Hexazinone (g/m3)	0.0009	0.0009
IPBC (3-Iodo-2-propynyl-n-butylcarbamate) (g/m3)	0.009	0.009
Kresoxim-methyl (g/m3)	0.0009	0.0009
Linuron (g/m3)	0.0019	0.0019
Malathion (g/m3)	0.0019	0.0019
Metalaxyl (g/m3)	0.0019	0.0019
Metolachlor (g/m3)	0.0009	0.0009
Metribuzin (g/m3)	0.0019	0.0019
Molinate (g/m3)	0.0039	0.0039
Myclobutanil (g/m3)	0.0019	0.0019
Naled (g/m3)	0.009	0.009

Date *	1/05/2022	2/05/2022
Norflurazon (g/m3)	0.0039	0.0039
Oxadiazon (g/m3)	0.0019	0.0019
Oxyfluorfen (g/m3)	0.0009	0.0009
Paclobutrazol (g/m3)	0.019	0.019
Parathion-ethyl (g/m3)	0.0019	0.0019
Parathion-methyl (g/m3)	0.0019	0.0019
Pendimethalin (g/m3)	0.0019	0.0019
Permethrin (g/m3)	0.00059	0.00059
Pirimicarb (g/m3)	0.0019	0.0019
Pirimiphos-methyl (g/m3)	0.0019	0.0019
Prochloraz (g/m3)	0.009	0.009
Procymidone (g/m3)	0.0019	0.0019
Prometryn (g/m3)	0.0009	0.0009
Propachlor (g/m3)	0.0019	0.0019
Propanil (g/m3)	0.0039	0.0039
Propazine (g/m3)	0.0009	0.0009
Propiconazole (g/m3)	0.00149	0.00149
Pyriproxyfen (g/m3)	0.0019	0.0019
Quizalofop-ethyl (g/m3)	0.0019	0.0019
Simazine (g/m3)	0.0019	0.0019
Simetryn (g/m3)	0.0019	0.0019
Sulfentrazone (g/m3)	0.009	0.009
TCMTB [2-(thiocyanomethylthio)benzothiazole,Busan] (g/m3)	0.0039	0.0039
Tebuconazole (g/m3)	0.0019	0.0019
Terbacil (g/m3)	0.0019	0.0019
Terbufos (g/m3)	0.0019	0.0019
Terbumeton (g/m3)	0.0019	0.0019
Terbuthylazine (g/m3)	0.0009	0.0009
Terbuthylazine-desethyl (g/m3)	0.0019	0.0019
Terbutryn (g/m3)	0.019	0.019
Thiabendazole (g/m3)	0.009	0.009
Thiobencarb (g/m3)	0.0019	0.0019
Tolylfluanid (g/m3)	0.0009	0.0009
Triazophos (g/m3)	0.0019	0.0019
Trifluralin (g/m3)	0.0019	0.0019
Vinclozolin (g/m3)	0.0019	0.0019
Dissolved Arsenic (g/m3)	0.0025	0.0023
Dissolved Cadmium (g/m3)	4.90E-05	4.90E-05
Dissolved Chromium (g/m3)	0.0062	0.0093
Dissolved Copper (g/m3)	0.019	0.0055
Dissolved Lead (g/m3)	0.00045	0.00015
Dissolved Nickel (g/m3)	0.0036	0.0039
Dissolved Zinc (g/m3)	0.043	0.021
Total Arsenic (g/m3)	0.0052	0.005
Total Cadmium (g/m3)	8.40E-05	0.000124
Total Chromium (g/m3)	0.029	0.057
Total Copper (g/m3)	0.078	0.086
Total Lead (g/m3)	0.0024	0.0026
Total Nickel (g/m3)	0.0069	0.008
Total Zinc (g/m3)	0.18	0.176
Pentachlorophenol (PCP) (g/m3)	4.90E-05	4.90E-05
2,3,4,6-Tetrachlorophenol (TCP) (g/m3)	4.90E-05	4.90E-05
Bis(2-chloroethoxy) methane (g/m3)	0.0049	0.0049
Bis(2-chloroethyl)ether (g/m3)	0.0049	0.0049
Bis(2-chloroisopropyl)ether (g/m3)	0.0049	0.0049
4-Bromophenyl phenyl ether (g/m3)	0.0049	0.0049
4-Chlorophenyl phenyl ether (g/m3)	0.0049	0.0049
2,4-Dinitrotoluene (g/m3)	0.009	0.009
2,6-Dinitrotoluene (g/m3)	0.009	0.009
Nitrobenzene (g/m3)	0.0049	0.0049
N-Nitrosodi-n-propylamine (g/m3)	0.009	0.009
N-Nitrosodiphenylamine + Diphenylamine (g/m3)	0.009	0.009
Aldrin (g/m3)	0.0049	0.0049
alpha-BHC (g/m3)	0.0049	0.0049
beta-BHC (g/m3)	0.0049	0.0049
delta-BHC (g/m3)	0.0049	0.0049
gamma-BHC (Lindane) (g/m3)	0.0049	0.0049
4,4'-DDD (g/m3)	0.0049	0.0049
4,4'-DDE (g/m3)	0.0049	0.0049
4,4'-DDT (g/m3)	0.009	0.009
Dieldrin (g/m3)	0.0049	0.0049
Endosulfan I (g/m3)	0.009	0.009

Date *	1/05/2022	2/05/2022
Endosulfan II (g/m3)	0.009	0.009
Endosulfan sulfate (g/m3)	0.009	0.009
Endrin (g/m3)	0.009	0.009
Endrin ketone (g/m3)	0.009	0.009
Heptachlor (g/m3)	0.0049	0.0049
Heptachlor epoxide (g/m3)	0.0049	0.0049
Hexachlorobenzene (g/m3)	0.0049	0.0049
Acenaphthene (g/m3)	0.0029	0.0029
Acenaphthylene (g/m3)	0.0029	0.0029
Anthracene (g/m3)	0.0029	0.0029
Benzo[a]anthracene (g/m3)	0.0029	0.0029
Benzo[a]pyrene (BAP) (g/m3)	0.0029	0.0029
Benzo[b]fluoranthene + Benzo[j]fluoranthene (g/m3)	0.0029	0.0029
Benzo[g,h,i]perylene (g/m3)	0.0029	0.0029
Benzo[k]fluoranthene (g/m3)	0.0029	0.0029
1&2-Chloronaphthalene (g/m3)	0.0029	0.0029
Chrysene (g/m3)	0.0029	0.0029
Dibenzo[a,h]anthracene (g/m3)	0.0029	0.0029
Fluoranthene (g/m3)	0.0029	0.0029
Fluorene (g/m3)	0.0029	0.0029
Indeno(1,2,3-c,d)pyrene (g/m3)	0.0029	0.0029
2-Methylnaphthalene (g/m3)	0.0029	0.0029
Naphthalene (g/m3)	0.0029	0.0029
Phenanthrene (g/m3)	0.0029	0.0029
Pyrene (g/m3)	0.0029	0.0029
4-Chloro-3-methylphenol (g/m3)	0.009	0.034
2-Chlorophenol (g/m3)	0.0049	0.0049
2,4-Dichlorophenol (g/m3)	0.0049	0.0049
2,4-Dimethylphenol (g/m3)	0.0049	0.0049
3 & 4-Methylphenol (m- + p-cresol) (g/m3)	0.042	0.06
2-Methylphenol (o-Cresol) (g/m3)	0.0049	0.0049
2-Nitrophenol (g/m3)	0.009	0.009
Pentachlorophenol (PCP) (g/m3)2	0.099	0.099
Phenol (g/m3)	0.032	0.013
2,4,5-Trichlorophenol (g/m3)	0.009	0.009
2,4,6-Trichlorophenol (g/m3)	0.009	0.009
Bis(2-ethylhexyl)phthalate (g/m3)	0.029	0.029
Butylbenzylphthalate (g/m3)	0.009	0.009
Di(2-ethylhexyl)adipate (g/m3)	0.0049	0.0049
Diethylphthalate (g/m3)	0.009	0.009
Dimethylphthalate (g/m3)	0.009	0.009
Di-n-butylphthalate (g/m3)	0.009	0.009
Di-n-octylphthalate (g/m3)	0.009	0.009
1,2-Dichlorobenzene (g/m3)	0.009	0.009
1,3-Dichlorobenzene (g/m3)	0.009	0.009
1,4-Dichlorobenzene (g/m3)	0.009	0.009
Hexachlorobutadiene (g/m3)	0.009	0.009
Hexachloroethane (g/m3)	0.009	0.009
1,2,4-Trichlorobenzene (g/m3)	0.0049	0.0049
Benzyl alcohol (g/m3)	0.049	0.049
Carbazole (g/m3)	0.0049	0.0049
Dibenzofuran (g/m3)	0.0049	0.0049
Isophorone (g/m3)	0.0049	0.0049
Benzene (g/m3)	0.0029	0.0029
Ethylbenzene (g/m3)	0.0049	0.0049
Toluene (g/m3)	0.01	0.008
m&p-Xylene (g/m3)	0.0049	0.0049
o-Xylene (g/m3)	0.0029	0.0029
Bromomethane (Methyl Bromide) (g/m3)	0.0029	0.0029
Carbon tetrachloride (g/m3)	0.0029	0.0029
Chloroethane (g/m3)	0.0029	0.0029
Chloromethane (g/m3)	0.0029	0.0029
1,2-Dibromo-3-chloropropane (g/m3)	0.0029	0.0029
1,2-Dibromoethane (ethylene dibromide, EDB) (g/m3)	0.0029	0.0029
Dibromomethane (g/m3)	0.0029	0.0029
Dichlorodifluoromethane (g/m3)	0.0029	0.0029
1,1-Dichloroethane (g/m3)	0.0029	0.0029
1,2-Dichloroethane (g/m3)	0.0029	0.0029
1,1-Dichloroethene (g/m3)	0.0029	0.0029
cis-1,2-Dichloroethene (g/m3)	0.0029	0.0029
trans-1,2-Dichloroethene (g/m3)	0.0029	0.0029
Dichloromethane (methylene chloride) (g/m3)	0.099	0.099

Date *	1/05/2022	2/05/2022
1,2-Dichloropropane (g/m3)	0.0029	0.0029
1,3-Dichloropropane (g/m3)	0.0029	0.0029
1,1-Dichloropropene (g/m3)	0.0029	0.0029
cis-1,3-Dichloropropene (g/m3)	0.0049	0.0049
trans-1,3-Dichloropropene (g/m3)	0.0049	0.0049
Hexachlorobutadiene (g/m3)3	0.0049	0.0049
1,1,1,2-Tetrachloroethane (g/m3)	0.0029	0.0029
1,1,2,2-Tetrachloroethane (g/m3)	0.0029	0.0029
Tetrachloroethene (tetrachloroethylene) (g/m3)	0.0029	0.0029
1,1,1-Trichloroethane (g/m3)	0.0029	0.0029
1,1,2-Trichloroethane (g/m3)	0.0029	0.0029
Trichloroethene (trichloroethylene) (g/m3)	0.0029	0.0029
Trichlorofluoromethane (g/m3)	0.0029	0.0029
1,2,3-Trichloropropane (g/m3)	0.0029	0.0029
1,1,2-Trichlorotrifluoroethane (Freon 113) (g/m3)	0.0029	0.0029
Vinyl chloride (g/m3)	0.0029	0.0029
Bromobenzene (g/m3)	0.0029	0.0029
Chlorobenzene (monochlorobenzene) (g/m3)	0.0029	0.0029
2-Chlorotoluene (g/m3)	0.0029	0.0029
1,2-Dichlorobenzene (g/m3)4	0.0029	0.0029
1,3-Dichlorobenzene (g/m3)5	0.0029	0.0029
1,4-Dichlorobenzene (g/m3)6	0.0029	0.0029
4-Chlorotoluene (g/m3)	0.0029	0.0029
1,2,3-Trichlorobenzene (g/m3)	0.0029	0.0029
1,2,4-Trichlorobenzene (g/m3)7	0.0029	0.0029
1,3,5-Trichlorobenzene (g/m3)	0.0029	0.0029
n-Butylbenzene (g/m3)	0.0049	0.0049
tert-Butylbenzene (g/m3)	0.0029	0.0029
4-Isopropyltoluene (p-Cymene) (g/m3)	0.0049	0.0049
Isopropylbenzene (Cumene) (g/m3)	0.0029	0.0029
n-Propylbenzene (g/m3)	0.0049	0.0049
sec-Butylbenzene (g/m3)	0.0029	0.0029
Styrene (g/m3)	0.0049	0.0049
1,2,4-Trimethylbenzene (g/m3)	0.0029	0.0029
1,3,5-Trimethylbenzene (g/m3)	0.0029	0.0029
Acetone (g/m3)	0.49	0.49
2-Butanone (MEK) (g/m3)	0.49	0.49
Methyl tert-butylether (MTBE) (g/m3)	0.0029	0.0029
4-Methylpentan-2-one (MIBK) (g/m3)	0.099	0.099
Bromodichloromethane (g/m3)	0.0029	0.0029
Bromoform (tribromomethane) (g/m3)	0.0029	0.0029
Chloroform (Trichloromethane) (g/m3)	0.0029	0.0029
Dibromochloromethane (g/m3)	0.0029	0.0029
Carbon disulphide (g/m3)	0.154	0.23
Naphthalene (2) (g/m3)	0.0049	0.0049
Chemical Oxygen Demand (COD) (g O2/m3)	440	1020
Electrical Conductivity (EC) (mS/m)	97.2	131.5
Total Suspended Solids (g/m3)	210	310
Hexavalent Chromium (g/m3)	0.009	0.009
Acid Soluble Mercury (g/m3)	7.90E-05	7.90E-05
Total Ammoniacal-N (g/m3)	18.2	19.3
Dissolved Reactive Phosphorus (g/m3)	2	1.72
Total Sulphide (g/m3)	0.23	1.42
Carbonaceous Biochemical Oxygen Demand (cBOD5) (g O2/m3)	150	400
Oil and Grease (g/m3)	44	67
Acid Soluble Arsenic (g/m3)	0.003	0.0022
Acid Soluble Cadmium (g/m3)	6.00E-05	6.00E-05
Acid Soluble Chromium (g/m3)	0.0093	0.0167
Acid Soluble Copper (g/m3)	0.0118	0.005
Acid Soluble Lead (g/m3)	0.0017	0.00158
Acid Soluble Nickel (g/m3)	0.0055	0.0059
Acid Soluble Zinc (g/m3)	0.11	0.12

Table 26: Condition 6 – Final Combined Wastewater – Daily Loading – Heavy Metals, Ammonia, TSS, and $cBOD_5$

Quarter No.	Sampling Date	Chromium-III (kg/day)	Chromium-VI (kg/day)	Copper (kg/day)	Zinc (kg/day)	Cadmium (kg/day)	Mercury (kg/day)	Lead (kg/day)	Nickel (kg/day)	Ammonia (kg/day)	TSS (kg/day)	$cBOD_5$ (kg/day)	FCW Volume * (m^3/day)
1	25/07/2021	0.4	5.8	0.30	1.28	0.12	0.040	0.0030	0.0027	330	8,753	14,477	33,667
	26/07/2021	1.6	26.6	0.34	0.41	0.16	0.163	0.0038	0.0030	661	23,182	12,921	38,004
	27/07/2021	1.2	3.8	0.37	0.33	0.14	0.037	0.0037	0.0033	695	5,157	18,716	41,592
	28/07/2021	2.4	8.3	0.38	0.20	0.17	0.092	0.0038	0.0033	819	13,024	15,545	42,014
	29/07/2021	5.3	5.1	0.37	0.07	0.17	0.054	0.0037	0.0033	701	34,655	16,915	41,256
	30/07/2021	0.9	5.8	0.36	0.07	0.19	0.065	0.0036	0.0032	933	17,436	18,653	40,549
	31/07/2021	3.1	12.3	0.32	0.06	0.22	0.215	0.0060	0.0028	880	40,853	19,018	35,218
2	1/11/2021	0.2	2.8	0.37	0.21	0.17	0.029	0.0037	0.0032	678	4,728	11,100	41,111
	2/11/2021	0.8	3.2	0.39	0.10	0.16	0.030	0.0039	0.0034	857	8,010	12,851	42,835
	3/11/2021	0.4	1.7	0.38	0.02	0.12	0.012	0.0021	0.0034	1,023	5,330	12,791	42,638
	4/11/2021	1.7	6.8	0.47	0.11	0.25	0.087	0.0047	0.0041	1,207	27,291	18,369	52,482
	5/11/2021	1.7	6.8	0.47	0.11	0.25	0.087	0.0047	0.0041	1,208	27,312	18,383	52,523
	6/11/2021	1.0	3.9	0.37	0.10	0.13	0.054	0.0037	0.0033	819	7,566	5,155	41,574
	7/11/2021	0.2	2.6	0.33	0.13	0.07	0.042	0.0018	0.0029	545	3,780	1,223	37,056
3	17/01/2022	0.6	4.9	0.36	0.14	0.28	0.076	0.0044	0.0032	764	15,208	18,809	40,020
	18/01/2022	1.7	3.7	0.42	0.14	0.19	0.061	0.0042	0.0037	637	15,464	26,242	46,861
	19/01/2022	2.4	3.3	0.42	0.42	0.42	0.088	0.0420	0.0037	821	16,329	15,396	46,654
	20/01/2022	1.1	4.3	0.43	0.43	0.43	0.089	0.0425	0.0037	1,181	15,591	27,402	47,246
	21/01/2022	17.5	3.5	0.39	1.13	0.16	0.061	0.0039	0.0034	807	15,273	21,819	43,638
	22/01/2022	5.4	9.5	0.34	0.11	0.21	0.107	0.0061	0.0030	838	20,183	15,232	38,080
	23/01/2022	0.4	2.7	0.30	0.11	0.07	0.039	0.0030	0.0026	578	5,219	5,318	32,826
4	26/04/2022	0.7	4.8	0.47	0.17	0.22	0.208	0.0078	0.0041	832	44,192	28,075	51,991
	27/04/2022	1.1	3.6	0.52	0.33	0.17	0.092	0.0052	0.0046	803	20,219	19,064	57,769
	28/04/2022	0.5	4.3	0.52	0.12	0.23	0.093	0.0040	0.0046	1,388	18,501	29,486	57,817
	29/04/2022	0.9	7.7	0.48	0.78	0.50	0.118	0.0048	0.0042	1,182	18,275	18,275	53,749
	30/04/2022	0.6	3.9	0.40	0.71	0.21	0.054	0.0027	0.0035	878	8,556	9,407	44,797
	1/05/2022	0.4	4.2	0.34	0.45	0.21	0.065	0.0023	0.0030	691	7,971	5,693	37,956
	2/05/2022	0.8	6.0	0.45	0.25	0.29	0.079	0.0030	0.0039	961	15,433	19,913	49,783
Analysis of Data Above	Annual Maximum	17.5	26.6	0.52	1.28	0.50	0.215	0.0425	0.0046	1,388	44,192	29,486	** Note: Refer to Figure 4 on page 22 for analysis of daily FCW volume. As daily volume data is available for the entire year*
	Annual Median	0.9	4.3	0.38	0.16	0.19	0.070	0.0038	0.0033	820	15,448	17,595	
	Annual Average	2.0	5.8	0.40	0.30	0.21	0.080	0.0067	0.0035	847	16,553	16,295	
	Annual Minimum	0.2	1.7	0.30	0.02	0.07	0.012	0.0018	0.0026	330	3,780	1,223	
	Standard Deviation	3.3	4.7	0.06	0.32	0.10	0.049	0.0101	0.0005	232	10,628	7,004	

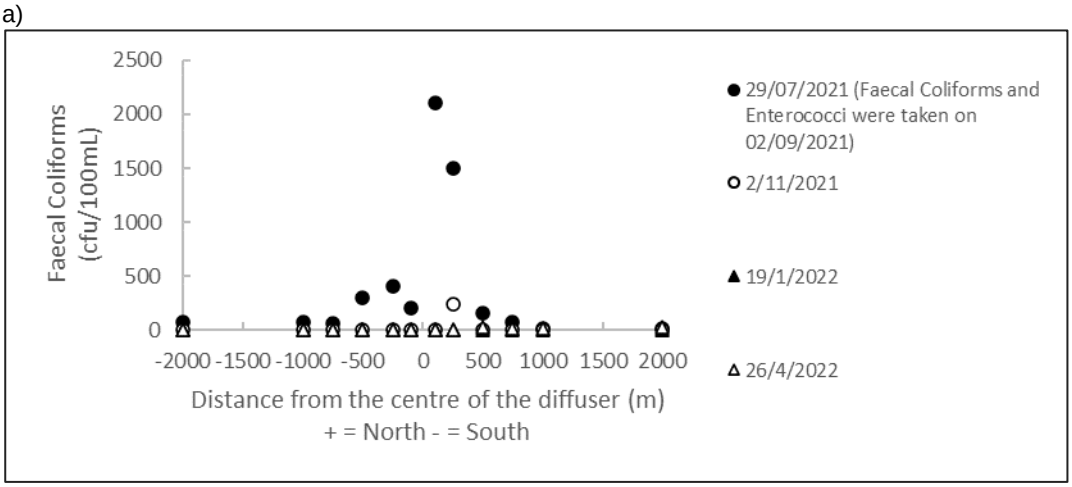
4.4 Tabulated Sampling Results and data analysis for Condition16

Table 27, Figure 19 to Figure 23, and Section 2.3.2.3 list the recorded laboratory testing results and field measurements completed during quarterly sampling of the receiving water. Figure 11 to Figure 18 provided scatter plots and boxplots representations of the recorded results and measurements. The scatter plots allow for spatial and temporal interpretation of the records. The boxplots compare records from within 500m of the diffuser and records beyond 500m. This enables additional interpretation of the records against Condition 7 of the consent. Samples from north and south of the diffuser were combined to reach statistically relevant sample number, as the observed seasonal variation made combining of seasonal data undesirable. Appendix A provides an explanation of the interpretation of boxplots.

Table 27: Condition 16 – Receiving Water – Laboratory Testing Results

Sampling Date	Location	Required by Condition 16		NOT Required by Condition 16. Additional Monitoring Undertaken by HDC					
		Faecal Coliforms (cfu / 100mL)	Enterococci (cfu / 100mL)	Total Suspended Solids (g/m^3)	Total Nitrogen (g/m^3)	Total Ammoniacal-N (g/m^3)	Nitrate-N + Nitrite-N (g/m^3)	Dissolved Reactive Phosphorus (g/m^3)	Total Phosphorus (g/m^3)
29/07/2021 (Faecal Coliforms and Enterococci were taken on 02/09/2021)	Ngaruroro	1	2	5	0.10	0.005	0.04	0.0104	0.01
	2000N	13	4	3	0.15	0.005	0.050	0.0087	0.011
	1000N	21	17	3	0.12	0.00	0.042	0.0082	0.012
	750N	70	19	4	0.11	0.005	0.03	0.0075	0.010
	500N	160	27	3	0.1	0.005	0.04	0.0080	0.011
	250N	1500	27	2.9	0.1	0.005	0.04	0.0080	0.011
	100N	2100	28	3	0.1	0.00	0.04	0.0077	0.011
	100S	210	36	3	0.12	0.00	0.04	0.0080	0.011
	250S	410	36	7	0.12	0.00	0.038	0.01	0.014
	500S	300	31	4	0.13	0.005	0.036	0.0076	0.011
	750S	60	41	3	0.12	0.00	0.0	0.0081	0.014
	1000S	80	29	4	0.12	0.00	0.029	0.0075	0.011
	2000S	70	52	4	0.17	0.005	0.033	0.0071	0.015
	TukiTuki	1	1	11.0	0.11	0.005	0.033	0.0108	0.013
2/11/2021	Ngaruroro	4	1	3	0.166	0.01	0.001	0.0076	0.018
	2000N	1	1	3	0.165	0.012	0.0044	0.0036	0.010
	1000N	1	1	3	0.119	0.010	0.0009	0.0036	0.010
	750N	1	0.9	3	0.190	0.01	0.001	0.0034	0.010
	500N	1	1	3	0.171	0.010	0.019	0.0060	0.012
	250N	240	6	18	0.181	0.01	0.015	0.0061	0.014
	100N	5	1	12	0.18	0.012	0.0135	0.0057	0.012
	100S	1	1	3	0.192	0.01	0.0081	0.0058	0.008
	250S	1	1	3	0.118	0.01	0.0107	0.0055	0.008
	500S	1	1	3	0.124	0.01	0.0107	0.0058	0.01
	750S	1.0	1	3	0.129	0.010	0.0168	0.0063	0.008
	1000S	1	1	3	0.113	0.011	0.0105	0.0057	0.008
	2000S	1	1	3	0.167	0.012	0.0009	0.0063	0.011
	TukiTuki	34.0	0.9	5	0.280	0.01	0.1140	0.0082	0.013
19/01/2022	Ngaruroro	1	0.9	8	0.199	0.007	0.0009	0.005	0.008
	2000N	1.0	0.9	2.9	0.150	0.007	0.0009	0.0030	0.006
	1000N	1.0	0.9	2.9	0.157	0.007	0.0009	0.0030	0.006
	750N	1.0	0.9	2.9	0.17	0.007	0.0009	0.0031	0.006
	500N	0.9	0.9	3.0	0.145	0.008	0.0009	0.0030	0.006
	250N	1	0.9	3.0	0.178	0.008	0.0009	0.0030	0.006
	100N	1	1	4.0	0.196	0.008	0.0009	0.0039	0.006
	100S	0.9	0.9	6.0	0.156	0.007	0.0009	0.0029	0.005
	250S	1	0.9	3.0	0.167	0.005	0.0009	0.0023	0.006
	500S	1	1	4.0	0.18	0.005	0.0009	0.0024	0.007
	750S	1	0.9	4.0	0.191	0.007	0.0009	0.0029	0.007
	1000S	1	0.9	2.9	0.18	0.005	0.001	0.0026	0.007
	2000S	0.9	1	4.0	0.16	0.007	0.0009	0.0032	0.006
	TukiTuki	2	1	10	0.18	0.008	0.001	0.006	0.010
26/04/2022	Ngaruroro	1	1	8	0.200	0.0049	0.0009	0.0022	0.009
	2000N	34	6	4	0.240	0.02	0.0120	0.0048	0.008
	1000N	12	2	6	0.270	0.0049	0.0009	0.0041	0.014
	750N	11	2	8	0.270	0.0049	0.0009	0.0034	0.011
	500N	33	5	6	0.240	0.0049	0.0039	0.0035	0.009
	250N	4	8	5	0.280	0.0049	0.0134	0.0016	0.01
	100N	9	4	5	0.260	0.0049	0.0260	0.0015	0.007
	100S	7	8	4	0.084	0.0049	0.0009	0.0035	0.009
	250S	3	5	2.9	0.092	0.0049	0.0009	0.0029	0.009
	500S	7	4	4	0.083	0.0049	0.0009	0.0034	0.009
	750S	5	2	4	0.084	0.0049	0.0009	0.0037	0.009
	1000S	4	3	5	0.076	0.0049	0.0009	0.0034	0.007
	2000S	3.0	4.0	5	0.083	0.0049	0.0009	0.0032	0.009
	TukiTuki	6.0	2	4	0.069	0.0049	0.0009	0.0032	0.008

a)



b)

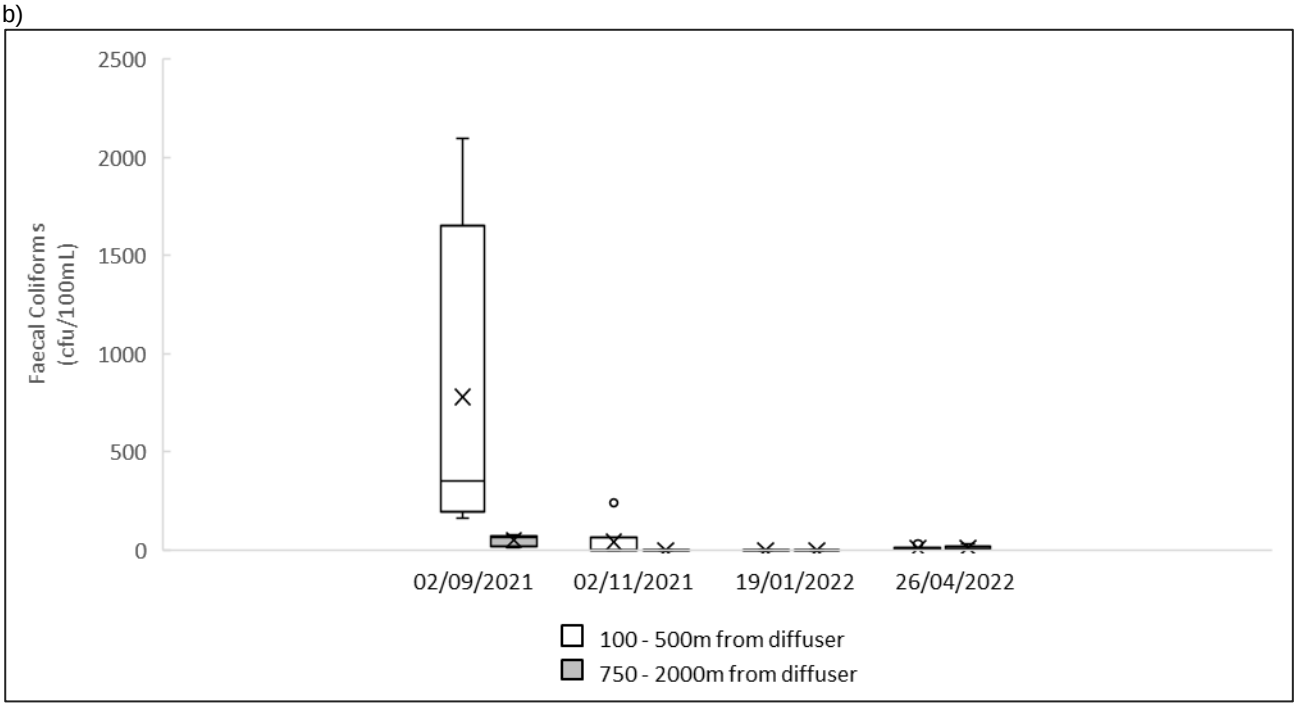


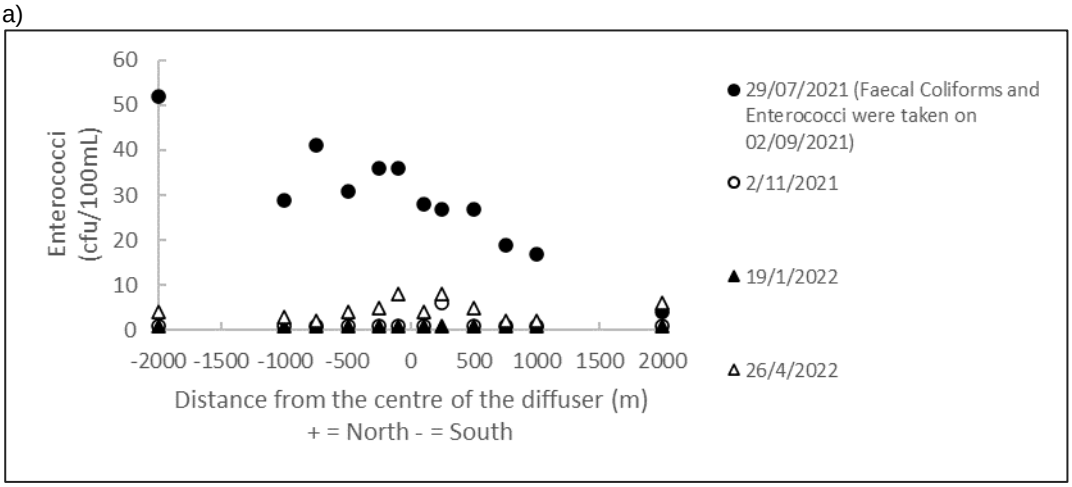
Figure 11: Analysis – Condition 16 – Receiving Water – Faecal Coliforms

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

[1] See Appendix A for a boxplot interpretation explanation

a)



b)

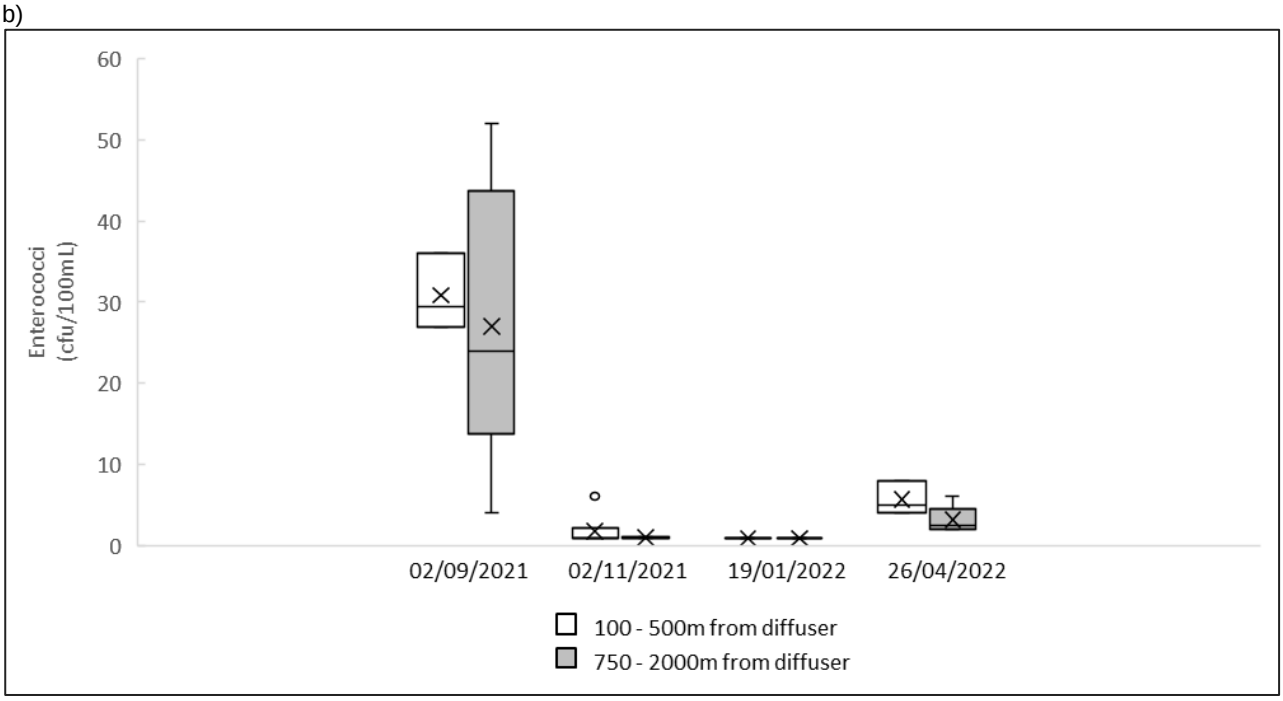
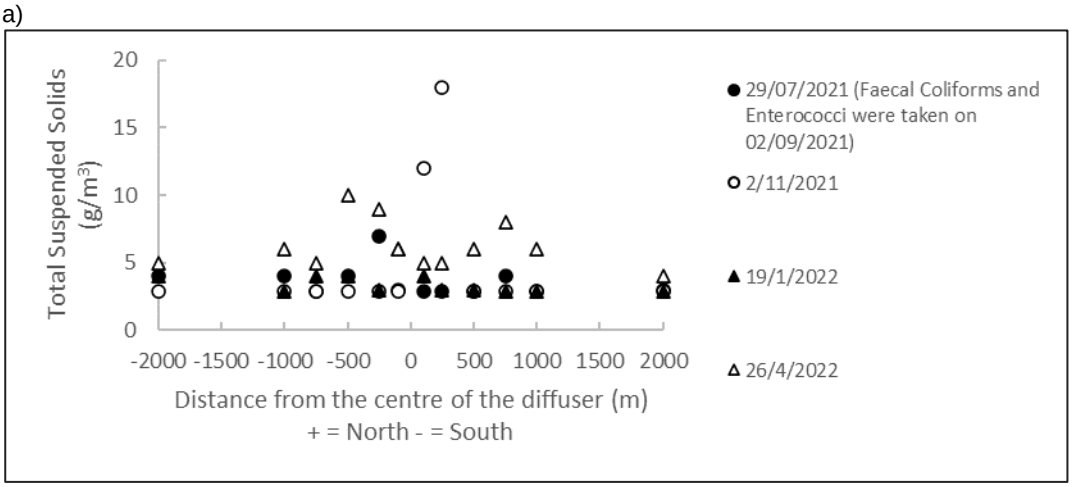


Figure 12: Analysis – Condition 16 – Receiving Water – Enterococci

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

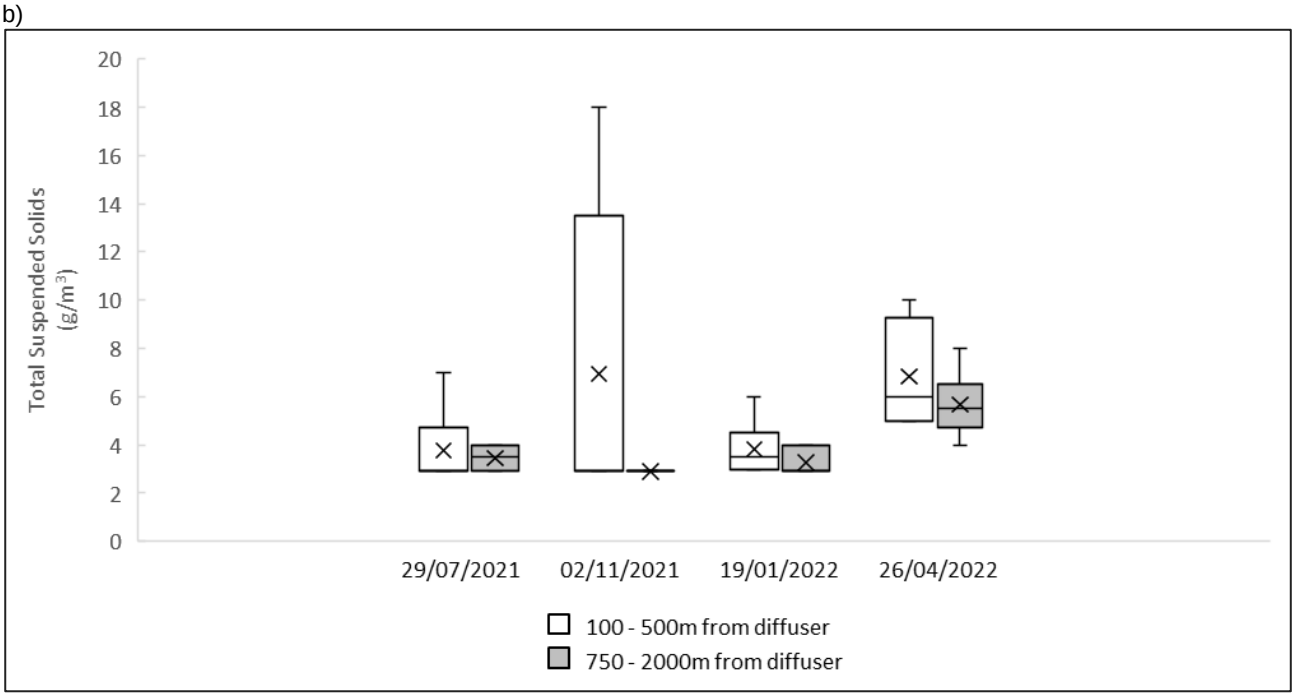
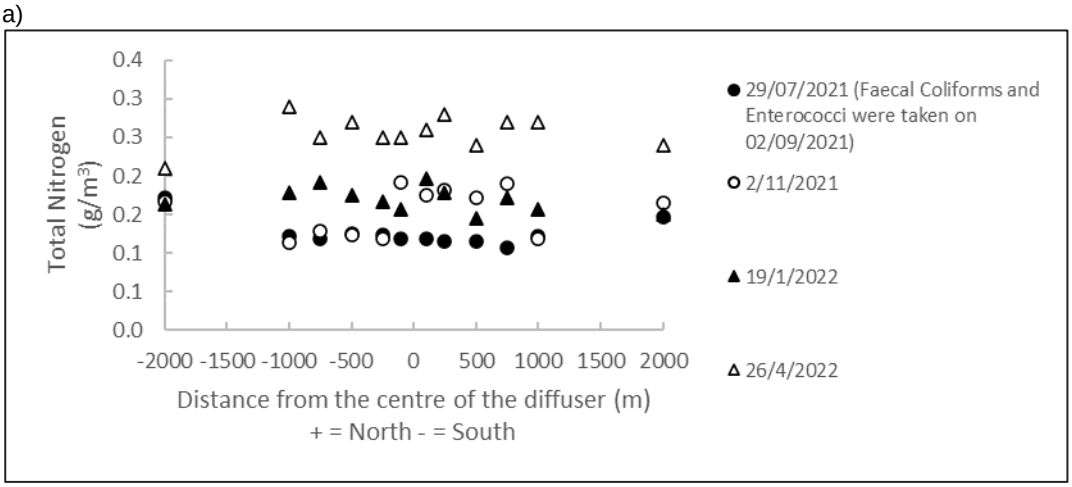


Figure 13: Analysis – Condition 16 – Receiving Water – Total Suspended Solids

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

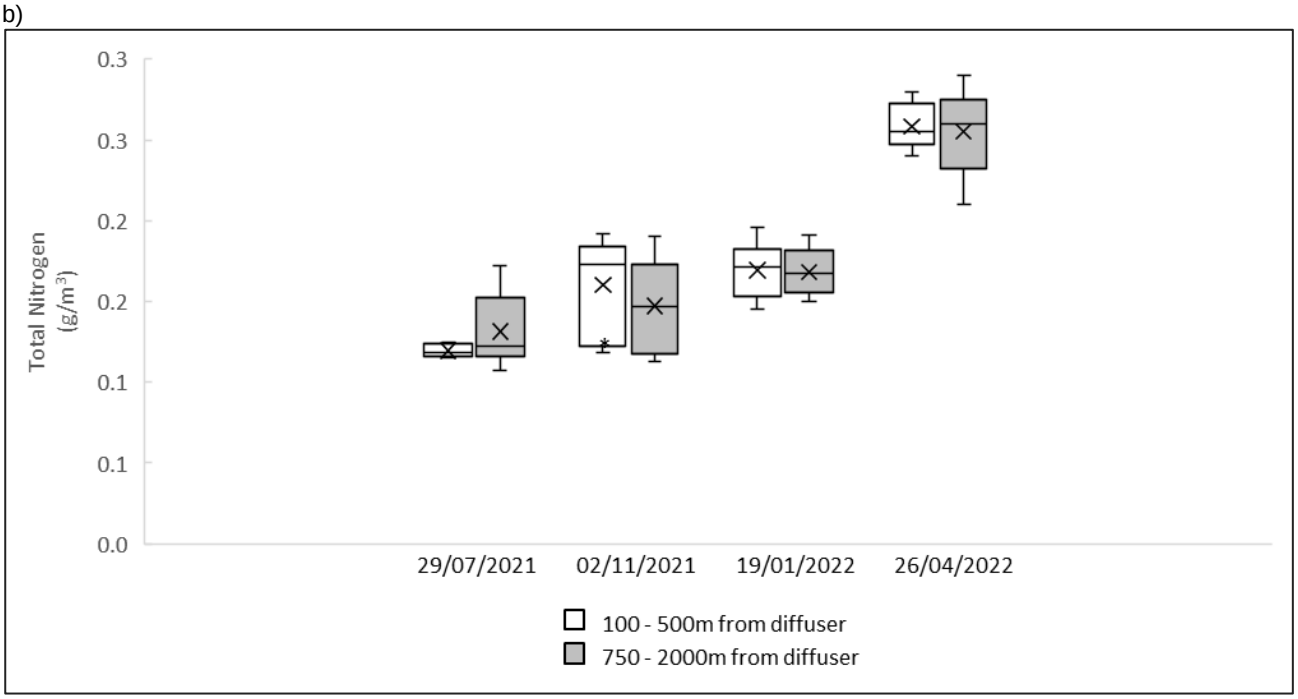
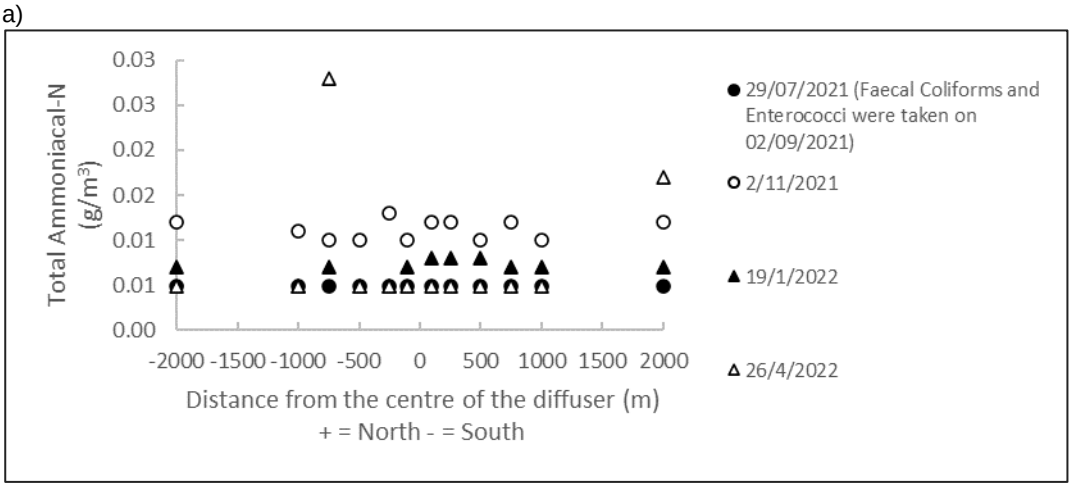


Figure 14: Analysis – Condition 16 – Receiving Water – Total Nitrogen

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

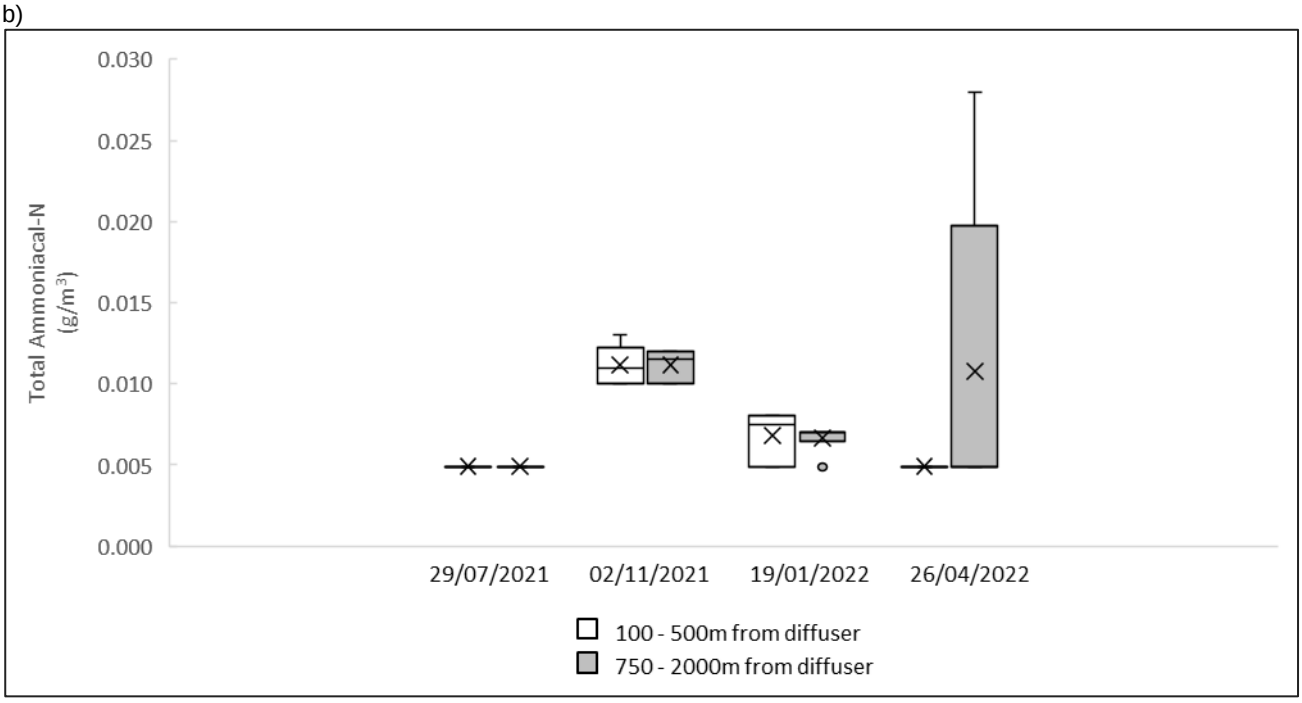
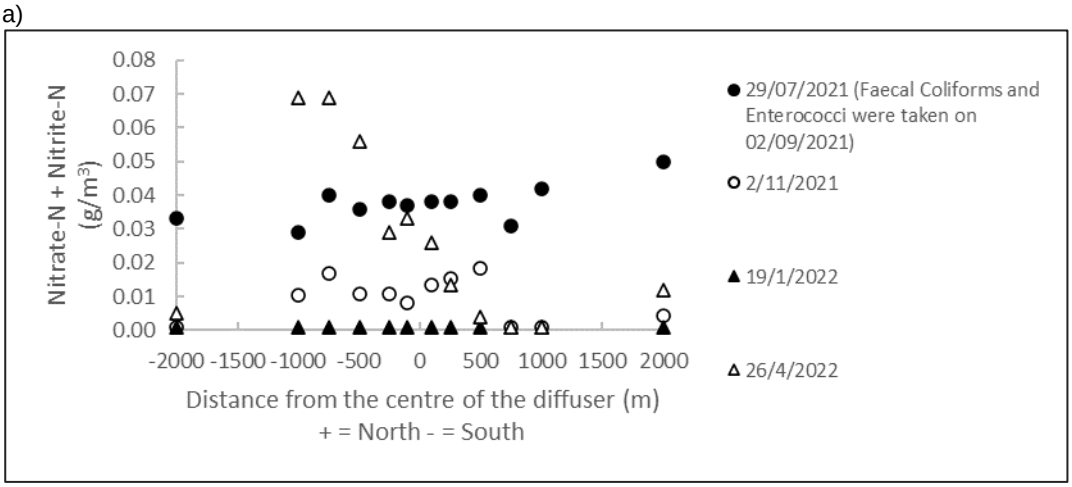


Figure 15: Analysis – Condition 16 – Receiving Water – Total Nitrogen

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

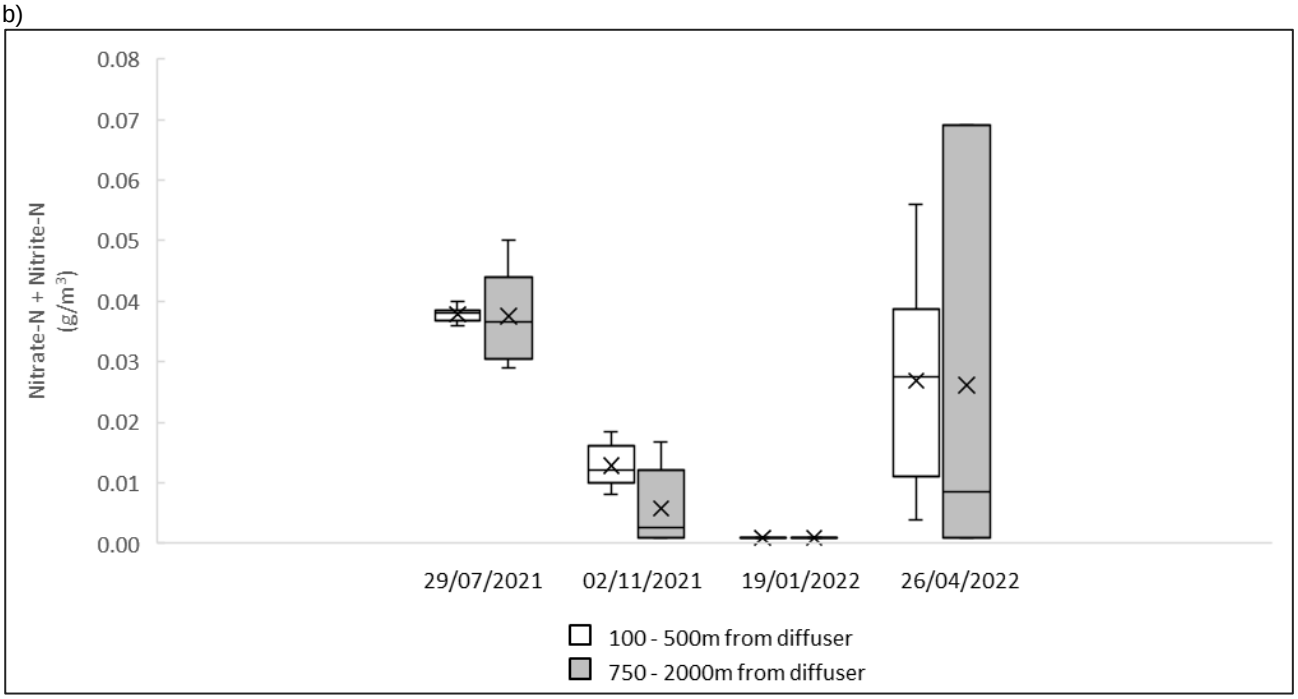
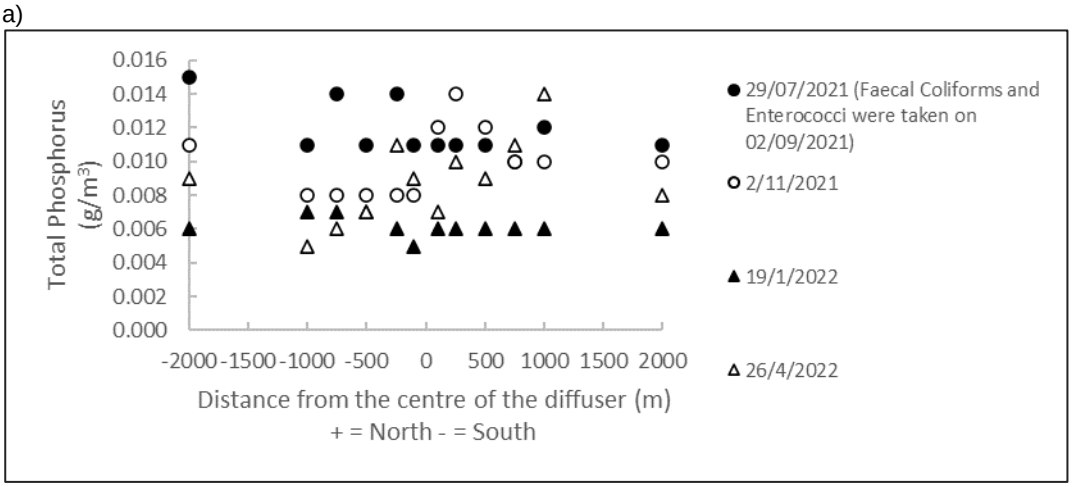


Figure 16: Analysis – Condition 16 – Receiving Water – Nitrate & Nitrite

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

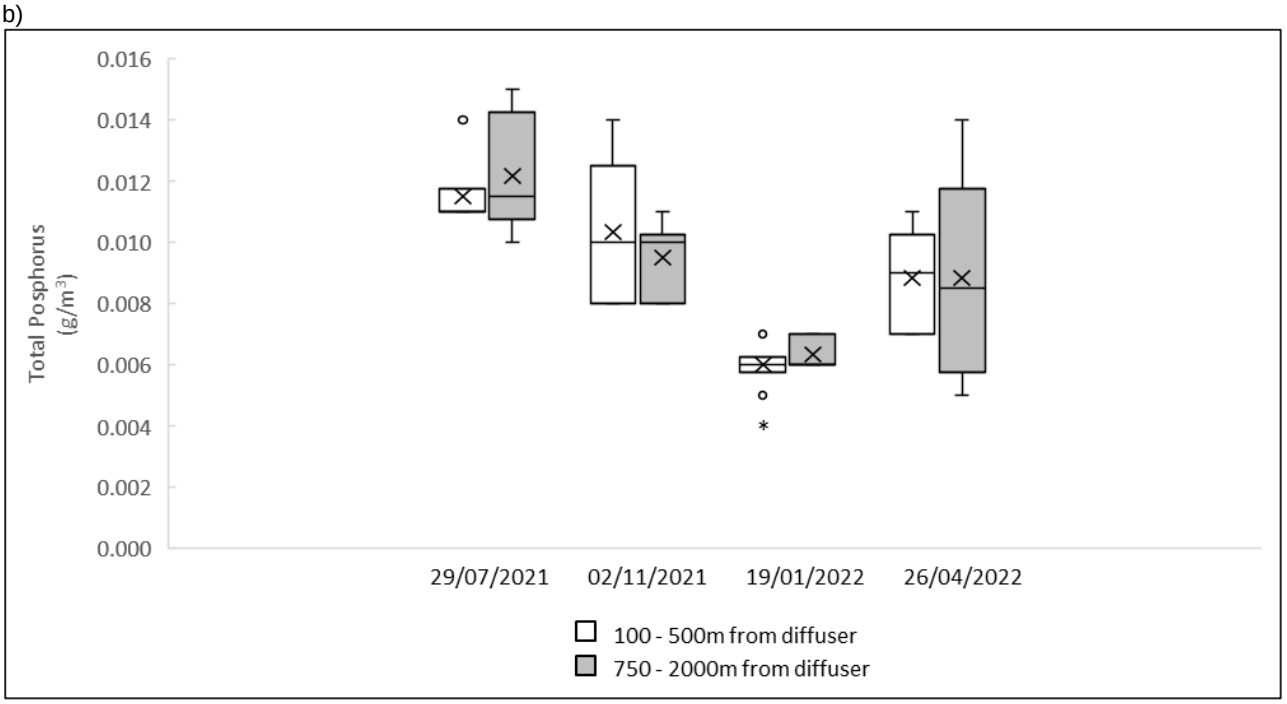
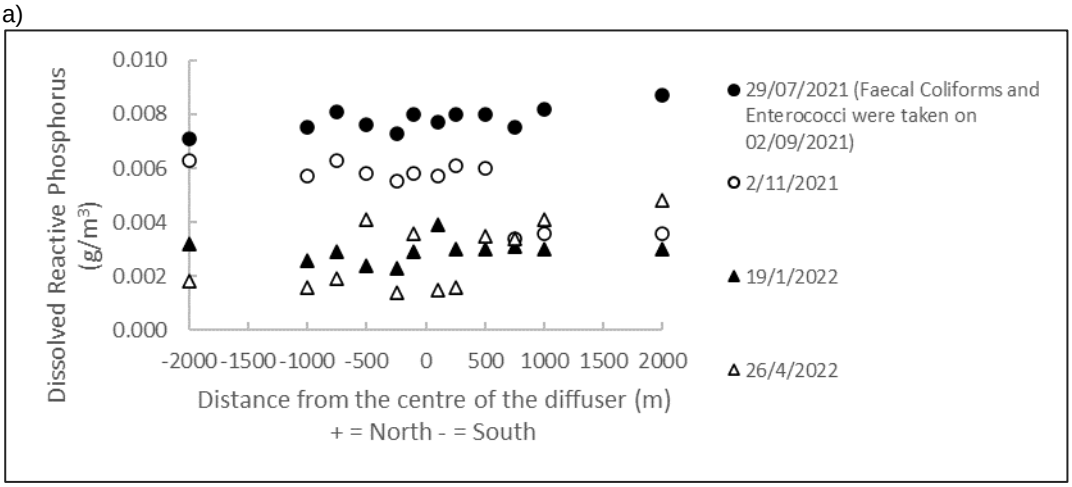


Figure 17: Analysis – Condition 16 – Receiving Water – Total Phosphorus

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)[1]

a)



b)

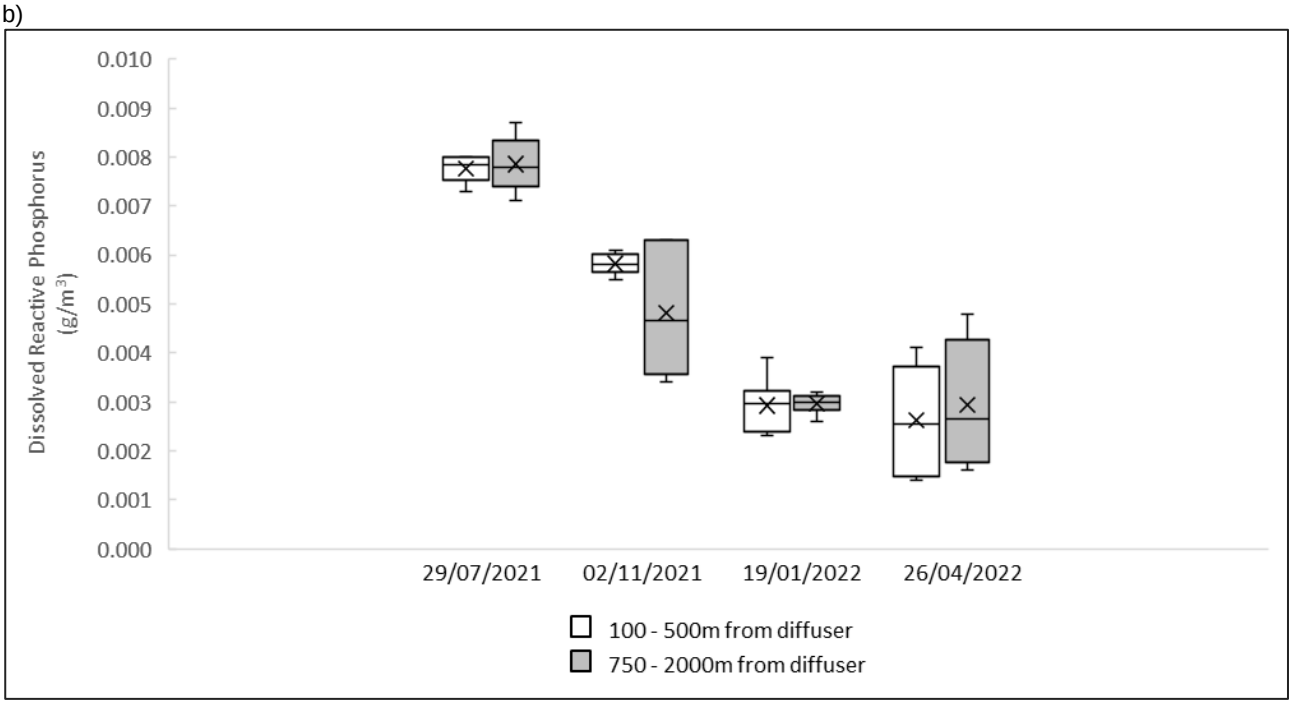
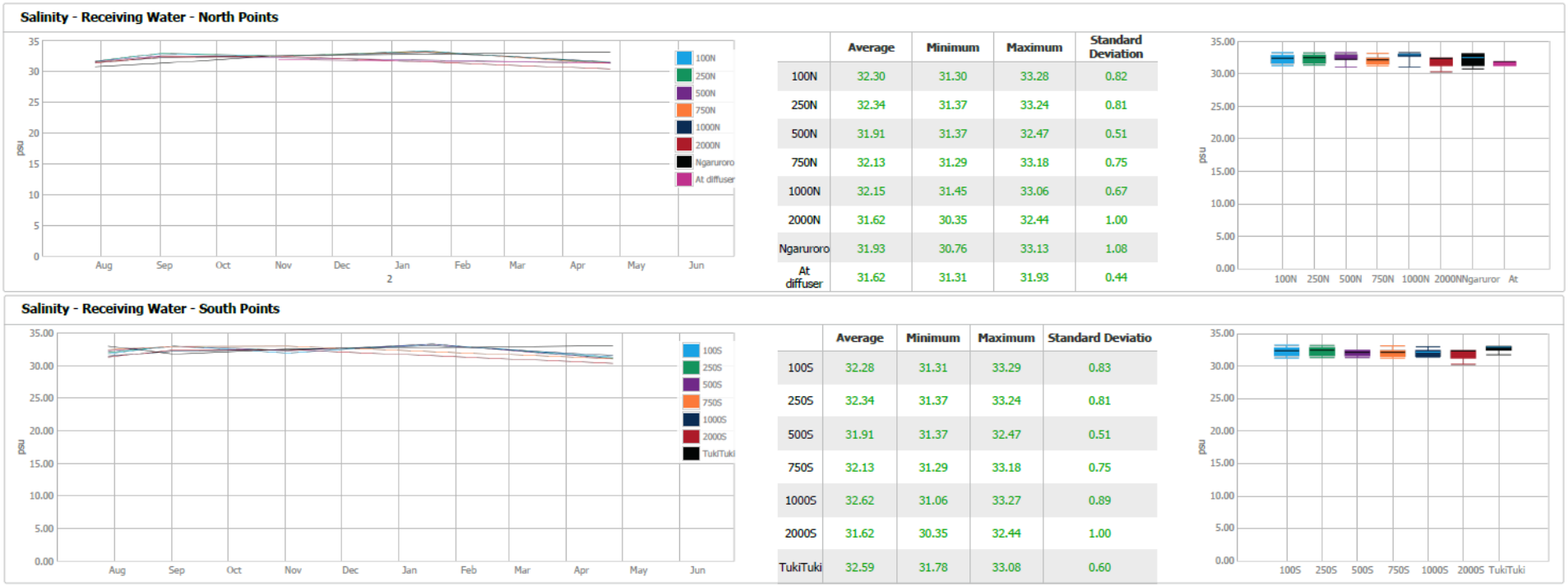


Figure 18: Analysis – Condition 16 – Receiving Water – Dissolved Reactive Phosphorus

a) Scatter plots; temporal and spatial variation analysis

b) <500m vs >500m from diffuser analysis (as per condition 7)

Figure 19: Analysis – Condition 16 – Receiving Water – pH
Sampling dates: 29/07/2021, 02/09/2021, 02/11/2021, 19/01/2022, 26/04/2022

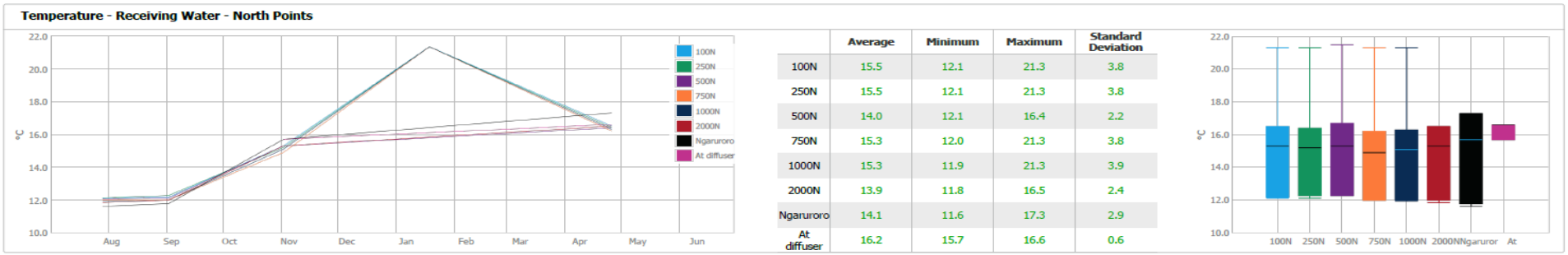


	Average	Minimum	Maximum	Standard Deviation
100N	32.30	31.30	33.28	0.82
250N	32.34	31.37	33.24	0.81
500N	31.91	31.37	32.47	0.51
750N	32.13	31.29	33.18	0.75
1000N	32.15	31.45	33.06	0.67
2000N	31.62	30.35	32.44	1.00
Ngaruroro	31.93	30.76	33.13	1.08
At diffuser	31.62	31.31	31.93	0.44

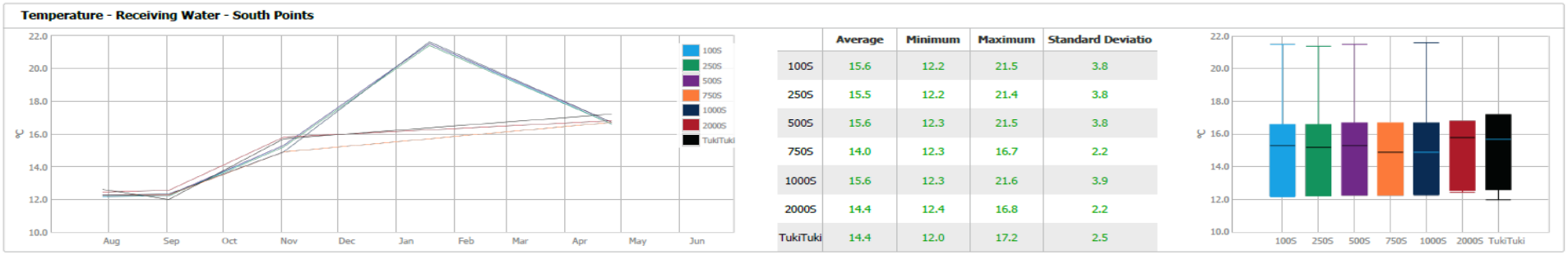
	Average	Minimum	Maximum	Standard Deviatio
100S	32.28	31.31	33.29	0.83
250S	32.34	31.37	33.24	0.81
500S	31.91	31.37	32.47	0.51
750S	32.13	31.29	33.18	0.75
1000S	32.62	31.06	33.27	0.89
2000S	31.62	30.35	32.44	1.00
TukiTuki	32.59	31.78	33.08	0.60

Figure 20: Analysis – Condition 16 – Receiving Water – Salinity
Sampling dates: 29/07/2021, 02/09/2021, 02/11/2021, 19/01/2022, 26/04/2022

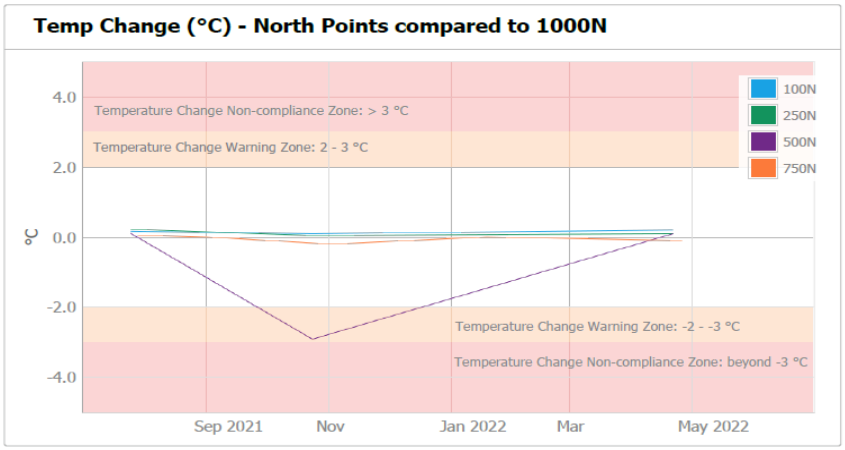
Figure 21: Analysis – Condition 16 – Receiving Water – Turbidity
Sampling dates: 29/07/2021, 02/09/2021, 02/11/2021, 19/01/2022, 26/04/2022



	Average	Minimum	Maximum	Standard Deviation
100N	15.5	12.1	21.3	3.8
250N	15.5	12.1	21.3	3.8
500N	14.0	12.1	16.4	2.2
750N	15.3	12.0	21.3	3.8
1000N	15.3	11.9	21.3	3.9
2000N	13.9	11.8	16.5	2.4
Ngaruroro	14.1	11.6	17.3	2.9
At diffuser	16.2	15.7	16.6	0.6



	Average	Minimum	Maximum	Standard Deviatio
100S	15.6	12.2	21.5	3.8
250S	15.5	12.2	21.4	3.8
500S	15.6	12.3	21.5	3.8
750S	14.0	12.3	16.7	2.2
1000S	15.6	12.3	21.6	3.9
2000S	14.4	12.4	16.8	2.2
TukiTuki	14.4	12.0	17.2	2.5



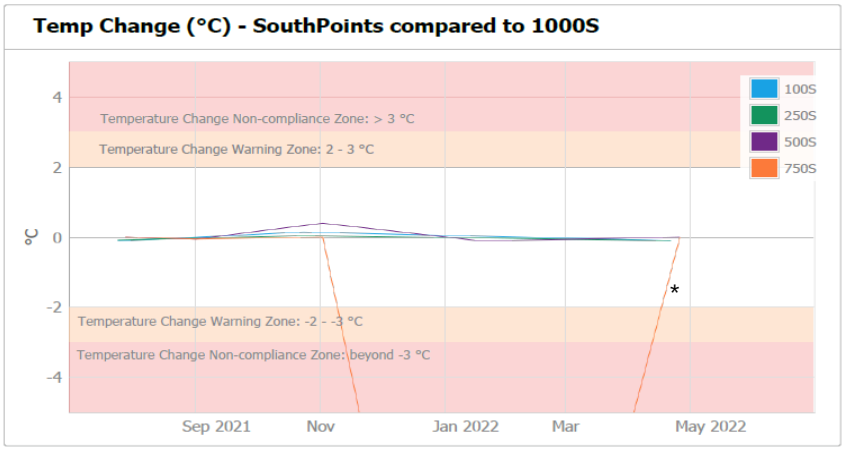
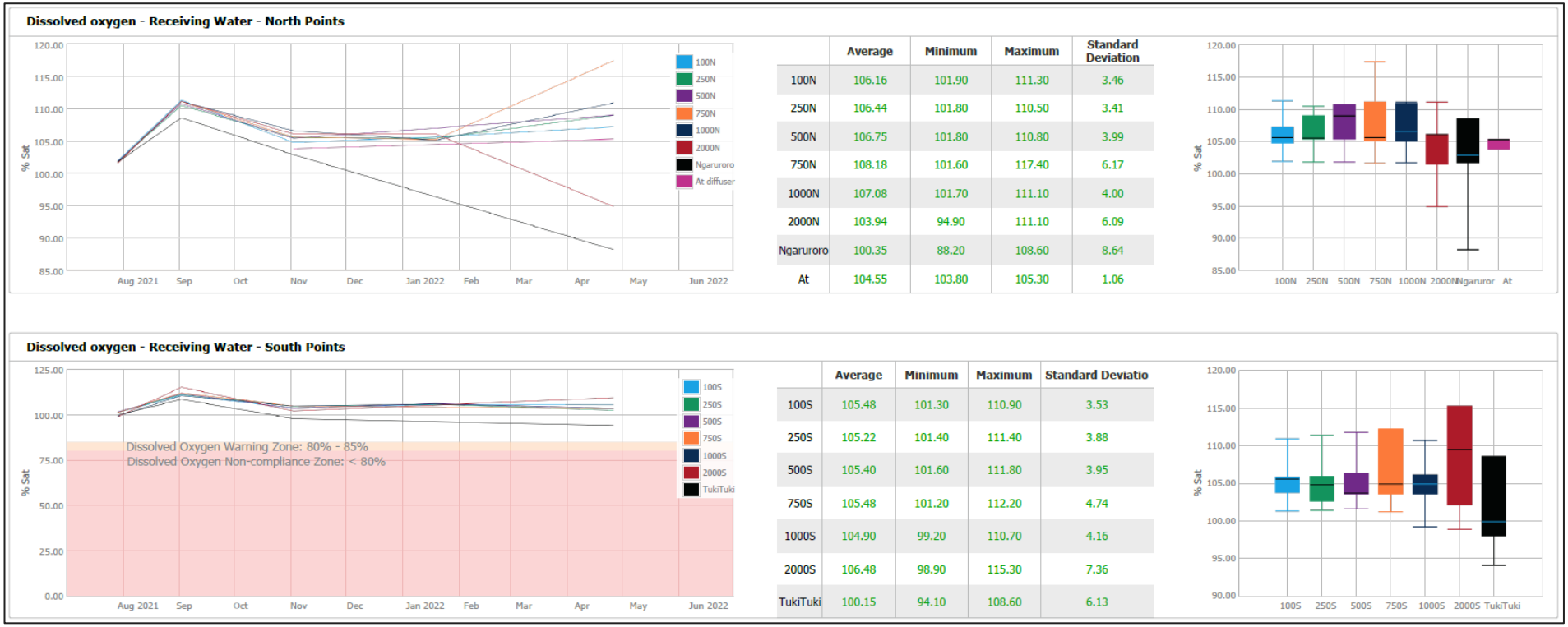


Figure 22: Analysis – Condition 16 – Receiving Water – Temperature
Sampling dates: 29/07/2021, 02/09/2021, 02/11/2021, 19/01/2022, 26/04/2022

* *Note: The temperature data for 750m south on 19/01/2022 is missing. Given the temperature changes on the same day at 100m south, 250m south and 500m south were all minimal (well within 0.5 °C), it is very unlikely the temperature change at 750m south was beyond 3 °C.*



	Average	Minimum	Maximum	Standard Deviation
100N	106.16	101.90	111.30	3.46
250N	106.44	101.80	110.50	3.41
500N	106.75	101.80	110.80	3.99
750N	108.18	101.60	117.40	6.17
1000N	107.08	101.70	111.10	4.00
2000N	103.94	94.90	111.10	6.09
Ngarururo	100.35	88.20	108.60	8.64
At	104.55	103.80	105.30	1.06

	Average	Minimum	Maximum	Standard Deviatio
100S	105.48	101.30	110.90	3.53
250S	105.22	101.40	111.40	3.88
500S	105.40	101.60	111.80	3.95
750S	105.48	101.20	112.20	4.74
1000S	104.90	99.20	110.70	4.16
2000S	106.48	98.90	115.30	7.36
TukiTuki	100.15	94.10	108.60	6.13

Figure 23: Analysis – Condition 16 – Receiving Water – Dissolved Oxygen
Sampling dates: 29/07/2021, 02/09/2021, 02/11/2021, 19/01/2022, 26/04/2022

4.5 Tabulated Sampling Results and data analysis for Condition 19

Table 28 lists the recorded laboratory testing results completed during quarterly sampling of the sediments near the diffuser. Figure 24 and Figure 25 provided scatter plots of the recorded results and measurements. The scatter plots allow for spatial and temporal interpretation of the records.

Table 28: Condition 19 – Sediments – Sampling Results

Location	750N				500N				250N				250S				500S				750S			
Sampling Date	29/07/21	02/11/21	19/01/22	26/04/22	29/07/21	02/11/21	19/01/22	26/04/22	29/07/21	02/11/21	19/01/22	26/04/22	29/07/21	02/11/21	19/01/22	26/04/22	29/07/21	02/11/21	19/01/22	26/04/22	29/07/21	02/11/21	19/01/22	26/04/22
Total Recoverable Zinc (mg/kg dry wt)	51	37	55	63	67	49	57	62	63	66	75	70	58	49	64	62	52	56	45	61	54	46	47	47
Total Recoverable Arsenic (mg/kg dry wt)	5.8	4.7	6.0	5.5	7.3	6.0	6.4	5.9	5.6	6.6	5.2	6.9	3.6	3.8	3.8	4.0	5.8	6.5	5.1	5.7	7.2	5.2	4.9	4.1
Total Recoverable Cadmium (mg/kg dry wt)	0.035	0.02	0.039	0.044	0.055	0.03	0.038	0.048	0.047	0.06	0.038	0.062	0.051	0.04	0.060	0.057	0.042	0.05	0.033	0.056	0.044	0.04	0.037	0.039
Total Recoverable Chromium (mg/kg dry wt)	20	13.2	21	21.0	27	19.3	24	24.0	34	29.0	20	32.0	38	28.0	31	28.0	23	28.0	19	27.0	27	23.0	20	19.9
Total Recoverable Copper (mg/kg dry wt)	7.6	4.4	8.9	10.1	11.6	7.1	9.1	11.0	10.6	12.0	8.4	13.3	11.5	9.3	12.1	11.2	8.5	10.5	6.7	11.9	9.1	7.8	7.1	7.0
Total Recoverable Tin (mg/kg dry wt)	0.77	0.87	0.85	0.97	1.16	0.85	0.96	1.07	1.19	1.17	0.84	1.84	1.50	1.34	1.34	1.26	0.94	1.35	0.86	1.34	1.02	0.86	0.84	0.86
Total Recoverable Nickel (mg/kg dry wt)	10.1	7	12	12.2	13.6	10	12	12.3	12.5	13	11	13.7	10.4	9	11	11.9	9.8	11	9	12.2	10.8	9	10	9.4
Total Recoverable Lead (mg/kg dry wt)	10.4	7.6	11.2	13.0	14.6	10.0	11.1	12.9	12.8	14.2	10.2	14.5	10.2	8.7	11.3	11.3	10.4	11.6	8.8	12.9	10.8	9.1	9.5	9.2
Total Recoverable Mercury (mg/kg dry wt)	0.06	0.05	0.07	0.08	0.10	0.07	0.07	0.09	0.08	0.09	0.07	0.09	0.07	0.18	0.07	0.11	0.06	0.08	0.05	0.08	0.06	0.06	0.05	0.06
Fraction >/= 2 mm (g/100g dry wt)	0.2	0.4	0.1	1.0	0.4	1.0	0.1	2.2	0.2	0.2	0.1	0.4	0.1	6.3	0.9	13.4	0.1	14.3	0.2	11.9	0.7	5.0	1.7	0.9
Fraction < 2 mm, >/= 63 µm (g/100g dry wt)	31	45.0	13.4	10.1	6	14.7	13.1	12.1	15	3.9	6.7	4.9	16	28.3	18.9	18.2	30	18.2	21.4	17.9	22	29.3	29.7	39.5
Fraction < 63 µm (g/100g dry wt)	69.3	54.5	86.5	88.9	93.3	84.3	86.9	85.7	85.0	95.9	93.3	94.7	84.0	65.4	80.2	68.3	69.7	67.5	78.4	70.1	77.2	65.7	68.6	59.5
Dry Matter (g/100g as rcvd)	71	71	60	58	52	55	60	55	51	54	67	53	57	66	50	58	68	59	65	59	60	65	61	66
Dry Matter of Sieved Sample (g/100g as rcvd)	65	72	59	58	52	59	56	58	53	53	60	55	54	58	56	56	66	55	60	56	60	62	62	67
Volatile Solids (g/100g dry wt)	3.8	2.7	4	4.8	6.3	4.1	4	4.6	4.8	4.5	4	4.8	5.0	4.3	5	5.3	3.8	5.9	4	5.5	4.7	4.1	4	3.9
Ash (g/100g dry wt)	96	97	96	95	94	96	96	95	95	96	96	95	95	96	95	95	96	94	96	94	95	96	96	96
Moisture (g/100g as rcvd)	29	29	40	42	48	45	40	45	49	46	33	47	43	34	50	42	32	41	35	41	40	35	39	34
1M HCl Extractable Mercury (mg/kg dry wt)	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059

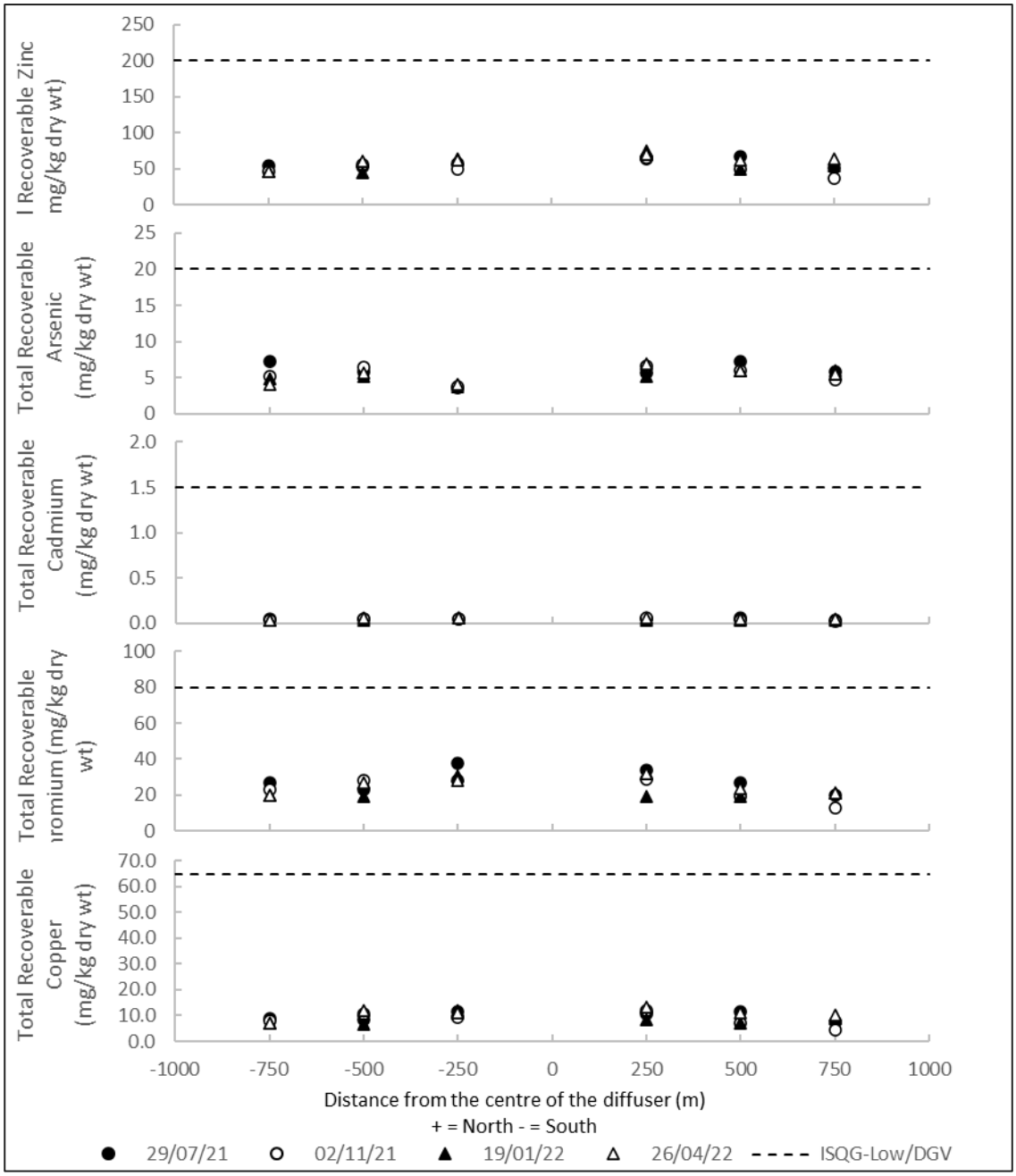


Figure 24: Analysis – Condition 19 – Sediments – Metals (Zn, As, Cd, Cr and Cu); Temporal and Spatial Variation Analysis

All the metal concentrations in the sediments included in Figure 24 were well below the consent limits.

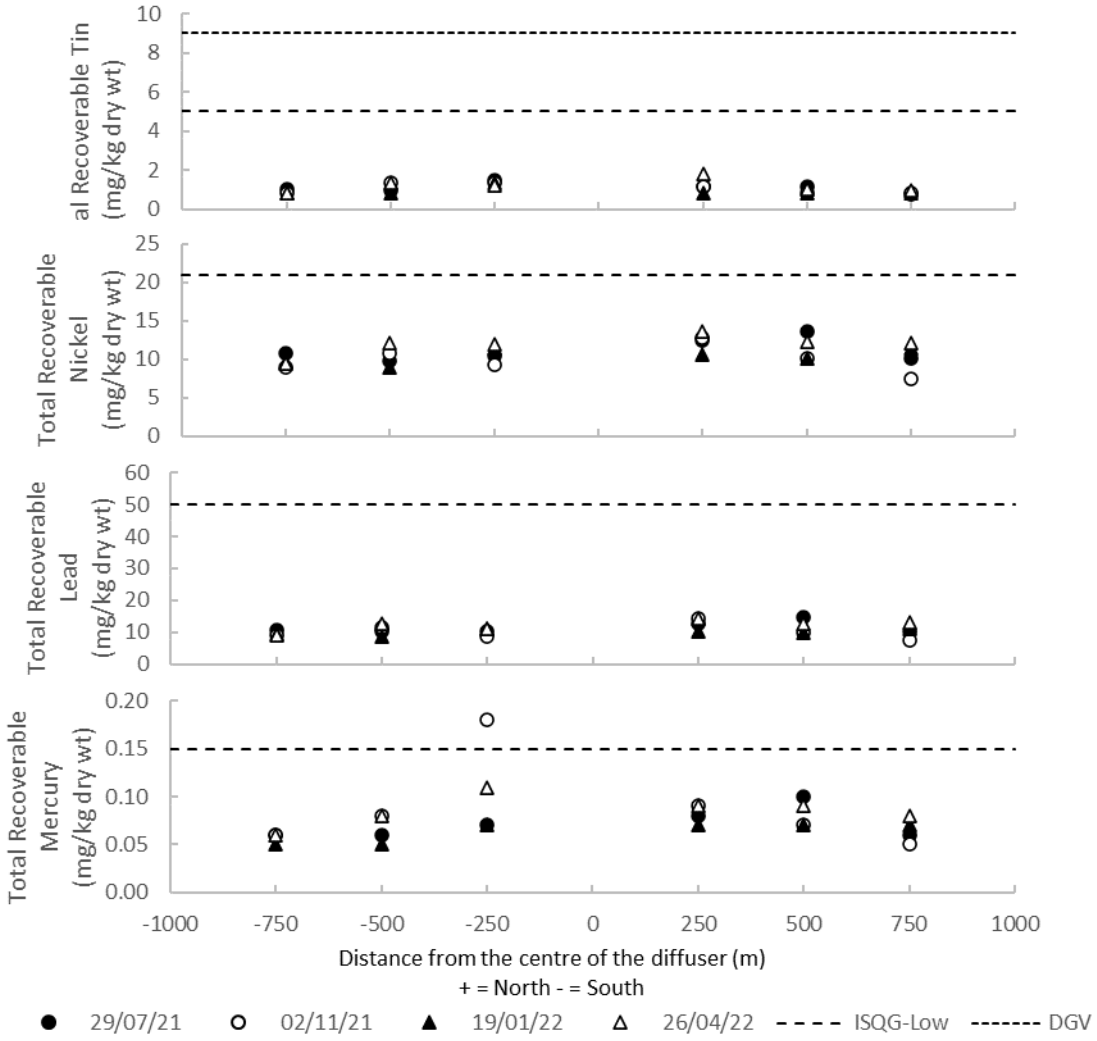


Figure 25: Analysis – Condition 19 – Sediments – Metals (Sn, Ni, Pg and Hg); Temporal and Spatial Variation Analysis

A single elevated measurement of mercury, above the guidelines, was observed during the spring sampling (02/11/21) 250m north of the diffuser. However, given the quarterly sample before and the two quarterly samples after the exceedance at the same location were within the guideline limits and comparable with values from other locations, it is likely that the high mercury result was an outlier.

Appendices

We design with community in mind

Appendix A Boxplot Interpretation Explanation

A box and whisker plot displays the number summary of a set of data. The number summary is the minimum, first quartile, median, third quartile, and maximum. These are defined as follows:

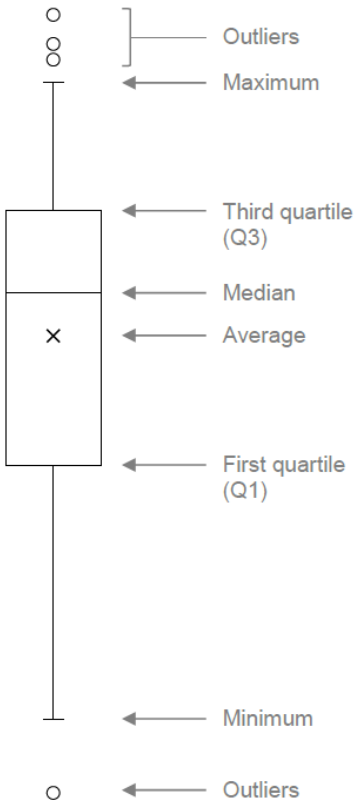
Minimum
The lowest data, excluding outliers.

First quartile (Q1)
Twenty-five percent (25%) of scores fall below the lower quartile value. It is also the median of the lower half of the dataset.

Median
The median marks the mid-point of the data and is shown by the line that divides the box into two parts (sometimes known as the second quartile). Half the scores are greater than
or equal to this value, and half are less.

Third quartile (Q3)
Seventy-five percent (75%) of the scores fall below the upper quartile value. Thus, 25% of the data are above this value. It is also the median of the upper half of the dataset.

Maximum
The highest score, excluding outliers.



Boxplot interpretation explanation

Appendix B Resource Consent CD130214W

HAWKE'S BAY
REGIONAL COUNCIL

RESOURCE CONSENT

Coastal Permit

In accordance with the provisions of the Resource Management Act 1991 (RMA) and subject to the attached conditions, Hawke's Bay Regional Council (the Council) grants a resource consent for a discretionary activity to:

Hastings District Council
Private Bag 9002
Hastings 4156

to discharge final combined wastewater (see Advice Note 1) into Hawke Bay at East Clive via the long offshore outfall.

LOCATION

Address of site: 284 Richmond Road, Clive

Legal description: Seabed, adjacent to Sec 3 Blk II Clive SD

Map reference: NZMG: Between approximately 2850993 6173388-2850592 6173222

NZTM: Between approximately 1941039 5611758-1940638 5611592

CONSENT DURATION

This consent is granted for a period expiring on 31 May 2049.

LAPSING OF CONSENT

This consent shall lapse in accordance with section 125 of the RMA on the 31 May 2019, if it is not exercised before that date.

Iain Maxwell
Group Manager
RESOURCE MANAGEMENT GROUP
Under authority delegated by Hawke's Bay Regional Council
25th June 2014

CONDITIONS

1. The Consent Holder shall discharge the final combined wastewater as authorised by this Resource Consent generally in accordance with the information supplied with the application. Where a conflict exists between the application and the conditions of this Resource Consent, the conditions shall prevail.

2. The rate of discharge of the final combined wastewater (see Advice Note 1) shall not exceed 2,800 litres per second.

3. The discharge of the final combined wastewater as authorised by this Resource Consent shall be by way of the existing long offshore outfall structure located at the end of Richmond Road, East Clive, and shall take place between approximately 2,450m and 2,750m offshore, being approximately NZMG 2850993 6173388 - 2850592 6173222.

4. The final combined wastewater discharged to Hawke Bay via the long offshore outfall shall pass through an ocean outfall diffuser which has been designed to achieve a minimum average dilution over the boil of not less than 100:1 on slack water.

Wastewater treatment and standards

5. The final combined wastewater discharged shall meet the following requirements:

   a) All separable industrial wastewater shall pass through a milliscreen having a maximum aperture slot width of 1mm.

   b) All domestic and non-separable industrial wastewater shall pass through a 3mm diameter hole size screening device or equivalent, followed by treatment in a biological trickling filter, with an annual average daily loading of carbonaceous biochemical oxygen demand (5 day test) ($cBOD_5$) that shall not exceed 0.4 kg per cubic metre of media, with the treatment plant managed in accordance with best wastewater engineering practice and industry standards, and:

      i) the media in the biological trickling filters shall consist of randomly packed plastic material that provides a specific surface area of not less than $90m^2/m^3$, and

      ii) the wastewater remaining after that treatment, prior to being discharged, shall pass through the Rakahore channel.

6. The final combined wastewater discharged shall meet the following standards:

Analyte	Maximum concentration (g/m^3)	Maximum Loading (kg/day)*
Chromium III	2.74	143
Chromium VI	0.44	22.9
Copper	0.13	6.8
Zinc	1.5	78
Cadmium	0.07	3.6
Mercury	0.01	0.5
Lead	0.44	23
Nickel	0.7	36
Ammonia	91	4738

* The maximum daily loading limit is based on the maximum treated wastewater concentration limits multiplied by the 75%ile wastewater flow rate ($52,070m^3$/day) over 12 months in 1998 (a dry year).

In the event that a limit is exceeded for any analyte, an additional 24 hour flow proportional sample shall be collected and tested for that analyte within 5 working days of receipt of the laboratory result. An investigation shall also be undertaken into the cause of the exceedence, and the findings of the investigation recorded and provided to the Regional Council (Manager Resource Use) within one month of the exceedence occurring.

7. The discharge of the final combined wastewater as authorised by this Resource Consent shall not cause any of the following effects beyond a distance of 750m from the midpoint of the outfall diffuser:

   a) The production of any conspicuous suspended materials; or

   b) Any conspicuous change in the colour or visual clarity;

   and shall not cause any of the following effects beyond a distance of 500m from the midpoint of the outfall diffuser:

   c) The production of any conspicuous oil or grease films, scums or foams, or floatable materials; or

   d) Any emission of objectionable odour; or

   e) Any significant adverse effects on aquatic life, or

   f) A change of the natural temperature of the receiving water by more than 3 degrees Celsius, or

   g) The Dissolved Oxygen concentration to be less than 80% of the saturation concentration, or

   h) Undesirable biological growths.

8. The average concentration of Total Oil and Grease in the final combined wastewater shall not exceed 200g/m^3 over any 24 hour period based on the sampling procedure set out in Conditions 13 and 14.

9. The Consent Holder shall inspect the diffuser at least annually and at intervals not more than 14 months apart, and at any other time as necessary, at which time any ports blocked by mussels or other debris will be cleared. The number of blocked ports shall be recorded and reported in the Annual Monitoring Report required by Condition 24 of this consent.

10. The Consent Holder shall ensure that all components of the wastewater treatment plant and outfall structures (including the diffuser on the long offshore outfall) are maintained in good working order, and in accordance with industry best practice guidelines.

11. The Consent Holder shall ensure that all sampling equipment, including meters and field measurement devices are maintained in good working order by suitably qualified persons in accordance with the manufacturer's instructions and industry best practice guidelines. Records of calibration shall be kept and made available to the Council (Manager Resource Use) upon request.

Monitoring

12. The Consent Holder shall continuously monitor and record the rate of discharge and the daily volume of the final combined wastewater discharged. The flow meters used to record the discharge shall have an accuracy within plus or minus 5%, as per the manufacturer's calibration records.

13. For a period of 12 months, from the date of commencement of this consent, at quarterly intervals, with not less than 2 months between each sample, the Consent Holder shall take two flow proportional samples during each 24 hour period on a minimum of 7 consecutive days. The samples shall be taken from the following waste streams, and analysed for the constituents stated:

    a) The domestic and non-separable industrial wastewater prior to the biological trickling filter treatment. These samples shall be analysed for:

        i) Total suspended solids;

        ii) Total oil and grease; and

        iii) $cBOD_5$.

    b) The domestic and non-separable industrial wastewater immediately after the biological trickling filter treatment. These samples shall be split into 2 separate samples which will be analysed separately. One sample shall be taken during the 21 hours of normal operation. One sample shall be taken during the 3 hours of the biomass flushing cycle. These samples shall be analysed for:

        i) Total suspended solids;

        ii) Total oil and grease; and

        iii) $cBOD_5$.

    c) The final combined wastewater. These samples shall be analysed for the analytes listed, at the detection limit shown, in Schedule 1 (attached) for quarterly and annual sampling.

14. Starting 12 months from the date of commencement of this consent, at quarterly intervals, with not less than 2 months between each sample, the Consent Holder shall take 24 hour flow proportional samples on a minimum of 7 consecutive days of the following waste streams, and analyse them for the constituents stated:

    a) The domestic and non-separable industrial wastewater prior to the biological trickling filter treatment. These samples shall be analysed for:

        i) Total suspended solids;

        ii) Total oil and grease; and

        iii) $cBOD_5$.

    b) The domestic and non-separable industrial wastewater immediately after the biological trickling filter treatment. These samples shall be analysed for:

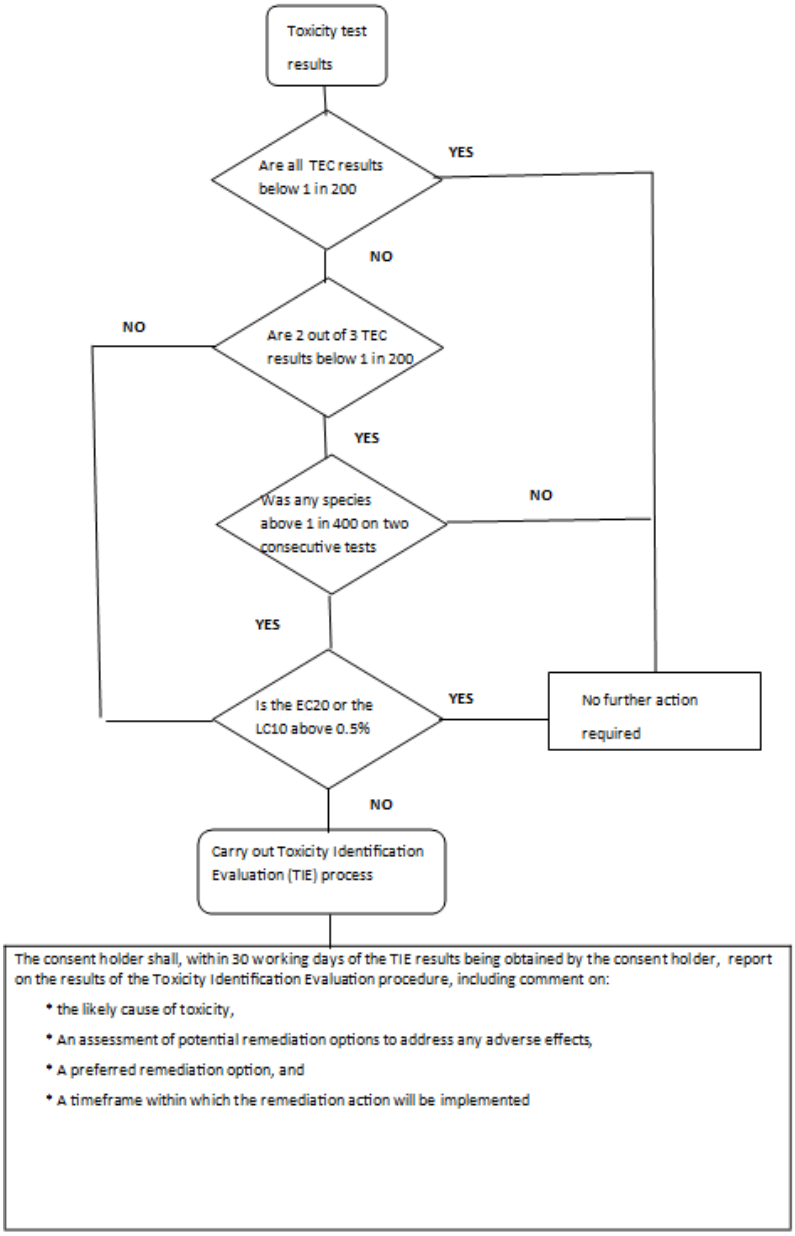
        i) Total suspended solids;

        ii) Total oil and grease; and

        iii) $cBOD_5$.

    c) The final combined wastewater. These samples shall be analysed for the analytes listed, at the detection limit shown, in Schedule 1 (attached) for quarterly and annual sampling.

15. At quarterly intervals, with not less than 2 months between each sample, the Consent Holder shall test the toxicity of the final combined wastewater to at least three species of marine organisms to determine if there is a statistically significant effect. A plan outlining the proposed testing method and the organisms to be tested shall be submitted to the Regional Council (Manager Science) for approval within 2 months of the commencement date of this consent. Changes to the plan (including changes to the organisms tested) can be made but must be submitted to the Regional Council for approval before the proposed changes can be made. The interpretation of results and the actions shall be undertaken using an adaptive management approach as is detailed in the figure below.



Advice Note

- Statistically significant effect is determined by the calculation of the Threshold Effect Concentration (TEC) and is the geometric mean of the No Observable Effect concentration (NOEC) and the Lowest Observable Effect Concentration (LOEC).
- EC20% is the effective concentration that causes the stated effect in 20% of the test organisms.
- LC10% is the lethal concentration that kills 10% of the test organisms.
- The TEC shall be expressed in terms of dilution (e.g. 1 in 200).
- The EC20 and LC10 shall be expressed in terms of percentage concentration (e.g. 0.5% equivalent to dilution 1 in 200).
- The decision tree above outlines the interpretation of the analysis and appropriate actions to be taken.

16. At quarterly intervals, with not less than 2 months between each sample, the Consent Holder shall take water quality samples at 10 sites perpendicular to the centre of the diffuser at distances of 100m, 250m, 500m, 750m and 1000m (on each side of the diffuser). These samples will be analysed for faecal coliform and enterococci. Field measurements are to be made of pH, salinity, turbidity, temperature, and dissolved oxygen (%saturation) at each location as well.

17. While samples are being taken in accordance with Condition 16, a GPS drogue shall be placed at the centre of the diffuser to measure the surface currents for at least 30 minutes.

18. The Consent Holder shall undertake surveys designed to show the impact of the discharge on the benthic fauna:

    a) The benthic survey shall include an assessment of marine sediments, benthic ecology, and trace metals in flatfish (comparable to that carried out by Golders Associates in 2012 and 2013) and shall be undertaken in the 8th, 17th and 26th years after the commencement date of this Resource Consent. The final design of each survey shall be submitted to the Regional Council (Manager Science) for approval prior to each survey being undertaken. Flatfish of the same species as those collected at the time of the first benthic survey required by this consent shall also be tested for pathogenic bacteria and parasites (see Advice Note 3).

    The results of all benthic surveys shall be provided to the Regional Council (Manager Resource Use) within 1 month of being received by the Consent Holder.

19. Twice during the year (summer and winter) the Consent Holder shall take seabed sediment grab samples at distances of approximately 250m, 500m and 750m to the north and 250m, 500m and 750m to the south of the midpoint of the outfall diffuser. Those samples shall be analysed for the analytes listed, at the detection limit shown, in Schedule 2.

    In the event that sediment monitoring required by this condition, results in two or more exceedances of ANZECC 2000 (ISQG – Low) sediment guidelines on one occasion of sampling, then an additional benthic survey shall be undertaken within one year of the sediment sampling exceedance(s) occurring. However, no more than one additional survey shall be required by this condition to be undertaken within each 9 year period specified in Condition 18 a).

20. All quality analysis of the wastewater discharged other than field measurements as required by the conditions of this consent shall be undertaken by an independent laboratory accredited to IANZ or other laboratory approved by the Regional Council (Manager Resource Use). Field measurements shall be undertaken in accordance with best industry practice.

21. Within three months of the commencement date of this consent, the Consent Holder shall submit to the Regional Council (Manager Resource Use) a Memorandum of Understanding (MOU) which shall include, but is not limited to the following:

    a) Details of sampling methodologies and procedures to be followed;

    b) Protocols that will be observed;

    c) Details of sampling locations;

    d) Details of when information (including data and sampling results) needs to be provided to the Regional Council, and in what format.

    The MOU shall be prepared in consultation with the Regional Council (Manager Resource Use) and can be varied upon agreement between the two parties. All sampling shall be

undertaken in accordance with the MOU. All records collected in accordance with the conditions of this Resource Consent shall be provided to the Regional Council (Manager Resource Use) at the times and in the formats specified in the MOU. Until the MOU is prepared, records shall be provided to the Regional Council (Manager Resource Use) no more than one month following the end of the month to which they relate, except for the flow data required in accordance with Condition 12 of this consent which shall be provided at quarterly intervals.

Administrative

22. The Consent Holder shall ensure that at all times clear and visible signage is placed on the buoys marking the two ends of the diffuser, incorporating the words "Shellfish unfit for human consumption".

23. The Consent Holder shall appoint a person to be responsible for the day-to-day operation of the treated wastewater disposal system and to act as a contact person for the Regional Council. The name and phone number of this contact person shall be advised to the Regional Council (Manager Resource Use) within 10 working days of the commencement date of this consent and within 10 days of any change.

Reporting

24. Before 1 October each year, the Consent Holder shall provide the Regional Council (Manager Resource Use) with an 'Annual Monitoring Report', covering the preceding 12 month period ending 30 June. The report shall be submitted together with a peer review completed by a suitably qualified and experienced professional expert. This monitoring report shall include, but not be limited to:

    a) A summary of all monitoring undertaken as required by this consent, and may include details of additional monitoring undertaken by the consent holder to better characterize the effects of the discharge on Hawke Bay;

    b) A critical analysis of the results of sampling required by Condition 13, in the Annual Monitoring Report completed the year following the collection of that data.

    c) A critical analysis of the monitoring information in terms of compliance and adverse environmental effects;

    d) An assessment of compliance in relation to the trigger values set out in the table below. Any exceedences of these trigger values shall be clearly identified and reasons for each exceedence (if known) provided. Comment shall also be provided about the significance of the exceedence in terms of effects (if any) on the receiving environment, and any measures that may be appropriate to reduce the concentration of the relevant analyte should that be necessary having regard to any adverse environmental effects. An assessment of trends in the concentrations of these parameters over the previous year, and also over the term of this Resource Consent must also be provided;

Analyte	**Trigger Value[2]**
$cBOD_5$[1]	48,000 kg/day
Total suspended solids[1]	39,000 kg/day
Total Daily (annual average)	66,000

volume	m^3/day

[1] The annual average mass load is calculated by multiplying the result for each day by the volume each day and then averaging the loads.

[2] The trigger value is calculated as an upper tolerance limit based on annual mean results from 1998 to 2013 inclusive.

e) Comment on any non-compliances and operational problems, and any actions undertaken to address these;

f) Details of any works undertaken or proposed to improve the performance of the treatment system, and the timeframe for completion of any proposed works;

g) Identification and comment on any trends in volumes, flows, toxicity (EC50 or LC50) and contaminant loads over the reporting period, and compared to previous years. This shall include any trends in water quality parameters/wastewater constituents including comment on the potential environmental implications of these trends; and

h) Recommendations regarding alterations or additions to the monitoring programme;

i) Details of any changes to the consent conditions that may be applied for within the next 12 month period;

j) Details of the date of the plant open day, numbers in attendance, and written questions submitted by members of the public, and responses given (except that this subsection cannot be addressed in the first Annual Monitoring Report completed in accordance with the conditions of this consent); and

k) The tabulated results of the laboratory analytical monitoring.

25. Each Annual Monitoring Report shall be made publicly available on the Consent Holder's website within one month of it being lodged with the Regional Council (Manager Resource Use). Notification of the availability of this Report shall also be included in the Consent Holder's next public newspaper general ratepayers' notice and also the next ratepayer newsletter.

26. During the month of November each year, the Consent Holder shall have a public 'open day' at the Wastewater Treatment Plant site, located on Richmond Road. Notification of this open day shall be done via the Consent Holder's website and in a Consent Holders public newspaper general ratepayers' notice at least 10 working days before the open day. The open day shall be attended by Hastings District Council Staff as well as a Regional Council Compliance Officer. The purpose of the open day is to give the community an opportunity to view the treatment plant, and discuss the Annual Monitoring Report. It is also an opportunity for members of the public to submit written questions to which the Consent Holder shall respond in writing within one calendar month.

    Details of the date of the open day, numbers in attendance, written questions submitted and responses given shall be included in the next Annual Monitoring Report, as noted in Condition 24 (j) above.

27. The Consent Holder shall submit to the Regional Council (Manager Resource Use) a Trends, Technology, Discharge, Environmental and Monitoring Review Report not later than the 9th, 18th and 27th year anniversaries of the issue of this discharge permit. Each Review Report shall be made publicly available on the Consent Holder's website within one month of being lodged with the Regional Council. Notification of the availability of this Report shall be included in the

Consent Holder's next public newspaper general ratepayers' notice and also the next ratepayer newsletter.

The Review Report shall address as a minimum, but not be limited to, the following matters for the nine year period since the last review:

a) Comparisons of population and industrial changes and possible trends as compared to the Heretaunga Plains Urban Development Strategy (2010) (HPUDS), and then latest reports on the Hastings Urban Development Strategy and the Hastings Industrial Strategy;

b) Volumes, flows and loads profile and changes assessed against future projections and wastewater projections as set out in section 4.3 of the Hastings Wastewater Resource Consents Project: Assessment of Effects on the Environment and Resource Consent Applications copy dated June 2013;

c) Trade waste profiles, trends and any significant changes in the Consent Holder's trade waste management practices and the trade waste contaminant profile;

d) Any new changes to environmental guidelines and / or standards applicable to the discharge of treated wastewater into Hawke Bay;

e) Changes in asset management and operational matters that may have relevance to the on-going operation and development of the Consent Holder's Wastewater Scheme from the perspective of the treated wastewater discharge, water conservation and efficient energy management;

f) Changes in wastewater treatment technologies that may be relevant to the Hastings Wastewater Scheme for either the domestic and non-separable waste stream and / or the industrial waste stream;

g) The results of a recreational usage survey undertaken during the nine year period, which is comparable to the survey undertaken between the summers of 2011 and 2013 (See Advice Note 4), and comparison of those results with previous surveys;

h) Options for treated wastewater disposal / discharge and beneficial reuses that may be appropriate to the Wastewater Scheme;

i) Effects of the treated wastewater discharge into Hawke Bay as evident from the resource consent monitoring; and

j) Details of consultation undertaken with the community to ascertain their views of the effects of the current wastewater discharge (see Advice Note 5).

Consideration of this existing Resource Consents Project objectives, opportunities for improvement and Best Practicable Option (BPO) in terms of the interpretation of this term in the Resource Management Act 1991.

28. The Consent Holder shall log all complaints received relating to the discharge. The log shall include:

a) The date and time of the complaint;

b) The nature of the complaint;

c) The name, telephone number, and address of the complainant;

d) Weather and sea condition information (including an estimate of wind speed and direction, and description of sea condition);

e) Details of key operating parameters at the time of the complaint; and

f) Any remedial action taken to prevent further incidents.

Complaints shall be reported to the Regional Council (Manager Resource Use) within 24 hours of receipt, and the log of complaints shall be made available to the Regional Council (Manager Resource Use) on request. Any complaints relating to potential adverse health effects associated with exposure to the wastewater discharge shall be notified to the Hawke's Bay District Health Board within 24 hours of receipt also.

29. In accordance with the principles of the Treaty of Waitangi (especially those of partnership and consultation) and recognising the role of Tangata Whenua as kaitiaki, the Consent Holder shall establish, and retain, as a committee of the Hastings District Council under Clause 31, Schedule 7, Local Government Act 2002, a Council Committee, half of the members of which shall be Tangata Whenua representatives the functions of which shall include:

    a) Developing the Hastings District Council's wastewater treatment and disposal system policies;

    b) Receiving, reviewing and recommending action on reports concerning the operation and performance of the Council's wastewater disposal system, treatment plant and ocean discharge;

    c) Receiving, reviewing and recommending from time to time the commissioning of reports and future Hastings District Council actions on wastewater issues including:

        i) Options for further or other treatments;

        ii) Options for alternative methods of disposal; and

        iii) Monitoring effects on the environment;

    d) Co-ordinating and overseeing education of the community including tangata whenua and trade waste dischargers on wastewater issues;

    e) Not less than three months before each of the Trends, Technology, Discharge, Environmental and Monitoring Nine Yearly Review as required in accordance with Condition 27 is commenced by the Consent Holder, providing to the Consent Holder any further suggested input in respect to the scope of the review;

    f) Advising the Consent Holder on the Condition 27 Trends, Technology, Discharge, Environmental and Monitoring Nine Yearly Review before it is finalised and submitted to the Regional Council (Manager Resource Use) (See Advice Note 6); and

    g) Recognising the role of tangata whenua as kaitiaki and the need to recognise and seek to satisfy the cultural concerns of tangata whenua.

30. In the event of the Consent Holder becoming aware of:

    a) unusual or extreme circumstances (not being circumstances such as would provide a defence under sections 341 – 341B, Resource Management Act 1991) that may lead to one or more of the conditions of this Resource Consent being breached, or

    b) circumstances having occurred that have, or could, lead to non-compliance,

    immediate notification of such problems shall be made to the Regional Council (Manager Resource Use). This notification shall include, but not be limited to, provision of the

following information as far as such information is known to the Consent Holder at that time:

i) The extent of non-compliance if it has occurred, including the duration of non-compliance, volume discharged during that period, and the nature and quality of the discharge,

ii) The immediate and further planned measures being undertaken to minimise and mitigate any adverse effects of the non-compliance,

iii) The Consent Holder's assessment of public health risk arising from the event including advice received from the Hawke's Bay District Health Board Chief Executive Officer and Medical Officer of Health, and

iv) Updating the Regional Council (Manager Resource Use) at not greater than 24 hourly intervals of the current situation until the problems are rectified and the Consent Holder is compliant with the Resource Consent conditions.

31. Within one calendar month of any unforeseen event that resulted in non-compliance with the conditions of this Resource Consent, the Consent Holder shall provide a further report to the Regional Council (Manager Resource Use). This report shall include, but not be limited to the provision of any further information on the reasons for the non-compliance and the measures investigated and put in place or to be put in place to avoid or at least minimise the possibility of any similar problems in the future that may cause non-compliance.

32. The Consent Holder shall make available to the Regional Council (Manager Resource Use) upon request records kept in relation to the discharge, and its effects on the environment including sampling, testing, and analysis.

ADVICE NOTES

1. "Final combined wastewater" refers to the separate industrial wastewater stream, which is trade waste (excluding all human excreta) transported through a separate piped network to the East Clive Wastewater Treatment Plant, and the domestic and non-separable industrial wastewater (which has been treated in the biological trickling filter) which are combined immediately prior to discharge via the ocean outfall.

2. It relation to Condition 6, the maximum wastewater concentration limits are based on ANZECC (2000) Aquatic Ecosystem guideline limits multiplied by a factor of 100 (for 100:1 dilution). Concentrations are for the Acid Soluble Fraction.

3. In relation to Condition 18, the Consent Holder shall discuss and agree the design of the flatfish analysis required at the time of the first benthic survey with the Hawke's Bay District Health Board Chief Executive Officer and Medical Officer of Health.

4. The results and methodology used in the Coastal Recreational and Commercial Survey 2013 is detailed in Support Document 9 to the AEE which was lodged with the Regional Council on 1 July 2013.

5. For clarity, it is noted that the consultation required by Condition 27(j) is in addition to consultation that must be undertaken in accordance with other conditions of this Resource Consent, including Condition 29 which relates to the Tangata Whenua committee.

6. The reason for Condition 29(f) is that the Hastings District Council Tangata Whenua Wastewater Joint Committee established in accordance with Condition 30 of Resource Consent CD990260Wd, and Condition 29 of this Resource Consent, and the Hastings District Council requested this linkage between the Trends, Technology, Discharge, Environmental

and Monitoring Nine Yearly Reviews and the activities of a Hastings District Council and Tangata Whenua Committee formed and having the functions in accordance with Condition 29.

Review of Consent Conditions by the Council

The Council may review conditions of this consent pursuant to sections 128, 129, 130, 131 and 132 of the RMA. The actual and reasonable costs of any review undertaken will be charged to the Consent Holder, in accordance with section 36 of the RMA.

Times of service of notice of any review: During the month of May of any year.

Purposes of review:

To deal with any adverse effect on the environment arising from the exercise of this consent, which it is appropriate to deal with at that time or which became evident after the date of issue.

To require the adoption of the best practicable option to remove or reduce any effects on the environment.

To modify any monitoring programme, or to require additional monitoring if there is evidence that current monitoring requirements are inappropriate or inadequate.

Reasons for Decision

The effects of the activity on the environment will not be more than minor. Granting the consent is consistent with the purpose and principles of the RMA and with all relevant plans and policies.

Monitoring Note

Routine monitoring

Routine monitoring inspections will be undertaken by Council officers at a frequency of no more than once every year to check compliance with the conditions of the consent. The costs of **any** routine monitoring will be charged to the consent holder in accordance with the Council's Annual Plan of the time.

Non-routine monitoring

"Non-routine" monitoring will be undertaken if there is cause to consider (e.g. following a complaint from the public, or routine monitoring) that the Consent Holder is in breach of the conditions of this consent. The cost of non-routine monitoring will be charged to the Consent Holder in the event that non-compliance with conditions is determined, or if the Consent Holder is deemed not to be fulfilling the obligations specified in section 17(1) of the RMA shown below.

Section 17(1) of the RMA states:

> *Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of the person, whether or not the activity is carried on in accordance with*

a) *any of sections 10, 10A, 10B, and 20A; or*

b) a national environmental standard, a rule, a resource consent, or a designation.

Consent Impact Monitoring

In accordance with section 36 of the RMA (which includes the requirement to consult with the Consent Holder) the Council may levy additional charges for the cost of monitoring the environmental effects of this consent, either in isolation or in combination with other nearby consents. Any such charge would generally be set through the Council's Annual Plan process.

Debt Recovery

It is agreed by the Consent Holder that it is a term of the granting of this Resource Consent that all costs incurred by the Council for, and incidental to, the collection of any debt relating to this Resource Consent, whether as an individual or as a member of a group, and charged under section 36 of the RMA, shall be borne by the Consent Holder as a debt due to the Council, and for that purpose the Council reserves the right to produce this document in support of any claim for recovery.

Consent History

Consent No. (Version)	Date	Event	Relevant Rule Number	Plan
CD130214W	25/06/2014	Consent initially granted	157	Proposed Regional Coastal Environment Plan

Schedule 1

Test / Analyte	Quarterly	Annually	Units	Recommended Detection Limit**
pH	X	X		0.1
Conductivity	X	X	mS/m	0.1
Total Oil and Grease	X	X	g/m^3	4
Total Solids		X	g/m^3	10
Total Suspended Solids	X	X	g/m^3	3
Total organic carbon		X	g/m^3	0.5
NH_4-N	X	X	g/m^3	0.01
NO_3-N/NO_2-N		X	g/m^3	0.002
$cBOD_5$	X	X	g/m^3	10
COD		X	g/m^3	6
Zn (acid sol)	X	X	g/m^3	0.001
Sulphide	X	X	g/m^3	0.002
TKN		X	g/m^3	0.1
DRP	X	X	g/m^3	0.004
TP		X	g/m^3	0.004
Total Phenols		X	g/m^3	0.002
Total CN		X	g/m^3	0.001
As (acid sol)	X	X*	g/m^3	0.00005
Cr III (acid sol)	X	X*	g/m^3	0.001
Cr VI	X	X*	g/m^3	0.001
Cu (acid sol)	X	X*	g/m^3	0.0005
Ni (acid sol)	X	X*	g/m^3	0.0005
Pb (acid sol)	X	X*	g/m^3	0.0001
Hg (acid sol)	X	X*	g/m^3	0.00008
VOC (inc BTEX)		X	g/m^3	To trace
SVOC		X	g/m^3	To trace
PCP		X	g/m^3	To trace
ON & OP pesticides		X	g/m^3	To trace

*Both total and dissolved fractions to be tested in annual survey.
** The detection level quoted may not be applicable in all circumstances due to interferences within the sample.

Schedule 2

Test / Analyte	Units	Detection Limit*
Zn (total recoverable)	mg/kg	0.4
As (total recoverable)	mg/kg	0.2
Cd (total recoverable)	mg/kg	0.01
Cr (total recoverable)	mg/kg	0.2
Cu (total recoverable)	mg/kg	0.2
Sn (total recoverable)	mg/kg	0.1
Ni (total recoverable)	mg/kg	0.2
Pb (total recoverable)	mg/kg	0.04
Hg (total recoverable)	mg/kg	0.01

*The detection level quoted may not be applicable in all circumstances due to interferences within the sample.

Appendix 1. Consent Condition Analysis

Condition No.	Reason for Condition
1	The effects of the proposed activity have been assessed based on the information provided by the applicant. It is important that the activity is undertaken as proposed because the effects of the activity may vary if the nature or intensity of the activity changes.
2	Rate of discharge influences the effects the proposed activity may have on the environment
3	The effects of the proposed activity have been assessed based on the environment surrounding the outfall. A discharge in another location may have different effects
4	The effects of the discharge have been assessed on the basis of a 100:1 dilution being achieved. It is important that this level of dilution continues to be achieved. Lower levels of dilution may result in adverse effects on the environment.
5	The effectiveness of BTF plants is closely linked to their loading rate (increased loading rate results in decreased levels of removal/treatment), therefore it is important that a loading rate is specified. The type of media installed in the tanks also has an effect on the quality of effluent produced and has therefore been specified. The Rakahore Channel (previously referred to as the Papatuanuku Channel) addresses tangata whenua concerns with the discharge and it is therefore important that it remains part of the treatment process.
6	The inclusion of end of pipe standards for metals and ammonia should ensure that quality of the wastewater discharged to Hawke Bay provides for 95% species protection (in accordance with ANZECC 2000 guidelines). End of pipe standards allow an easy assessment of the effects of the discharge, because they cannot be influenced by other possible sources of contamination that monitoring in the receiving environment can be.
7	In accordance with section 107, any discharge to the environment cannot result in the effects listed. Including this as a condition of consent ensures that the consent holder is aware of the effects it may not cause after reasonable mixing.
8	The inclusion of a Total Oil and Grease standard should ensure that the quality of the discharge to Hawke Bay is maintained.
9	Regular maintenance of the diffuser will ensure that the dilution rate in Condition 4 continues to be achieved.
10	Ongoing good practice in the operation of the outfall and diffuser will assist in ensuring compliance with the rest of the conditions of this consent.
11	Requiring the consent holder to regularly check and maintain sampling equipment should ensure that sampling results are accurate, and give confidence that the effects of the discharge are being correctly measured.
12	Allows compliance with Condition 2 to be assessed.
13	Allows compliance with Condition 8 to be assessed and also the nature of the discharge compared against the trigger values set out in Condition 24. Also will provide further information about the quality of the discharge during the flushing cycle. This condition was included to address a concern raised by the submitter who initially opposed the applications.
14	Allows compliance with Condition 8 to be assessed and also the nature of the discharge compared against the trigger values set out in Condition 24.
15	High toxicity levels can have an adverse effect on the environment. It is important that toxicity levels are assessed against criteria that will provide a level of protection that is appropriate to the sensitivity of the species found in it. This condition allows greater flexibility than the previous toxicity condition, which reflects the technical nature of toxicity assessments, and the difficulty in collecting meaningful data over a period of time.
16	High concentrations of faecal coliform and enterococci in the receiving environment can have an adverse effect on public health. It is important to sample these regularly to allow any trends in concentration to be identified. Sampling at a distance of 100 and 250 m also

	allows the adequacy of the mixing zone to be assessed and potentially decreased if the effects of the discharge are shown to be limited to a smaller radius around the diffuser.
17	The direction of current at the time of sampling can have an effect on the results of that sampling.
18	Benthic surveys will allow the effect of the discharge, particularly its solids component, to be assessed, and any adverse effect on the environment identified in a timely fashion. The requirement to sample flatfish at the time of the first survey reflected a request made in the HBDHB's submission.
19	Some constituents of wastewater discharges accumulate in sediments. Regular assessment of the concentrations of these constituents is important because they can bio accumulate and adversely affect other species that feed on them. The requirement for an additional benthic survey to be undertaken if two samples (taken during one sampling run) exceed the ANZECC guidelines provide further certainty that any adverse effects of the discharge will be identified in a timely fashion.
20	It is important that the analysis of sampling results is undertaken in accordance with industry best practice and in a manner that allows the results to be assessed with other sampling results. Use of an accredited laboratory and adherence to industry best practice guidelines ensures this.
21	To ensure the sampling results have integrity it is important that sampling methodologies and procedures are agreed and always followed, appropriate protocols are observed and the timing of the provision of information to Council is agreed. It is considered more appropriate to have this information set out in an MOU rather than consent conditions because is important that it can easily be amended to reflect industry best practice.
22	Signs indicate the presence of a potential public health risk as a result of the discharge.
23	It is important that the consent authority knows who the primary contact for the consent is, particularly in emergencies.
24	The requirement for an annual report ensures that the consent holder assesses the performance of the treatment plant over a 12 month period, and its effect on the receiving environment. The annual report also requires trends over time to be assessed, which ensures that the long term effect of the discharge is regularly reviewed, and necessary changes to the operation and/or design of the treatment plant made before the discharge has any adverse effect on the receiving environment. The specification of trigger values for the concentration of $cBOD_5$, TSS and total volume in this condition, and a requirement to assessment performance against these, ensures that the nature of the discharge remains within that which has been assessed, and historically observed to have no more than minor adverse effects on the environment. Increased loads will not necessarily have an adverse effect on the environment, but nominating these trigger values ensures that any higher concentrations are investigated. The requirement to submit a peer review together with the annual monitoring report provides an additional layer of transparency to the assessment of the WWTP's performance, and confidence that monitoring results are being thoroughly assessed, and any unusual trends identified.
25	It is important that the community has regular access to information about the quality and effects of the wastewater discharge. Making the annual monitoring report available is one way of ensuring that the public is regularly informed about the performance of the plant.
26	The facilitation of a public open day at the WWTP each year provides a further oportunity for members of the public to be regualarly updated on its performance, and also have an opportunity to ask questions of Council staff involved with it. This condition was developed to address a concern raised by one submitter about the lack of any regular formal engagement with the wider community.
27	The requirement for the consent holder to undertake a through review every nine years was one of the reasons on which a 35 year consent duration could be justified. It is important that at this interval the consent holder reviews the performance of the WWTP, and also engages with the community, and the Tangata Whenua Joint Committee to ensure that they are comfortable with the continuation of the current level of treatment, or

	whether there is a desire to increase the level of treatment that the plant provides. There are a number of other matters that the consent holder must assess also. The nine yearly review must also be made available to the public.
28	The consent holder needs to record and take action to address any complaints made by the public about the activity. This is a useful resource at the time of consent replacement also, as it helps gain an understanding of the effect of the activity on adjoining properties.
29	The applicant requested the inclusion of this particular consent condition as it had been discussed and agreed with the Tanagata Whenua Wastewater Joint Committee which as set up in accordance with the conditions of the previous consent. The condition ensures the ongoing engagement of the consent holder with tangata whenua over matters relating to the WWTP.
30	Discharge of an unusual nature have the potential to have adverse effects on both the enviornment and human health. It is therefore important that the Regional Council is aware of these as soon as possible, so that appropriate measures can be taken to ensure the protection of public health in the first instance.
31	It is important that the reason for any discharges of an unusual nature are identified so that hopefully they can be avoided in the future.
32	As the consent authority it is important that the Regional Council has the ability to obtain all relevant information from the consent holder relaing to this discharge, and its potential effects on the environment.

Appendix C Memorandum of Understanding

Memorandum of Understanding
Consent No. CD130214W

(Updated on 05 November 2020)

Prepared By:

R. McWilliams
Wastewater Treatment Manager
Hastings District Council

Contents

1. Introduction

The purpose of this Memorandum to provide the methodology of how Hastings District Council is going to comply with the Discharge Consent No. CD130214W (AUTH120712-01).

2. Conditions

2.1 Condition 2

Condition 2 specifies the maximum wastewater discharge rate. The final treated wastewater discharge rate is rounded to one decimal place.

The rate of discharge is governed by the speed of the pumps and the number of pumps running. The design of the pumps is that at the maximum revolutions of the pump and two duty pumps operating the outfall will discharge 2800 l/s. The instantaneous flow rate will depend on the state of the tide, swell and wet well levels but on average should not be capable of exceeding the maximum of 2800 l/s.

2.2 Condition 3

Condition 3 specifies the minimum dilution rate for the ocean outfall diffuser.

The current diffuser is located in the sea bed as in the consent document.

2.3 Condition 5

Condition 5 specifies the screening, biological trickling filter media, and Rakahore channel requirements.

The screens for the separated industrial influent wastewater are 1mm wedgewire ContraShear screens. The non-separated influent wastewater (DNSI) screens are 3mm diameter (hexagonal) Centre Flo band screens.

The current biological trickling filter has been designed for a daily loading rate of 0.3 Kg of carbonaceous biochemical oxygen demand (cBOD-5 day test) per cubic meter of media so it should not exceed the 0.4Kg limit. The loading rate is checked on each daily samples each quarter so increases will be readily identified long before the annual average is exceeded.

The loading rate is the average cBOD loading rate for the entire consent sampling period and calculate in kg/m3/day. The daily individual loading rates are calculated based on the influent flow rates (m3/day) and the cBOD (g/m3) for that day.

The final loading rates are rounded to 3 decimal places.

2.4 Condition 6

Condition 6 specifies the final combined wastewater discharge quality standards for heavy metals and ammonia.

The maximum daily loading/discharge calculation is based on the maximum treated wastewater (effluent) concentration limits multiplied by the average treated wastewater flow rate in m3/day over 12 months.

The analyte concentrations and the loading rates are rounded to 3 three decimal places.

This condition gives a procedure to be undertaken (another sample) if any analyte is exceeded for any test. Any exceedance will be reported to the HBRC compliance officer, as soon as practicable on receipt of the analyses, the compliance officer will determine non-compliance and notify the Hastings District Council of the decision.

2.5 Condition 7

Condition 7 specifies the adverse odour, visual, chemical, biological and ecological effects to be avoided as a result of the discharges.

Observations of these parameters will be made when carrying out the quarterly sampling around the outfall. Any exceptions will be reported to HBRC compliance Officer.

2.6 Condition 8

Condition 8 specifies the Total Oil and Grease limits in the final combined wastewater over a 24-hour period.

The total oil and grease in g/m3 will be calculated on a daily basis based on the final combined waste water flow (m3/day) during the sampling period. This calculated data is rounded to one decimal place.

Any exceedance will be reported to the HBRC compliance officer as soon as practicable on receipt of the analyses, the compliance officer will determine non-compliance and notify the Hastings District Council of the decision.

3. Monitoring

3.1 Condition 12

Condition 12 specifies the monitoring requirements for the discharge of final combined wastewater.

A Raven Eye^{R} flow meter is installed in the industrial outlet channel leading to the wet well (upstream of the grit removal system). The specification of the flow meter is stored in the HDC ID (Infrastructure Data Historian of the HDC).

This allows the comparison between the incoming flows and the outgoing flow (this is not required by the consent). The information from the flow meter is transferred to the local historian via the site SCADA system. The final combined wastewater flow rates are integrated to calculate the daily total combined effluent discharge volume.

Micronics Ultrasonic Doppler flow meters are installed on the outlet of each pump.

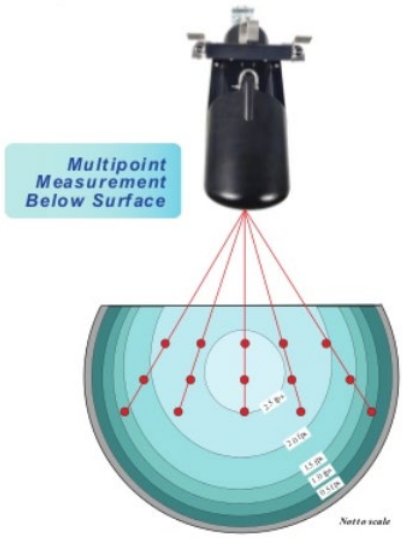
The accuracy of each meter is plus or minus 2%. This provides for a secondary measurement of the flow rate.

3.2 Condition 14 (Condition 13 no longer applies).

3.2.1 Condition 14a) and 14b)

Condition 14 specifies the sampling requirements of the DNSI wastewater.

A ”Laserflow” flow meter is installed in the domestic and non-separable (DNSI) sewer influent channel (Sewer 03). This flowmeter measures the height by an ultrasonic level meter and uses a laser to measure the depth at various points in the flow.



The specification for this instrument is stored in the HDC ID (Infrastructure Data Historian).

The control system at the site integrates the flow rates from the domestic laser flow meter and generates and historise daily volumetric flow data in an excel spread sheet through the SCADA.

In a steady state, the incoming flow to the Biological Trickling Filters will be the same as the flow exiting the filters and being discharged through the Rock Channel.

The sampler before the Biological Trickling Filter is located in an area of high turbulence at the exit of the screen structure and consists a peristaltic pump which is controlled by the plant control

system to have flow proportional composite samples as required by consent. The operation sequence of the sample pumps are described in the sample pump Functional Description document.

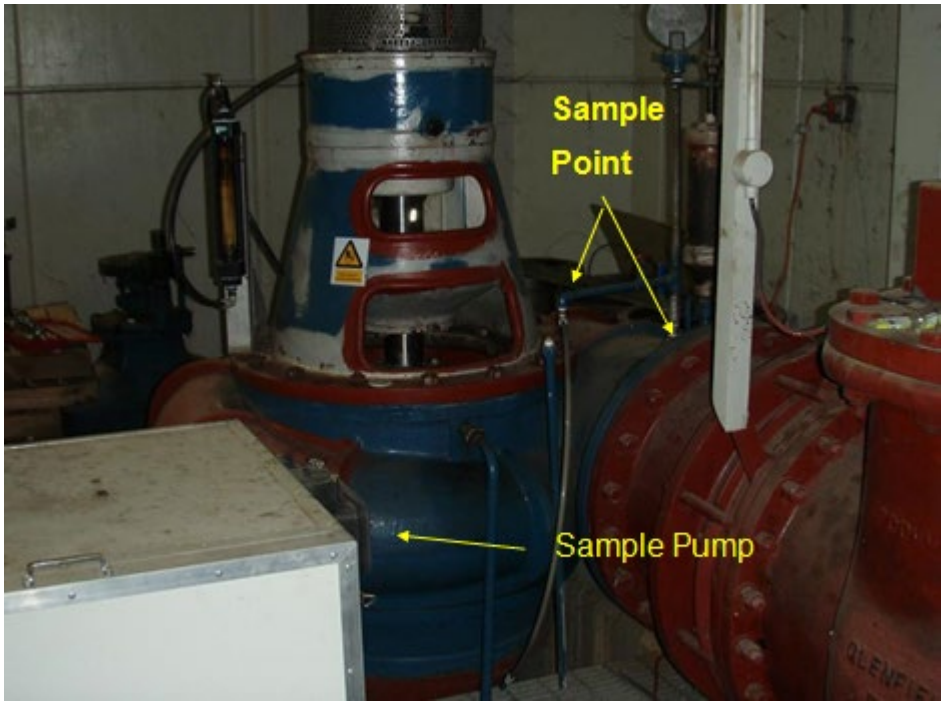
The sample is taken from 8am to 8am each day.

The sampler after the Biological Trickling Filter is located at the structure where the flow exits from both tanks prior to being conveyed to the recycle pump station, this is an area of high turbulence and sampler intake is in the centre of this structure.

The samples are refrigerated (maximum 4 days) and couriered overnight in chilly bins to Hills Laboratories in Hamilton for analysis. The BOD sample is frozen to preserve. The methods of analysis used are the standard methods of Hill Laboratories to achieve the required detection limits. Hill Laboratories is an IANZ Accredited Laboratory; they are accredited for a very wide range of tests on waters, effluents, soils, sediments, plants and biota. Copies of the Accreditation are available on request to Hill Laboratories.

3.2.2 Condition 14 c

The final combined wastewater is sampled at the outlet of the Duty 1 pump. At this point the wastewater will be turbulent and well mixed.



The peristaltic Watson Marlow sample pump sample pump is controlled by the control system which makes sure that the flow proportional sample is taken for analysis.

The sample pump operation sequence ensures that the fresh and representative samples are taken for testing purposes. The sample pump operation sequence is clearly described in the functional description (Refer the section 16 of the functional description FH-152-03-ENG-FDS-001_0.93).

The composite sample container is located in a refrigerated container. The sample is collected from 8am to 8am each day during the sampling period.

The sample pump operates for the full 7 days with containers being swapped at 8am for each day's sample. The composite sample is mixed and subsampled into containers provided by Hill Laboratories with the appropriate preservative added.

The samples are refrigerated (maximum 4 days) and couriered overnight in chilly bins to Hills Laboratories in Hamilton for analysis. The BOD sample is frozen to preserve. The methods of analysis used are the standard methods of Hill Laboratories to achieve the required detection limits. Hill Laboratories is an IANZ Accredited Laboratory; they are accredited for a very wide range of tests on waters, effluents, soils, sediments, plants and biota. Copies of the Accreditation are available on request to Hill Laboratories.

In case of any unforeseen failures in the sampling equipment or its control or operations during the sampling period, HBRC will be notified as soon as practicable and an alternative arrangement will be made to take more samples to compensate the lost samples as per the instructions from HBRC.

3.3 Condition 15

Condition 15 specifies the toxicity sampling & testing requirements of the final combined treated wastewater.

A 24 hour flow proportional sample of the final combined wastewater is taken (same as Condition 13c). The sample is sent to NIWA in Hamilton in a chilly bin (packed with ice or ice substitute) for testing. The current testing regime is:

- Marine algae (Mintocellus polymorphus) 48 hour growth test
- Wedge shell (Macomona liliana) 96 hour survival and burial test
- Blue mussel embryo (Mytilus gallprovincialis) 48 hour embryo development test.

These species have been approved by HBRC for measuring toxicity in our final combined discharge water.

The samples for the toxicity assessments do not need to be necessarily taken during the sampling for Hills Laboratory analysis.

3.4 Condition 16

Condition 16 specifies the sampling requirements in the receiving water (at the ocean outfall diffuser).

The 10 sites for sampling under this condition are:

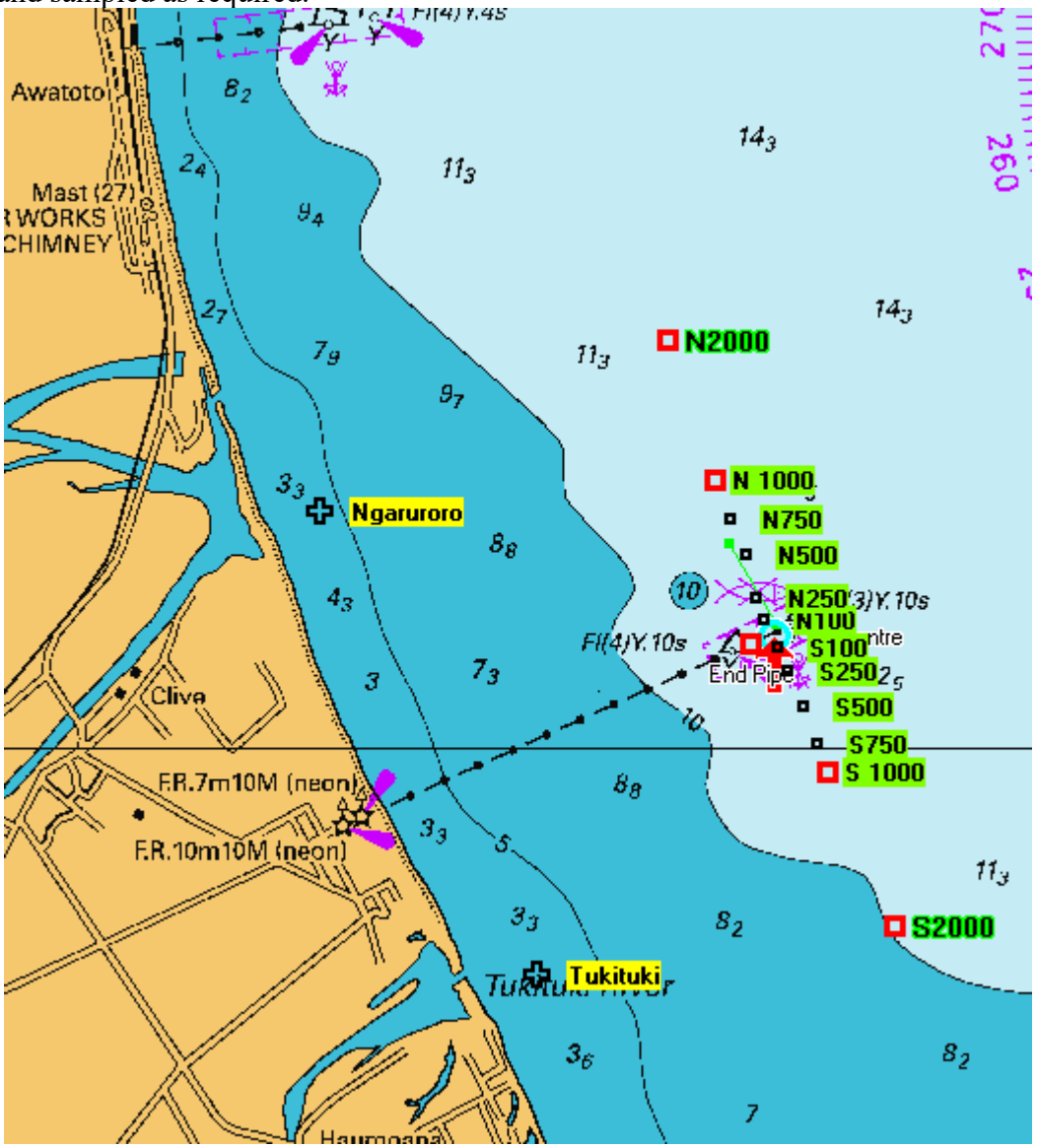
Site	Latitude S (WGS84)	Longitude E (WGS84)
1000m North	39.56785	176.96385
750m North	39.5702823	176.9650796
500m North	39.5723639	176.9662276
250m North	39.5748556	176.9669917
100m North	39.5760528	176.9675806
100m South	39.5777083	176.9686111
250m South	39.5790750	176.9694222
500m South	39.5811278	176.9705278
750m South	39.5832389	176.9715583
1000m South	39.5847338	176.9721880

Extra sites that are not required by the consent are also included in the sampling

Site	Latitude S (WGS84)	Longitude E (WGS84)
2000m North	39.5599111	176.9602111

2000m South	39.5937306	1769772333
Ngaruroro	39.5698861	176.9343917
Tukituki	39.5966444	176.9506306

These sites are depicted on the following chart along with two sites which are placed at the river outlets and sampled as required.



The field measurements will be taken using an YSI PRO DSS. The sample is taken 500mm to 1m below the surface to take the measurements for pH, Salinity, Turbidity, Temperature and Dissolved Oxygen. The instrument is calibrated according to the manufacturer's instructions prior to each use as follows:

pH – calibrated with standard pH 7 and pH 4 buffers

Turbidity – Calibrated Zero (filtered water) and 1000NTU standards

Salinity – Calibrated against conductivity standard 12.88mS/cm

Dissolved Oxygen – Calibrated in air saturated with water

All solutions used for calibration will be commercially sourced standard solutions. The standard will be diluted with deionised water to achieve the required strength as required. (E.g. turbidity standard).The microbiological samples are taken approximately 150mm below the surface using a polythene bottle and stored in a chilly bin (with an ice pack). On return the samples are transferred to bottles supplied by Hill Laboratories and packed into a Chilly Bin (with ice packs) and sent by overnight courier to Hill Laboratories.

These samples are sent the same day they are collected. In addition to the sampling required by the consent, the sample are analysed for Total Suspended Solids, Ammoniacal Nitrogen, Nitrate & Nitrite Nitrogen, Total Nitrogen, Dissolved Reactive Phosphorous and Total Phosphorous.

In case of any unforeseen failures in the sampling equipment or field measurement devices during sampling, HBRC will be notified as soon as practicable and an alternative arrangement will be made for sampling and measurements as required above and as per the instructions from HBRC.

3.5 Condition 17

Condition 17 specifies the requirement to measure surface currents at the ocean outfall diffuser

The surface currents are measured using a holey sock drogue with a Garmin Extrex10 GPS installed in the float. The GPS is set to log at 1 min intervals. For redundancy, two GPS devices will be used for surface current measurements.

The drogue with two GPS devices is released at the approximate centre of the outfall and left in the water while all the other sampling is carried out. The time and the position of the drogue at the start and the finish are recorded; this allows the calculation of the average current speed and direction, if required.

3.6 Condition 18

Condition 17 specifies the requirement for a Benthic Survey.

The Benthic Survey we will put out to tender at the appropriate time. The tender documents will include the requirements for consultation with the Hawkes Bay Regions Council and the Hawkes Bay District Health Board as required by the condition.

3.7 Condition 19

Condition 19 specifies the sampling requirements for seabed sediments.

The sediment samples will be taken the sites listed (see diagram Condition 16 for locations) using a mini ponar dredge.

The samples are placed in a sealed plastic container and stored in a chilly bin (with ice pack). On return the samples are subsampled into containers provided by Hill Laboratories, placed in a chilly bin (with ice packs) and sent to Hill Laboratories by overnight courier. If the samples cannot be sent the same day they will be refrigerated until they are sent.

3.8 Condition 20

Condition 20 specifies requirements of the laboratories undertaking analysis and field measurements.

All analyses other than field measurements and toxicity testing will be carried out by Hill Laboratories. The toxicity testing will be carried out by NIWA.

3.9 Condition 21

The results from the monitoring shall be sent to the HBRC (Manager Resource Use – via compliance officer) yearly unless there are any potential non-compliances in the sampling or analysis of samples. The results including a repeat analysis (if any) shall be sent with the final yearly consent report. .

However, the following data shall be readily made available to HBRC via HDC ID (Infrastructure Data Historian). ID access to HBRC shall be granted to view the following data from the day we receive the final analytical report for the quarter two (Q2) of the consent year.

- Daily Flow and Peak Flow
- Quarterly and Annual Analyses of the Total wastewater (excluding pesticides, VOC etc.)
- Domestic Analysis
- Sediments
- Receiving Water Quality
- Drogue
- Toxicity (Will record the “No toxicity” dilution)
- Odour Complaints

3.10 Condition 22

The buoys marking the outfall have recently been refurbished with new signage and lights. The photographs shows the signage.

3.11 Condition 23

The contact person is:

David McKenzie (Wastewater Manager)	06 871 5000 or 027 359 4494

3.12 Condition 28

Any odour complaints will be reported to HBRC as soon as practicable (and as per the WWTP Odour Management Plan), a list of the complaints will be forwarded along with the monitoring results. And also, all the odour complaints shall be logged in the ID with all the information (as per the Odour Management Plan) required by the ID form (WWATER-WWTP-ADHOC-Odour Investigation Report).

Appendix D Treated Wastewater Toxicity Testing Reports

NIWA Toxicity Testing Report – Jul 2021
NIWA Toxicity Testing Report – Nov 2021
NIWA Toxicity Testing Report – Jan 2022
NIWA Toxicity Testing Report – May 2022

Quarterly Whole Effluent Toxicity Testing for East Clive Wastewater Treatment Plant

1st Quarter

Prepared for Hastings District Council

September 2021

Climate, Freshwater & Ocean Science

Prepared by:
Anathea Albert

For any information regarding this report please contact:

Anathea Albert
Ecotoxicology Lab Services Manager
Ecotoxicology
+64-7-856 1723

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

NIWA CLIENT REPORT No: 2021284HN
Report date: September 2021
NIWA Project: HDC21201

Quality Assurance Statement		
	Reviewed by:	Jennifer Gadd
	Formatting checked by:	Carole Evans
	Approved for release by:	Scott Stephens

Contents

Tables

Executive summary

NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of a treated wastewater effluent sample from East Clive Wastewater Treatment Plant to determine resource consent compliance. The sample, collected 27–28 July 2021, was tested with three marine organisms, a marine alga (*Minutocellus polymorphus* – 48-hour chronic growth test), and two bivalve species: wedge shell (*Macomona liliana* – 96-hour acute survival and burial test) and blue mussel embryos (*Mytilus galloprovincialis* – 48-hour chronic embryo development test). The sample was also analysed for ammoniacal-N and total sulfide.

This report documents the results of the toxicity testing. The algae, wedge shell and blue mussel tests met their respective test acceptability criteria based on control performance.

The algae, wedge shell and blue mussel tests did not show statistically significant toxicity at a 200-fold dilution (0.5% effluent). After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

Based on the algae, wedge shell and blue mussel test results for the supplied sample (27-28 July 2021), the wastewater complies with the HBRC consent compliance criteria for no toxicity at the prescribed 200-fold dilution. Ammoniacal-N and hydrogen sulfide concentrations at a 200-fold dilution were 9-fold and 10-fold less than the respective ANZG (2018) default guideline values to protect from chronic toxicity.

1 Introduction

East Clive Wastewater Treatment Plant treats both industrial and domestic wastewater and the treated effluent is discharged through an ocean outfall into Hawke Bay. NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of effluent from the East Clive Wastewater Treatment Plant for compliance with Hawke's Bay Regional Council (HBRC) resource consent CD130214W condition 15. The effluent sample was tested with three organisms, a marine alga (*Minutocellus polymorphus*–48-hour chronic growth test), and 2 bivalve species: wedge shell (*Macomona liliana*–96-hour acute survival and burial test) and blue mussel embryos (*Mytilus galloprovincialis*–48-hour chronic embryo development test).

Condition 15 states that there shall be no statistically detectable difference in toxicity between a water sample taken from uncontaminated near shore water (from a location to be approved by Hawke's Bay Regional Council[1]), and treated wastewater when diluted 200-times with that water. No toxicity is defined as a no-toxicity dilution less than 200-fold. If the no-toxicity dilution is greater than 200-fold, the following three conditions must be met:[2]

1. EC_{20}[3] (chronic tests) and LC_{10} (acute tests) for all tests shall be greater than 0.5% effluent.
2. No more than one test species with a TEC[4] < 0.5% effluent in any given quarter.
3. No more than one consecutive incidence of TEC < 0.25% effluent within any given species between quarters.

[1] Dilution water is 0.2 µm filtered offshore seawater collected by NIWA.
[2] These conditions interpret the flow chart in Appendix A describing the HBRC consent supplied to NIWA 25 Jun 2014.
[3] EC_x = dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an X% effect on the test organisms.
[4] TEC=threshold effect concentration

2 Methods

2.1 Samples

A 2 L, single use, food grade high density polyethylene (HDPE) container was supplied by NIWA to HDC for collection of the 24 h composite effluent sample. The sample was collected by HDC staff on 27–28 July 2021 and a subsample was collected for total sulfide at the same time in a bottle supplied by Hill Laboratories. On arrival at NIWA Hamilton on 29 July 2021 the effluent sample was assigned a unique sample code (2668/TB4) and the physicochemical parameters measured. The effluent was subsampled for ammoniacal-N and the remaining sample was stored in the dark at 4°C until toxicity testing commenced. The samples for ammoniacal-N and total sulfide were sent to Hill Laboratories for analysis.

2.2 Toxicity testing methods

Tests were completed according to NIWA Standard Operating Procedures (SOP):

- NIWA SOP 14.1–Marine algae chronic toxicity for *Minutocellus polymorphus.*
- NIWA SOP 58.0–Marine bivalve acute toxicity for *Macomona liliana.*
- NIWA SOP 21.2–Marine bivalve chronic toxicity for *Mytilus galloprovincialis.*

A summary of test conditions and test acceptability information specified in each of the SOP manuals is provided in Appendix B.

2.3 Sample dilutions

Each test included a range of sample dilutions. The diluent for the algae, wedge shell and blue mussel tests was NIWA's offshore seawater. The sample was adjusted to the required test salinities, as specified by the standard operating procedures. For the wedge shell and blue mussel test, the effluent sample was adjusted to the test salinity of 34 ppt using brine (made from frozen 0.2 µm filtered oceanic water) and tested at a maximum concentration of 20% effluent and 16% effluent respectively. For the algal test, the sample was adjusted to the required test salinity of 26 ppt using NIWA's offshore seawater for a maximum concentration of 32% effluent.

2.4 Reference toxicant

A reference toxicant test using zinc was undertaken concurrently using the standard test procedures to measure the sensitivity and condition of the organisms in the current test. This is part of the quality control procedures and allows comparability between laboratory test results undertaken at different times by comparing results to the known sensitivity of the test organism to zinc (NIWA, unpublished long-term database). NIWA uses zinc for all species as a reference toxicant because of the large amount of available toxicity data. Zinc was considered the "most suitable reference toxicant" by Environment Canada (1990) for its solubility, stability and shelf-life. The zinc sulfate stock concentration was validated by chemical analysis (Hill Laboratories).

2.5 Test acceptability criteria

Each test has criteria that must be met for the test to be considered acceptable (Appendix B). In the alga test the increase in cell density in the control water must be greater than 16-fold and the coefficient of variation in the control replicates must be less than 20%. For the wedge shell test there must be at least 90% survival in control and less than 10% morbidity in reburial control. For the blue mussel test the control embryos must have at least 80% normal development.

2.6 Method detection limit

The method detection limit is a measure of the natural variability associated with each test calculated from the NIWA long-term database of test results. If the percent effect is smaller than the method detection limit, then the effect may be due to natural variability in the test response—in this event, for compliance purposes, the NOEC and LOEC would be corrected to the concentrations at which the percent effect is greater than the method detection limit. The method detection limits were updated February 2021.

2.7 Statistics

Statistical analyses were completed using CETIS v1.9.7.7 (Comprehensive Environmental Toxicity Information System) by Tidepool Scientific.

3 Results

Results are summarized in this section (Tables 3-1 and 3-2). Raw data and detailed results from the statistical analyses are provided for all tests in Appendix C and chemistry results are provided in Appendix D.

Table 3-1: Measurements of municipal wastewater 24-hour composite sample after arrival at NIWA (29 July 2021) and results from analyses at Hill Laboratories.

Sample ID	NIWA Lab ID	pH	Temp (°C)	Salinity (ppt)	Total NH_4-N (mg L^{-1})	Total Sulfide (S^{2-}) (mg L^{-1})
HDC 27–28/07/2021	2668/TB4	6.7	17.1	0.8	19.6	0.4

Table 3-2: Summary of key toxicity metrics for the test organisms exposed to HDC effluent collected 27–28 July 2021. Full results are provided in Appendix C.

Organism	EC_{10} [a] %	EC_{20} [a] %	EC_{50} [a] %	NOEC [b] %	LOEC [b] %	TEC [b] %	No-Toxicity Dilution [c]	Complies Y/N [d]
Algae	2.3	2.6	3.8 (3.6–3.9)	2.0	4.0	**2.8**	35 x	**Y**
Wedge shell reburial [e]	-	>20.0	>20.0	20.0	>20.0	**>20.0**	<5 x	**Y**
Wedge shell survival	-	>20.0	>20.0	20.0	>20.0	**>20.0**	<5 x	**Y**
Blue mussel	2.2	2.8	4.2 (3.9–4.5)	0.5	1.0	**0.7**	141 x	**Y**

[a] EC_x= dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an effect on X% of test organisms. Values in parentheses indicate the 95% confidence intervals; [b] NOEC=No observed effect concentration; LOEC=Lowest observed effect concentration; TEC=threshold effect concentration (Geometric mean of NOEC and LOEC); [c] No-toxicity dilution is calculated as (1/TEC*100); [d] Bold indicates value used for compliance; [e] 60-minute reburial results (morbidity).

3.1 Algae – cell growth inhibition

The chronic algal growth test achieved the test acceptability criteria with a 113-fold increase in mean control cell density after 48 hours and a coefficient of variation (CV) < 20% (CV = 9%).

At concentrations < 4.0% effluent, there was no statistical difference in the algal cell density when compared to the control. There was a statistically significant, 54% decrease in algal cell density at a concentration of 4.0% effluent (Appendix C), resulting in a LOEC of 4.0% and a NOEC of 2.0% (Table 3-2). The no-toxicity dilution of 35-fold is within the compliance threshold of maximum 200-fold dilution.

3.2 Bivalve – wedge shell survival and morbidity

The acute wedge shell test uses a sub-lethal endpoint (reburial, termed 'morbidity') to assess adverse effects on the test organisms because classification of juvenile bivalves into either live or recently dead is difficult to determine accurately. The reburial test is undertaken following 96 hours exposure to the effluent solutions and is a more sensitive and accurate endpoint than survival for this test species.

The wedge shell test achieved the test acceptability criterion with 98% survival and 97% reburial for the control treatments.

The pH and dissolved oxygen were in the acceptable range for the test (Appendix D, Table D–2). The survival and reburial in brine control treatments were not significantly different from the controls (data not shown).

For the effluent samples, there was no significant reduction in survival or reburial at any concentration tested (0.25–20% effluent). Therefore, the no-toxicity dilution of <5 fold (Table 3-2) is within the compliance threshold of maximum 200-fold dilution.

3.3 Bivalve - Blue Mussel embryo development

The chronic embryo development test achieved the test acceptability criterion of at least 80% normal embryo development in the controls (mean 90%). Salinity and pH were in the acceptable range for the test (Appendix D, Table D-1). Dissolved oxygen (DO) was in the acceptable range for the test except at the highest concentration (16% effluent) which had DO of 38% (2.8 mg L^{-1} at pH 8, 20°C). Normal embryo development was significantly (α=0.05) reduced compared to controls at 1% effluent, however, at this concentration the DO was within the acceptable range for the test so was not a factor in reduced normal embryo development. The brine solution did not affect normal embryo development at concentrations used in this test (data not shown).

There was a statistically significant effect on normal blue mussel embryo development at 1.0% effluent (Table 3-2), with an 8.8% decrease in normal embryo development (Appendix C). The no-toxicity dilution of >141 fold is within the compliance threshold of maximum 200-fold dilution.

3.4 Total sulfide

ANZG (2018) default guideline value for un-ionised sulfide: 0.001 mg L^{-1} H_2S.

The subsample for total sulfide was preserved at the time of sample collection. The total sulfide in the effluent sample collected 27–28 July 2021 was 0.4 mg L^{-1} which is equivalent to 0.02 mg L^{-1} of un-ionised sulfide[5], the more toxic form of sulfide in an aquatic ecosystem. The total sulfide concentration of the July 2021 effluent sample is 3-fold lower than the long-term median value of 1.2 mg L^{-1} total sulfide for all HDC effluent samples analysed since 1992 (n=112).

After applying a 200-fold dilution, the resulting un-ionised sulfide concentration of 0.0001 mg L^{-1} is 10-fold lower than the ANZG (2018) default guideline value of 0.001 mg L^{-1} H_2S. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.5 Ammoniacal-N

ANZG (2018) default guideline value: 0.910 mg L^{-1} ammoniacal-N, pH 8.

The ammoniacal-N concentration in the effluent sample was 19.6 mg L^{-1}, which is 1.2 fold higher than the long-term median value of 15.9 mg L^{-1} for all HDC effluent samples analysed since 1992 (n=111). Applying a 200-fold dilution to the effluent sample results in a concentration of 0.1 mg L^{-1} ammoniacal-N, which is 9 fold lower than the ANZG (2018) default guideline value of 0.91 mg L^{-1} (at pH 8) for protection of 95% of marine species. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

[5] Calculated as 4.06% of total sulfide at pH 8.0, 20°C, 32.5 ppt (coastal waters) (ANZG 2018).

3.6 Reference toxicant

The EC_{50} values for the reference toxicant tests using zinc were within the expected range (± 2 SD of long-term mean) for the algae, wedge shell and blue mussel tests. The results were as follows: algae EC_{50} = 0.01 mg L^{-1} Zn^{2+}, wedge shell survival EC_{50} = 3.6 mg L^{-1} Zn^{2+}, wedge shell reburial, EC_{50} = 1.6 mg L^{-1} Zn^{2+}, blue mussel EC_{50} = 0.17 mg L^{-1} Zn^{2+} (also shown in Appendix B).

Based on chronic NOEC values derived from the zinc sulfate tests, the algae, blue mussels, wedge shell reburial, and wedge shell survival would rank within the 1st, 40th, 44th and 53rd percentiles respectively of the most sensitive test organisms used for derivation of the ANZG (2018) Guideline values for zinc in marine waters (adopted from ANZECC (2000)).

The results from this suite of toxicity tests provide a moderate degree of confidence in assessing the toxic hazard of the sample. However, these sensitivity rankings are specific to zinc and care must be taken when extrapolating these results where other classes of contaminants (e.g., organics) may be present and for protection of all organisms present in a particular receiving water environment (e.g., Hawke's Bay).

4 Compliance Statement

Hawke's Bay Regional Council Resource Consent No. CD130214W condition 15 requires that there be no detectable toxicity at a 200-fold effluent dilution. If there is toxicity at a 200-fold dilution the following conditions must be examined: are EC_{20} (chronic tests) and LC_{10} (acute tests) for all tests greater than 0.5% effluent; is there more than one test species with a TEC[6]<0.5% effluent in any given quarter; is there a consecutive incidence of TEC<0.25% effluent within any given species between quarters

The algae, wedge shell and blue mussel tests did not show detectable toxicity at a 200-fold dilution.

After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

[6] TEC=threshold effect concentration

5 References

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand. Canberra.

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

Environment Canada (1990) *Guidance document for control of toxicity test precision using reference toxicants.* No. EPS 1/RM12. Conservation and Protection, Environment Canada: 90.

NIWA (2013) Standard Operating Procedure Number 58. *Macomona liliana* 96-h Acute Toxicity Test Procedure. Hamilton, New Zealand, *NIWA Client Report:* 35.

NIWA (1996) Standard Operating Procedure Number *14.1*: Marine algal microplate method. Hamilton, New Zealand. *NIWA Client Report*: 13.

NIWA (2008) Standard Operating Procedure 21.2: Marine blue mussel embryo (Mytilus galloprovincialis). Short-term Chronic Toxicity Test Protocol. Hamilton, New Zealand, *NIWA Client Report*: 41.

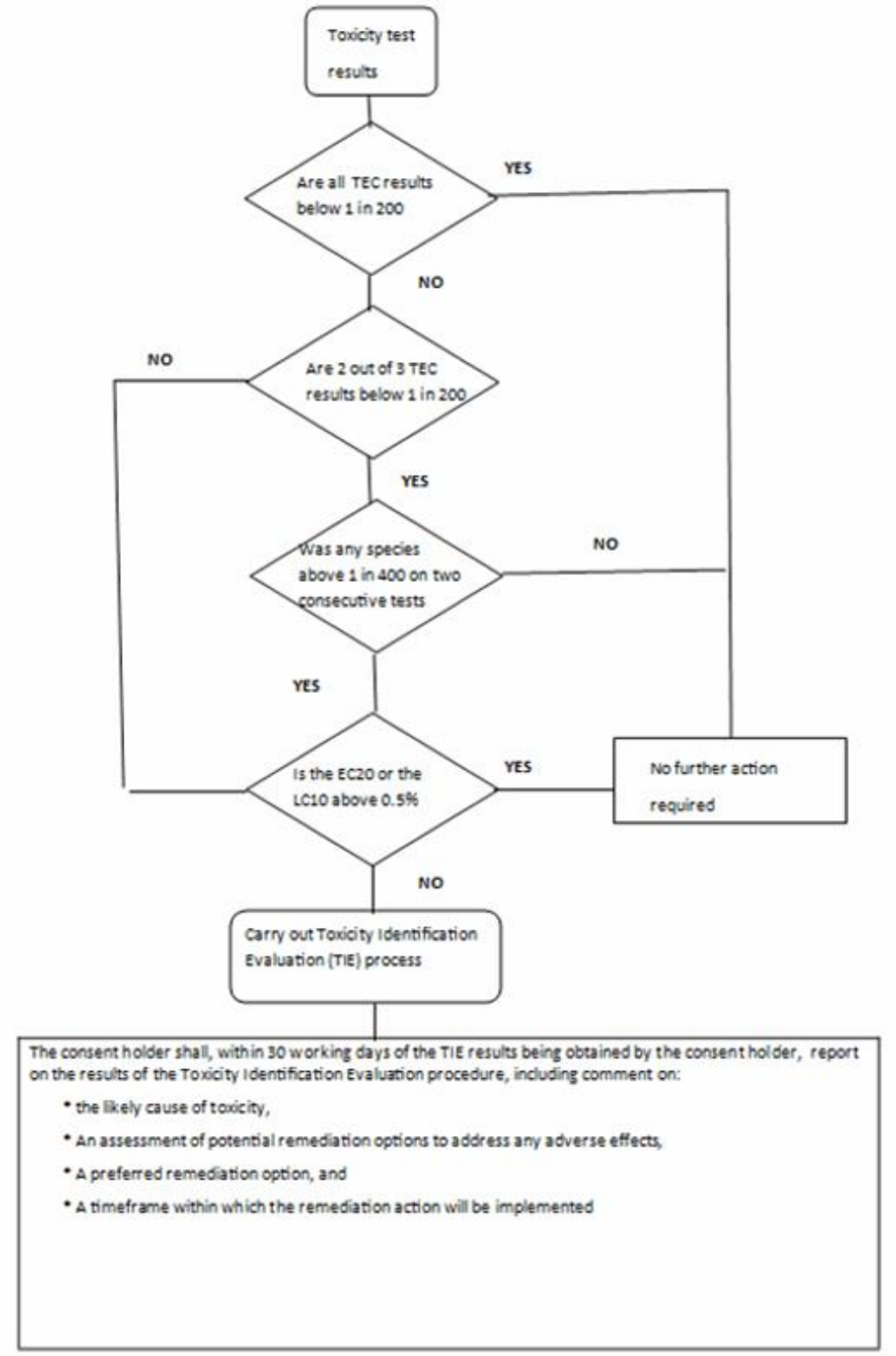
Roper, D.S., Hickey, C.W. (1994) Behavioural responses of the marine bivalve *Macomona liliana* exposed to copper- and chlordane-dosed sediments. *Marine Biology*, 118: 673–680.

Tidepool (2000-2020) CETIS™ Comprehensive Environmental Toxicity Information System. *CETIS Users Guide v.1.9.7.7* Tidepool Scientific Software, McKinleyville, CA, USA: 241

USEPA (1987) *Methods for toxicity tests of single substances and liquid complex wastes with marine unicellular algae. EPA-600-8/87/043*. US Environmental Protection Agency, Cincinnati, Ohio.

Williams, E.K., Hall, J.A. (1999) Seasonal and geographic variability in toxicant sensitivity of Mytilus galloprovincialis larvae. *Australasian Journal of Ecotoxicology*, 5(1): 1–10.

Appendix A Flow chart describing HBRC consent CD130214W condition 15[a]



[a]Supplied to NIWA 25 Jun 2014

Appendix B Test Conditions

Test conditions and dilutions for sample 2668/TB4

Project Name:	Hastings DC Effluent Bioassays: 2020–2021	**Project Number**	HDC21201
Test Material:	Hastings District Council 27–28/07/2021	**Reference Toxicant:**	Zinc sulphate
Dilution Water:	0.2 µm filtered offshore seawater from Pacific Ocean		

	Algae	**Bivalve–wedge shell**	**Bivalve–blue mussel embryos**
Test Initiation:	30/07/2021	29/07/2021	30/07/2021
Reference Method:	US EPA (1987) modified with Environment Canada (1992)	Adapted from Roper & Hickey (1994)	Williams & Hall (1999b)
Test Protocol:	NIWA SOP 14.1 NIWA (1996)	NIWA SOP 58.0 NIWA (2013)	NIWA SOP 21.2 (2008)
Test Organisms:	*Minutocellus polymorphus*	*Macomona liliana*	*Mytilus galloprovincialis*
Source:	Lab culture (500), imported from Bigelow Laboratories, USA	Manukau Harbour, Wiroa Island control site	Coromandel Harbour
Organisms/Container:	10,000 cells mL^{-1}	10	600 fertilised embryos
Test Concentrations	Control, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%
Test Duration:	48 hours	96 hours	48 hours
Replicates:	10 for controls, 5 for treatments	5 for controls, 3 for treatments	10 for controls, 5 for treatments
Sample pre-treatment:	0.45 µm filtration	Brine added to adjust salinity	Brine added to adjust salinity
Salinity:	26‰	34 ± 2‰	34 ± 2‰
Brine:	Nil	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection
Test Chambers:	96 well sterile microplates	55 ml polystyrene beakers	16x100 mm glass tubes
Lighting:	Continuous overhead lighting	Complete darkness	16:8 light dark
Temperature:	25 ± 1°C	20 ± 1°C	20 ± 1°C
Aeration:	Nil	Nil	Nil
Chemical Data:	Initial salinity	Initial and final salinity, final pH, temperature, dissolved oxygen	Initial and final salinity, temperature, dissolved oxygen, pH
Effect Measured:	Growth inhibition	Survival and morbidity (survival, reburial)	Abnormal embryo development
Zn sensitivity current test; long term mean (EC_{50}±2sd):	0.01; 0.01 (0.000–0.02) mg Zn L^{-1} (n=20)	Survival 3.6; Reburial 1.6; 3.7 (1.4–6.0) mg L^{-1} Zn^{2+} (n=20) (survival); 1.8 (0.7–2.9) mg L^{-1} Zn^{2+} (n=20) (reburial)	0.17; 0.17 (0.13–0.21) mg Zn L^{-1} (n=20)
Test Acceptability:	Control coefficient of variation within 20%; at least 16x cell growth increase in controls.	At least 90% survival in control and less than 10% morbidity in control reburial	80% of control embryos normally developed
Method Detection Limit (MDL):	12.4% reduction relative to controls	4.1% reduction relative to controls	5.1% reduction relative to controls
Percent Minimum Significant Difference (PMSD):	9.6%	Survival 7.5% Reburial 10.2%	5.4%
Test Acceptability Compliance:	**Achieved**	**Achieved**	**Achieved**

Appendix C Statistics

Algae

CETIS Analytical Report

Report Date: 18 Aug-21 16:50 (p 1 of 2)
Test Code/ID: 2668/TB4 MP7 / 05-1909-7440

Phytoplankton Growth Inhibition Test — **NIWA Ecotoxicology**

Analysis ID:	17-9418-7297	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	18 Aug-21 16:49	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	4628A4512C3C3B902A381CB55362D2BC	**Editor ID:**	
Batch ID:	09-2427-5048	**Test Type:**	Cell Growth	**Analyst:**	A Albert
Start Date:	30 Jul-21	**Protocol:**	NIWA (1996)	**Diluent:**	Offshore seawater
Ending Date:	01 Aug-21	**Species:**	Minutocellus polymorphus	**Brine:**	Not Applicable
Test Length:	48h	**Taxon:**		**Source:**	CCMP Bigelow Laboratory f **Age:**
Sample ID:	09-8032-5955	**Code:**	2668/TB4 MP7	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	28 Jul-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	29 Jul-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Untransformed	C > T	2	4	2.828	50	108300	9.55%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.0625	24	---	0	13	Exact	0.2488	Non-Significant Effect
		0.125	49	---	0	13	Exact	1.0000	Non-Significant Effect
		0.25	44	---	0	13	Exact	1.0000	Non-Significant Effect
		0.5	52	---	0	13	Exact	1.0000	Non-Significant Effect
		1	27	---	0	12	Exact	1.0000	Non-Significant Effect
		2	59	---	0	13	Exact	1.0000	Non-Significant Effect
		4*	15	---	0	13	Exact	0.0030	Significant Effect
		8*	15	---	0	13	Exact	0.0030	Significant Effect
		16*	15	---	0	13	Exact	0.0030	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.122E+13	1.247E+12	9	224.2	<1.0E-05	Significant Effect
Error	2.446E+11	5.559E+09	44			
Total	1.146E+13		53			

ANOVA Assumptions Tests

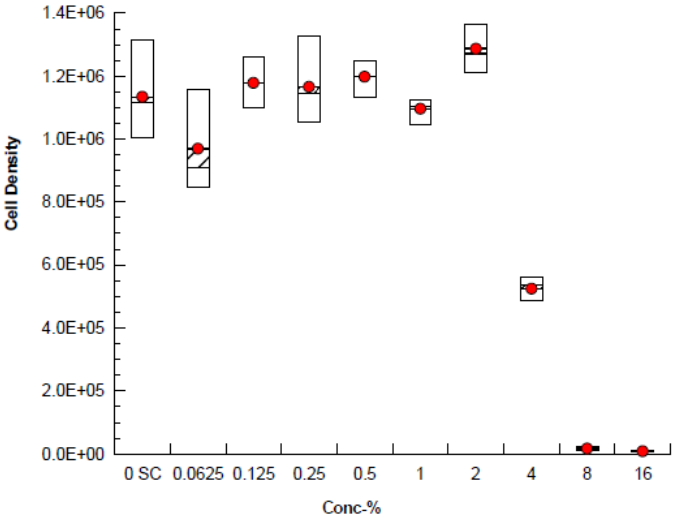
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	48.81	21.67	<1.0E-05	Unequal Variances
	Levene Equality of Variance Test	3.574	2.84	0.0021	Unequal Variances
	Mod Levene Equality of Variance Test	2.135	2.946	0.0518	Equal Variances
Distribution	Anderson-Darling A2 Test	0.9271	3.878	0.0186	Normal Distribution
	D'Agostino Kurtosis Test	1.617	2.576	0.1058	Normal Distribution
	D'Agostino Skewness Test	2.072	2.576	0.0382	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	6.911	9.21	0.0316	Normal Distribution
	Kolmogorov-Smirnov D Test	0.135	0.14	0.0155	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9492	0.9407	0.0230	Normal Distribution

Cell Density Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	1.134E+6	1.063E+6	1.205E+6	1.117E+6	1.005E+6	1.316E+6	3.135E+4	8.74%	0.00%
0.0625		5	9.696E+5	8.162E+5	1.123E+6	9.105E+5	8.488E+5	1.158E+6	5.526E+4	12.74%	14.52%
0.125		5	1.178E+6	1.103E+6	1.254E+6	1.178E+6	1.101E+6	1.264E+6	2.716E+4	5.15%	-3.88%
0.25		5	1.166E+6	1.034E+6	1.298E+6	1.145E+6	1.056E+6	1.327E+6	4.750E+4	9.11%	-2.79%
0.5		5	1.198E+6	1.141E+6	1.256E+6	1.198E+6	1.131E+6	1.248E+6	2.074E+4	3.87%	-5.65%
1		4	1.096E+6	1.038E+6	1.154E+6	1.105E+6	1.048E+6	1.127E+6	1.831E+4	3.34%	3.37%
2		5	1.287E+6	1.203E+6	1.371E+6	1.271E+6	1.209E+6	1.368E+6	3.015E+4	5.24%	-13.49%
4		5	5.245E+5	4.840E+5	5.651E+5	5.361E+5	4.845E+5	5.620E+5	1.462E+4	6.23%	53.75%
8		5	1.702E+4	1.126E+4	2.278E+4	1.584E+4	1.128E+4	2.242E+4	2.075E+3	27.25%	98.50%
16		5	7.992E+3	4.340E+3	1.164E+4	7.100E+3	5.880E+3	1.312E+4	1.315E+3	36.80%	99.30%

Cell Density Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	1.316E+6	1.137E+6	1.246E+6	1.216E+6	1.120E+6	1.005E+6	1.115E+6	1.013E+6	1.080E+6	1.096E+6
0.0625		1.158E+6	9.105E+5	8.488E+5	9.043E+5	1.026E+6					
0.125		1.264E+6	1.178E+6	1.101E+6	1.148E+6	1.201E+6					
0.25		1.327E+6	1.095E+6	1.056E+6	1.207E+6	1.145E+6					
0.5		1.234E+6	1.198E+6	1.131E+6	1.179E+6	1.248E+6					
1		1.127E+6	1.048E+6	1.122E+6	1.087E+6						
2		1.243E+6	1.209E+6	1.345E+6	1.271E+6	1.368E+6					
4		5.434E+5	4.845E+5	5.361E+5	4.967E+5	5.620E+5					
8		2.242E+4	1.452E+4	2.106E+4	1.128E+4	1.584E+4					
16		1.312E+4	7.100E+3	7.560E+3	5.880E+3	6.300E+3					



Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1279056	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC10	2.296	2.127	2.313	43.55	43.23	47.01
IC15	2.455	2.294	2.482	40.73	40.29	43.58
IC20	2.621	2.45	2.662	38.15	37.56	40.82
IC25	2.796	2.627	2.849	35.77	35.09	38.06
IC40	3.372	3.219	3.47	29.66	28.81	31.06
IC50	3.803	3.634	3.945	26.3	25.35	27.52

Wedge shell survival

CETIS Analytical Report

Report Date: 18 Aug-21 17:07 (p 4 of 6)
Test Code/ID: 2668/TB4 MAC / 04-0398-2437

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	12-9020-3943	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	18 Aug-21 17:07	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	480967B5D8D9511CBB7703EAF802B6B3	**Editor ID:**	
Batch ID:	05-2988-4783	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	29 Jul-21	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	02 Aug-21	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	06-2106-9067	**Code:**	2668/TB4 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	28 Jul-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	29 Jul-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	20	>20	---	5	0.07309	7.45%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	18.5	---	2	11	Exact	1.0000	Non-Significant Effect
		0.5	24	---	1	11	Exact	1.0000	Non-Significant Effect
		1	24	---	1	11	Exact	1.0000	Non-Significant Effect
		2	18.5	---	2	11	Exact	1.0000	Non-Significant Effect
		5	24	---	1	11	Exact	1.0000	Non-Significant Effect
		10	19.5	---	2	11	Exact	1.0000	Non-Significant Effect
		20	18.5	---	2	11	Exact	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0140215	0.0020031	7	0.4332	0.8712	Non-Significant Effect
Error	0.106348	0.0046238	23			
Total	0.12037		30			

ANOVA Assumptions Tests

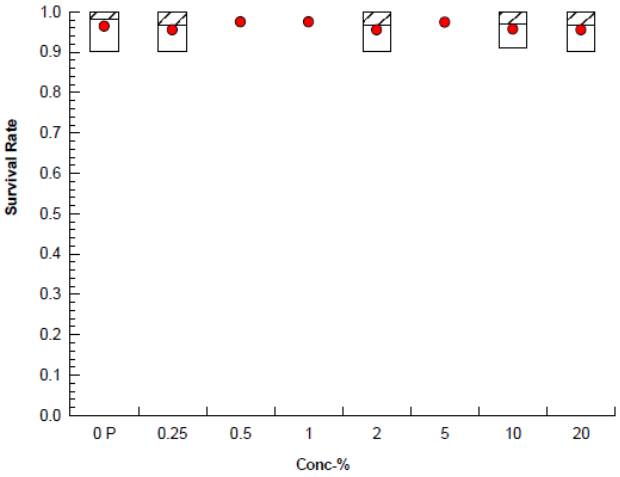
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test				Indeterminate
	Levene Equality of Variance Test	3.885	3.539	0.0062	Unequal Variances
	Mod Levene Equality of Variance Test	0.5712	4.026	0.7689	Equal Variances
Distribution	Anderson-Darling A2 Test	3.137	3.878	<1.0E-05	Non-Normal Distribution
	D'Agostino Kurtosis Test	0.4112	2.576	0.6809	Normal Distribution
	D'Agostino Skewness Test	2.69	2.576	0.0072	Non-Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	7.403	9.21	0.0247	Normal Distribution
	Kolmogorov-Smirnov D Test	0.2742	0.1825	<1.0E-05	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.7737	0.9056	1.7E-05	Non-Normal Distribution

Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	0.9809	0.9521	1.0000	1.0000	0.9000	1.0000	0.0128	4.11%	0.00%
0.25		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	1.45%
0.5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-1.95%
1		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-1.95%
2		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	1.45%
5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-1.95%
10		3	0.9697	0.8393	1.0000	1.0000	0.9091	1.0000	0.0303	5.41%	1.14%
20		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	1.45%

Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	9/10	10/10	10/11	10/10	10/10	10/10	10/10	10/10	10/10	10/10
0.25		10/10	10/10	9/10							
0.5		10/10	10/10	10/10							
1		10/10	10/10	10/10							
2		9/10	10/10	10/10							
5		9/9	10/10	10/10							
10		10/10	10/10	10/11							
20		10/10	9/10	10/10							



Wedge shell reburial

CETIS Analytical Report

Report Date: 18 Aug-21 17:07 (p 1 of 6)
Test Code/ID: 2668/TB4 MAC / 04-0398-2437

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	12-0001-4903	**Endpoint:**	Eff. Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	18 Aug-21 17:07	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	D65F2517F00B20CDCBD5120C813FE9C0	**Editor ID:**	
Batch ID:	05-2988-4783	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	29 Jul-21	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	02 Aug-21	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	06-2106-9067	**Code:**	2668/TB4 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	28 Jul-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	29 Jul-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	20	>20	---	5	0.0994	10.24%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	12.5	---	1	11	Exact	0.4406	Non-Significant Effect
		0.5	25.5	---	1	11	Exact	1.0000	Non-Significant Effect
		1	20	---	2	11	Exact	1.0000	Non-Significant Effect
		2	20	---	2	11	Exact	1.0000	Non-Significant Effect
		5	20	---	2	11	Exact	1.0000	Non-Significant Effect
		10	21.5	---	2	11	Exact	1.0000	Non-Significant Effect
		20	8	---	1	11	Exact	0.1469	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.134236	0.0191766	7	2.267	0.0655	Non-Significant Effect
Error	0.194576	0.0084598	23			
Total	0.328813		30			

ANOVA Assumptions Tests

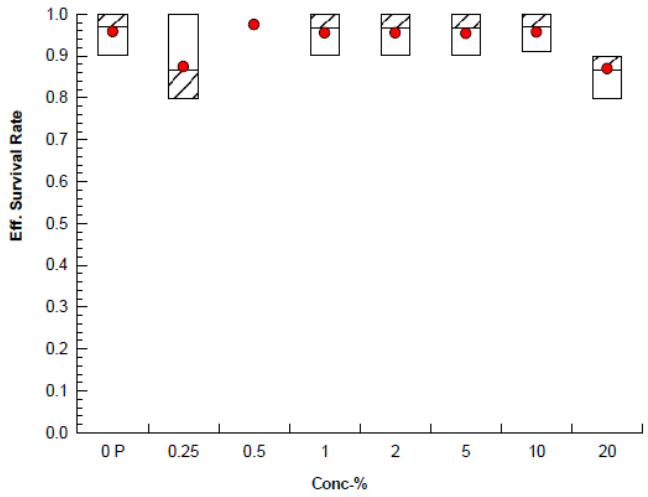
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test				Indeterminate
	Levene Equality of Variance Test	3.75	3.539	0.0075	Unequal Variances
	Mod Levene Equality of Variance Test	0.4179	4.026	0.8772	Equal Variances
Distribution	Anderson-Darling A2 Test	3.399	3.878	<1.0E-05	Non-Normal Distribution
	D'Agostino Kurtosis Test	0.3043	2.576	0.7609	Normal Distribution
	D'Agostino Skewness Test	0.208	2.576	0.8353	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.1358	9.21	0.9343	Normal Distribution
	Kolmogorov-Smirnov D Test	0.3021	0.1825	<1.0E-05	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.793	0.9056	3.8E-05	Non-Normal Distribution

Eff. Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	0.9709	0.9374	1.0000	1.0000	0.9000	1.0000	0.0148	4.83%	0.00%
0.25		3	0.8667	0.5798	1.0000	0.8000	0.8000	1.0000	0.0667	13.32%	10.74%
0.5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-3.00%
1		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	0.44%
2		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	0.44%
5		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	0.44%
10		3	0.9697	0.8393	1.0000	1.0000	0.9091	1.0000	0.0303	5.41%	0.12%
20		3	0.8667	0.7232	1.0000	0.9000	0.8000	0.9000	0.0333	6.66%	10.74%

Eff. Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	9/10	10/10	10/11	10/10	10/10	10/10	10/10	10/10	9/10	10/10
0.25		8/10	10/10	8/10							
0.5		10/10	10/10	10/10							
1		10/10	10/10	9/10							
2		9/10	10/10	10/10							
5		9/9	9/10	10/10							
10		10/10	10/10	10/11							
20		9/10	9/10	8/10							



Blue mussel

CETIS Analytical Report

Report Date: 25 Aug-21 16:06 (p 1 of 3)
Test Code/ID: 2668/TB4 MyG / 19-3813-8626

Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

Analysis ID:	10-7388-5072	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	25 Aug-21 16:05	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	61C23209E0166AE700656E542E720FA2	**Editor ID:**	
Batch ID:	11-0868-4373	**Test Type:**	Development	**Analyst:**	Ecotox Team
Start Date:	30 Jul-21 12:40	**Protocol:**	NIWA (2008)	**Diluent:**	Seawater
Ending Date:	01 Aug-21 13:00	**Species:**	Mytilus galloprovincialis	**Brine:**	Frozen Coastal Seawater
Test Length:	48h	**Taxon:**		**Source:**	Coromandel **Age:**
Sample ID:	14-9252-3566	**Code:**	2668/TB4 MyG	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	28 Jul-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	29 Jul-21 09:20	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	61h (2.6 °C)	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	0.5	1	0.7071	200	0.04834	5.37%

Bonferroni Adj t Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.25	0.7933	2.522	0.077	13	CDF	1.0000	Non-Significant Effect
		0.5	-0.2254	2.522	0.077	13	CDF	1.0000	Non-Significant Effect
		1*	3.829	2.522	0.077	13	CDF	0.0016	Significant Effect
		2*	3.755	2.522	0.077	13	CDF	0.0020	Significant Effect
		4*	15.94	2.522	0.077	13	CDF	<1.0E-05	Significant Effect
		8*	31.33	2.522	0.077	13	CDF	<1.0E-05	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4.07743	0.679572	6	220.3	<1.0E-05	Significant Effect
Error	0.101779	0.0030842	33			
Total	4.17921		39			

ANOVA Assumptions Tests

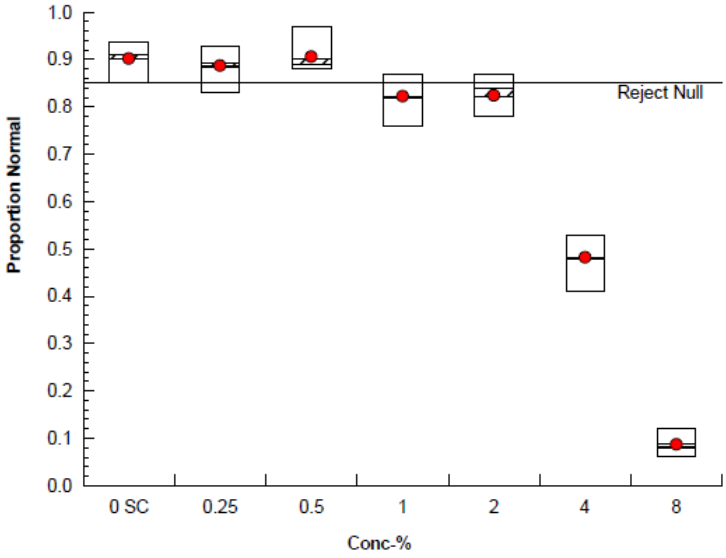
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	1.518	16.81	0.9583	Equal Variances
	Levene Equality of Variance Test	0.2561	3.406	0.9532	Equal Variances
	Mod Levene Equality of Variance Test	0.1479	3.558	0.9879	Equal Variances
Distribution	Anderson-Darling A2 Test	0.4105	3.878	0.3471	Normal Distribution
	D'Agostino Kurtosis Test	0.4073	2.576	0.6838	Normal Distribution
	D'Agostino Skewness Test	0.8441	2.576	0.3986	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.8783	9.21	0.6446	Normal Distribution
	Kolmogorov-Smirnov D Test	0.08322	0.1617	0.6887	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9659	0.9236	0.2641	Normal Distribution

Proportion Normal Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	0.9001	0.8781	0.9221	0.9100	0.8500	0.9388	0.0097	3.42%	0.00%
0.25		5	0.8847	0.8358	0.9336	0.8911	0.8317	0.9300	0.0176	4.45%	1.70%
0.5		5	0.9021	0.8553	0.9489	0.8889	0.8800	0.9691	0.0169	4.18%	-0.22%
1		5	0.8208	0.7680	0.8737	0.8200	0.7600	0.8700	0.0190	5.19%	8.80%
2		5	0.8228	0.7741	0.8714	0.8400	0.7800	0.8687	0.0175	4.76%	8.59%
4		5	0.4820	0.4228	0.5412	0.4800	0.4100	0.5300	0.0213	9.88%	46.45%
8		5	0.0882	0.0556	0.1209	0.0800	0.0600	0.1212	0.0117	29.76%	90.20%

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	92/100	87/100	91/100	92/98	93/101	85/100	91/100	90/101	93/100	86/100
0.25		86/100	92/101	90/101	84/101	93/100					
0.5		88/99	89/100	90/102	88/100	94/97					
1		87/100	82/100	78/97	76/100	85/100					
2		86/99	84/100	78/100	85/101	76/97					
4		52/100	48/100	53/100	41/100	47/100					
8		12/99	8/100	7/100	11/100	6/100					



Linear Regression Options

Model Name	Link Function	Threshold Option	Thresh	PMSD	Optimize	Pooled	Het Corr	Weighted
Log-Normal (Probit)	η=inv Φ[π]	Control Threshold	0.117424	1.87%	Yes	No	Yes	Yes

Regression Summary

Iters	LL	AICc	BIC	Mu	Sigma	Cov	R2	F Stat	P-Value	Decision(α:5%)
10	-114.7	236.1	240.5	0.6247258	0.21993	-0.044984	0.9812	5.192	0.0023	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	1.832	1.532	2.101	54.58	47.59	65.29
EC10	2.202	1.894	2.474	45.41	40.42	52.79
EC15	2.493	2.185	2.765	40.11	36.17	45.77
EC20	2.752	2.446	3.021	36.34	33.1	40.88
EC25	2.995	2.693	3.262	33.39	30.65	37.14
EC40	3.707	3.418	3.974	26.98	25.16	29.26
EC50	4.214	3.928	4.495	23.73	22.25	25.46

Appendix D Hill Laboratories results and bioassay physico-chemistry

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T **0508 HILL LAB** (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	NIWA Corporate	**Lab No:**	2666860	SPv1
Contact:	Anathea Albert	**Date Received:**	29-Jul-2021	
	C/- NIWA Corporate	**Date Reported:**	03-Aug-2021	
	PO Box 11115	**Quote No:**	51353	
	Hillcrest	**Order No:**	11305163	
	Hamilton 3251	**Client Reference:**		
		Submitted By:	Anathea Albert	

Sample Type: Aqueous

Sample Name:		2668/TB4 28-Jul-2021				
Lab Number:		2666860.1				
Total Ammoniacal-N	g/m³	19.6	-	-	-	-
Total Sulphide	g/m³	0.40	-	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m³	1
Total Sulphide Trace	In-line distillation, segmented flow colorimetry. APHA 4500-S^{2-} E (modified) 23rd ed. 2017.	0.002 g/m³	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 02-Aug-2021 and 03-Aug-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Table D-1: Water quality measures from the blue mussel test.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
30/07/2021	0 hour	Control	0	20	8.0	7.9	107	35
		TB4	0.25	19	8.0	8.3	110	35
			16	19	7.8	8.1	108	35
1/08/2021	48 hour	Control	0	20	8.1	7.5	102	35
		TB4	0.25	20	8.1	7.6	103	35
			0.5	20	8.1	7.5	102	35
			1	20	8.1	7.4	100	35
			2	20	8.0	7.0	95	35
			4	20	8.0	6.5	88	35
			8	20	7.9	6.5	88	35
			16	20	7.8	2.8	38	35

Table D-2: Water quality measures from the wedge shell test.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
29/07/2021	0 hour	Control	0	20	8.0	7.5	102	35
		TB4	0.25	20	8.0	7.5	102	35
			16	20	8.0	7.5	102	34
2/08/2021	96 hour	Control	0	19	8.0	7.4	98	36
		TB4	0.25	19	8.1	7.3	97	37
			0.5	19	8.1	7.3	97	36
			1	19	8.1	7.3	97	35
			2	19	8.1	7.3	97	35
			4	19	8.1	7.2	96	35
			8	19	8.0	7.2	96	35
			16	19	8.0	6.7	89	35

Quarterly Whole Effluent Toxicity Testing for East Clive Wastewater Treatment Plant

Prepared for Hastings District Council

December 2021

Climate, Freshwater & Ocean Science

Prepared by:
Anathea Albert

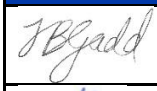
For any information regarding this report please contact:

Anathea Albert
Ecotoxicology Lab Services Manager
Ecotoxicology
+64 7 856 1723

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

NIWA CLIENT REPORT No: 2021393HN
Report date: December 2021
NIWA Project: HDC22202

Quality Assurance Statement		
	Reviewed by:	Jennifer Gadd
	Formatting checked by:	Carole Evans
	Approved for release by:	Michael Bruce

Contents

Tables

Executive summary

NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of a treated wastewater effluent sample from East Clive Wastewater Treatment Plant to determine resource consent compliance. The sample, collected 1-2 November 2021, was tested with three marine organisms, a marine alga (*Minutocellus polymorphus* – 48-hour chronic growth test), and two bivalve species: wedge shell (*Macomona liliana* – 96-hour acute survival and burial test) and blue mussel embryos (*Mytilus galloprovincialis* – 48-hour chronic embryo development test). The sample was also analysed for ammoniacal nitrogen and total sulfide.

This report documents the results of the toxicity testing. The algae, wedge shell and blue mussel tests met their respective test acceptability criteria based on control performance.

The algae test had an anomalous concentration response curve at the lower concentrations and a no-toxicity dilution could not be calculated. The wedge shell tests showed statistically significant toxicity at 5% effluent and higher but did not show statistically significant toxicity at a 200-fold dilution (0.5% effluent). Normal blue mussel embryo development was significantly affected at the lowest test concentration (0.25% effluent) resulting in a no toxicity dilution of >400-fold. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

For the effluent sample tested in this quarter, one species had a TEC > 0.5% effluent, one species had a TEC < 0.5% effluent and for the third species a TEC could not be calculated. As no species has had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent, no further action is required

1 Introduction

East Clive Wastewater Treatment Plant treats both industrial and domestic wastewater and the treated effluent is discharged through an ocean outfall into Hawke Bay. NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of effluent from the East Clive Wastewater Treatment Plant for compliance with Hawke Bay Regional Council (HBRC) resource consent CD130214W condition 15. The effluent sample was tested with three organisms, a marine alga (*Minutocellus polymorphus* 48-hour chronic growth test), and 2 bivalve species: wedge shell (*Macomona liliana* 96-hour acute survival and burial test) and blue mussel (*Mytilus galloprovincialis* 48-hour chronic embryo development test).

Condition 15 states that there shall be no statistically detectable difference in toxicity between a water sample taken from uncontaminated near shore water (from a location to be approved by Hawke's Bay Regional Council[1]), and treated wastewater when diluted 200-times with that water. No toxicity is defined as a no-toxicity dilution less than 200-fold. If the no-toxicity dilution is greater than 200-fold, the following three conditions must be examined:[2]

1. No more than one test species with a TEC[3] < 0.5% effluent in any given quarter.
2. No more than one consecutive incidence of TEC < 0.25% effluent within any given species between quarters.
3. EC_{20}[4] (chronic tests) and LC_{10} (acute tests) for all tests shall be greater than 0.5% effluent.

[1] Dilution water is 0.2 µm filtered offshore seawater collected by NIWA.
[2] These conditions interpret the flow chart in Appendix A describing the HBRC consent supplied to NIWA 25 Jun 2014.
[3] TEC=threshold effect concentration
[4] EC_x = dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an X% effect on the test organisms.

2 Methods

2.1 Samples

A 2 L, single use, food grade high density polyethylene (HDPE) container was supplied by NIWA to HDC for collection of the 24 h composite effluent sample. The sample was collected by HDC staff on 1-2 November 2021 and a subsample was collected for total sulfide at the same time in a bottle supplied by Hill Laboratories. On arrival at NIWA Hamilton on 3 November 2021 the effluent sample was assigned a unique sample code (2682/TP1) and the physicochemical parameters measured. The effluent was subsampled for ammoniacal nitrogen and remaining sample was stored in the dark at 4°C until toxicity testing commenced. The samples for ammoniacal nitrogen and total sulfide were sent to Hill Laboratories for analysis.

2.2 Toxicity testing methods

Tests were completed according to NIWA Standard Operating Procedures (SOP):

- NIWA SOP 14.1–Marine algae chronic toxicity for *Minutocellus polymorphus.*
- NIWA SOP 58.0–Marine bivalve acute toxicity for *Macomona liliana.*
- NIWA SOP 21.2–Marine bivalve chronic toxicity for *Mytilus galloprovincialis.*

A summary of test conditions and test acceptability information specified in each of the SOP manuals is provided in Appendix B.

2.3 Sample dilutions

Each test included a range of sample dilutions. The diluent for the algae, wedge shell and blue mussel tests was NIWA's offshore seawater. The sample was adjusted to the required test salinities, as specified by the standard operating procedures. For the wedge shell and blue mussel test, the effluent sample was adjusted to the test salinity of 34 ppt using brine (made from frozen 0.2 µm filtered offshore seawater water) and tested at a maximum concentration of 20% effluent and 16% effluent respectively. For the algal test, the sample was adjusted to the required test salinity of 26 ppt using NIWA's offshore seawater for a maximum concentration of 32% effluent.

2.4 Reference toxicant

A reference toxicant test using zinc was undertaken concurrently using standard test procedures to measure the sensitivity and condition of the organisms in the current test. This is part of the quality control procedures and allows comparability between laboratory test results undertaken at different times by comparing results to the known sensitivity of the test organism to zinc (NIWA, unpublished long-term database). NIWA uses zinc for all species as a reference toxicant because of the large amount of available toxicity data. Zinc was considered the "most suitable reference toxicant" by Environment Canada (1990) for its solubility, stability and shelf-life. The zinc sulfate stock concentration was validated by chemical analysis (Hill Laboratories).

2.5 Test acceptability criteria

Each test has criteria that must be met for the test to be considered acceptable (Appendix B). For the alga test the increase in cell density in the control water must be greater than 16-fold and the coefficient of variation in the control replicates must be less than 20%. For the wedge shell test there must be at least 90% survival in control and less than 10% morbidity in reburial control. For the blue mussel test the control embryos must have at least 80% mean normal development.

2.6 Method detection limit

The method detection limit is a measure of the natural variability associated with each test calculated from the NIWA long-term database of test results. If the percent effect is smaller than the method detection limit, then the effect may be due to natural variability in the test response—in this event, for compliance purposes, the NOEC and LOEC would be corrected to the concentrations at which the percent effect is greater than the method detection limit. The current method detection limits were calculated February 2021.

2.7 Statistics

Statistical analyses were completed using CETIS v1.9.7.7 (Comprehensive Environmental Toxicity Information System) by Tidepool Scientific.

3 Results

Results are summarized in this section (Tables 3-1 and 3-2). Raw data and detailed results from the statistical analyses are provided for all tests in Appendix C and chemistry results are provided in Appendix D.

Table 3-1: Measurements of municipal wastewater 24-hour composite sample after arrival at NIWA (3 November 2021) and results from analyses at Hill Laboratories.

Sample ID	NIWA Lab ID	pH	Temp (°C)	Salinity (ppt)	Total NH_4-N (mg L^{-1})	Total Sulfide (S^{2-}) (mg L^{-1})
HDC 1-2/11/2021	2682/TP1	6.7	3.4	0.5	17.2	0.3

Table 3-2: Summary of key toxicity metrics for the test organisms exposed to HDC effluent collected 1-2 November 2021. Full results are provided in Appendix C.

Organism	EC_{10} [a] %	EC_{20} [a] %	EC_{50} [a] %	NOEC [b] %	LOEC [b] %	TEC [b] %	No-Toxicity dilution [c]	Complies Y/N [d]
Algae	0.05	0.6	1.2 (1.1–1.3)	-[e]	-[e]	**-[e]**	-[e]	**-[e]**
Wedge shell reburial[f]	-	-	14.6	2.0	5.0	**3.2**	32 x	**Y**
Wedge shell survival	2.2	4.9	>20.0	2.0	5.0	**3.2**	32 x	**Y**
Blue mussel	0.4	0.5	0.8 (0.8–0.9)	<0.3	0.3	**<0.3**	>400 x	**N**

[a] EC_x= dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an effect on X% of test organisms. Values in parentheses indicate the 95% confidence intervals; [b] NOEC=No observed effect concentration; LOEC=Lowest observed effect concentration; TEC=threshold effect concentration (Geometric mean of NOEC and LOEC); [c] No-toxicity dilution is calculated as (1/TEC*100); [d] Bold indicates value used for compliance; [e] Anomalous concentration response curve; [f] 60-minute reburial results (morbidity).

3.1 Algae – cell growth inhibition

The chronic algal growth test achieved the test acceptability criteria with a 163-fold increase in mean control cell density after 48 hours and a coefficient of variation (CV) < 20% (CV = 3%).

There was an anomalous concentration response in the lowest four concentrations of the algae test, with alternating significant and non-significant differences from the control replicates. Guidance from USEPA (2000) indicates that under these circumstances NOEC and LOEC values would be severely compromised and therefore these are not reported for this test. As no TEC can be calculated, a no-toxicity dilution also could not be calculated. Point estimates were calculated including EC_{20}=0.6% and EC_{50}=1.2% effluent.

3.2 Bivalve – wedge shell survival and morbidity

The acute wedge shell test uses a sub-lethal endpoint (reburial, termed 'morbidity') to assess adverse effects on the test organisms because classification of juvenile bivalves into either live or recently dead is difficult to determine accurately. The reburial test is undertaken following 96 hours exposure to the effluent solutions and is a more sensitive and accurate endpoint than survival for this test species.

The wedge shell test achieved the test acceptability criterion with 95% survival and 95% reburial for the control treatments.

The pH and dissolved oxygen were in the acceptable range for the test (Appendix D, Table D–2). Salinity in the lowest test concentration (0.25%) increased during the test to 41 ppt, likely due to evaporation of the sample. The salinity for this concentration was outside the acceptable range for the test but survival and reburial were not affected in these replicates (100% survival and reburial). There was a difference between mean survival and reburial in control (100%) and brine control (90%) replicates (data not shown).

There was an anomalous concentration response relationship for both survival and reburial. A statistically significant decrease in survival and reburial occurred at 5% effluent, but an increase in both survival and reburial occurred at 10% effluent and then a significant decrease at 20% effluent. The statistically significant reduction in survival and reburial at 5% effluent resulted in no-toxicity dilutions of 32-fold, these are within the compliance threshold of maximum 200-fold dilution.

3.3 Bivalve - Blue Mussel embryo development

The chronic embryo development test achieved the test acceptability criterion of at least 80% normal embryo development in the controls (mean 89%). Salinity and pH were in the acceptable range for the test (Appendix D, Table D-1). Dissolved oxygen (DO) was in the acceptable range for the test except in the highest concentration (16% effluent) at the end of the test where DO was 55% (4.0 mg L^{-1} at pH 8, 20°C). The brine solution did not affect normal embryo development at concentrations used in this test (data not shown). Data are only shown in Appendix C for concentrations which had greater than 1% normal embryo development.

There was a statistically significant effect on normal blue mussel embryo development at 0.25% effluent (Table 3-2), with an 8.3% decrease in normal embryo development (Appendix C). The no-toxicity dilution of >400 fold is not within the compliance threshold of maximum 200-fold dilution.

3.4 Total sulfide

ANZG (2018) default guideline value for un-ionised sulfide: 0.001 mg L^{-1} H_2S.

The subsample for total sulfide was preserved at the time of sample collection. The total sulfide in the effluent sample collected 1-2 November 2021 was 0.3 mg L^{-1} which is equivalent to 0.01 mg L^{-1} of un-ionised sulfide[5], the more toxic form of sulfide in an aquatic ecosystem. The total sulfide concentration of the November 2021 effluent sample is 4-fold lower than the long-term median value of 1.14 mg L^{-1} total sulfide for all HDC effluent samples analysed since 1992 (n=113).

After applying a 200-fold dilution, the resulting un-ionised sulfide concentration of 0.00006 mg L^{-1} is 16-fold lower than the ANZG (2018) default guideline value of 0.001 mg L^{-1} H_2S. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.5 Ammoniacal-N

ANZG (2018) default guideline value: 0.910 mg L^{-1} ammoniacal-N, pH 8.

The ammoniacal-N concentration in the effluent sample was 17.2 mg L^{-1}, which is similar to the long-term median value of 16.0 mg L^{-1} for all HDC effluent samples analysed since 1992 (n=112).

[5] Calculated as 4.06% of total sulfide at pH 8.0, 20°C, 32.5 ppt (coastal waters) (ANZG 2018).

Applying a 200-fold dilution to the effluent sample resulted in a concentration of 0.09 mg L^{-1} ammoniacal-N, which is 11 fold lower than the ANZG (2018) default guideline value of 0.91 mg L^{-1} (at pH 8) for protection of 95% of marine species. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.6 Reference toxicant

The EC_{50} values for the reference toxicant tests using zinc were within the expected range (± 2 SD of long-term mean) for the algae, wedge shell and blue mussel tests. The results were as follows: algae EC_{50} = 0.01 mg L^{-1} Zn^{2+}, wedge shell survival EC_{50} = 2.1 mg L^{-1} Zn^{2+}, wedge shell reburial, EC_{50} = 1.8 mg L^{-1} Zn^{2+}, blue mussel EC_{50} = 0.16 mg L^{-1} Zn^{2+} (also shown in Appendix B).

Based on chronic NOEC values derived from the zinc sulfate tests, the algae, blue mussels, wedge shell reburial, and wedge shell survival would rank within the 1st, 68th, 82nd and 85th percentiles respectively of the most sensitive test organisms used for derivation of the ANZG (2021) guideline values for zinc in marine waters.

The results from this suite of toxicity tests provide a moderate degree of confidence in assessing the toxic hazard of the sample. However, these sensitivity rankings are specific to zinc and care must be taken when extrapolating these results where other classes of contaminants (e.g., organics) may be present and for protection of all organisms present in a particular receiving water environment (e.g., Hawke's Bay).

4 Compliance Statement

Hawke's Bay Regional Council Resource Consent No. CD130214W condition 15 requires that there be no detectable toxicity at a 200-fold effluent dilution. If there is toxicity at a 200-fold dilution the following conditions must be examined: is there more than one test species with a TEC[6]<0.5% effluent in any given quarter; is there a consecutive incidence of TEC<0.25% effluent within any given species between quarters; are EC_{20} (chronic tests) and LC_{10} (acute tests) for all tests greater than 0.5% effluent?

The algae test had an anomalous concentration response curve at the lower concentrations and the no-toxicity dilution could not be calculated. The EC_{20} was greater than 0.5% effluent.

The wedge shell tests did not show detectable toxicity at a 200-fold dilution.

The blue mussel test showed statistically significant toxicity at a 200-fold dilution: normal blue mussel embryo development was significantly affected at the lowest test concentration (0.25% effluent) resulting in a no toxicity dilution of >400-fold.

For the effluent sample in this quarter, one species had a TEC < 0.5% effluent, one species had a TEC > 0.5% effluent and a TEC could not be calculated for one species. No species has had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent so no further action is required (Appendix A).

After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

[6] TEC=threshold effect concentration

5 References

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

ANZG (2021) Toxicant default guideline values for aquatic ecosystem protection: Zinc in marine water. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. CC BY 4.0. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

Environment Canada (1990) *Guidance document for control of toxicity test precision using reference toxicants.* No. EPS 1/RM12. Conservation and Protection, Environment Canada: 90.

NIWA (2013) Standard Operating Procedure Number 58. *Macomona liliana* 96-h Acute Toxicity Test Procedure. Hamilton, New Zealand, *NIWA Client Report:* 35.

NIWA (1996) Standard Operating Procedure Number *14.1*: Marine algal microplate method. Hamilton, New Zealand. *NIWA Client Report*: 13.

NIWA (2008) Standard Operating Procedure 21.2: Marine blue mussel embryo (Mytilus galloprovincialis). Short-term Chronic Toxicity Test Protocol. Hamilton, New Zealand, *NIWA Client Report*: 41.

Roper, D.S., Hickey, C.W. (1994) Behavioural responses of the marine bivalve *Macomona liliana* exposed to copper- and chlordane-dosed sediments. *Marine Biology*, 118: 673–680.

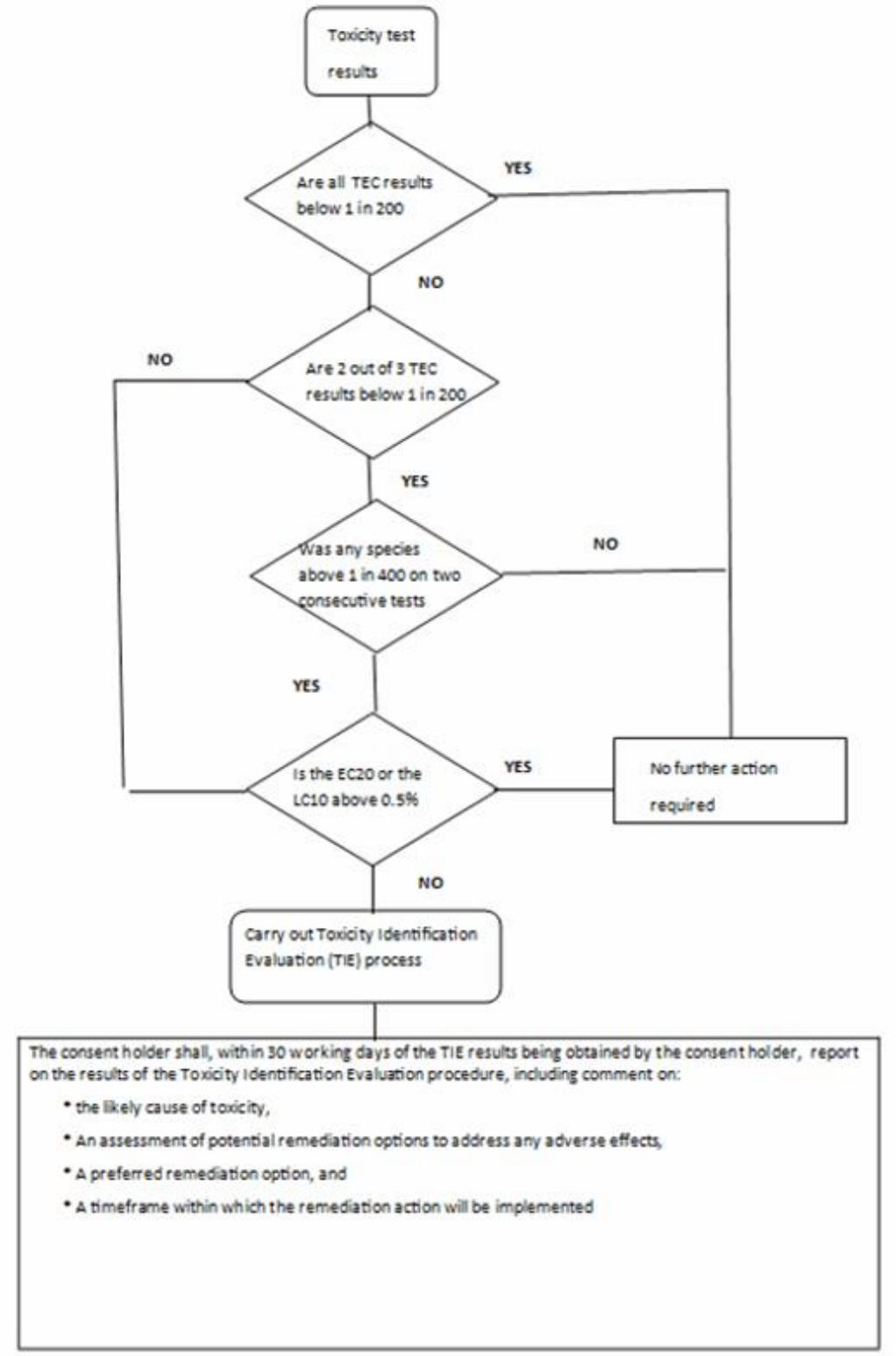
Tidepool (2000-2020) CETIS™ Comprehensive Environmental Toxicity Information System. *CETIS Users Guide v.1.9.7.7* Tidepool Scientific Software, McKinleyville, CA, USA: 241

USEPA (2000) *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136)*. US Environmental Protection Agency, Cincinnati, Ohio.

USEPA (1987) *Methods for toxicity tests of single substances and liquid complex wastes with marine unicellular algae. EPA-600-8/87/043*. US Environmental Protection Agency, Cincinnati, Ohio.

Williams, E.K., Hall, J.A. (1999) Seasonal and geographic variability in toxicant sensitivity of Mytilus galloprovincialis larvae. *Australasian Journal of Ecotoxicology*, 5(1): 1–10.

Appendix A Flow chart describing HBRC consent CD130214W condition 15[a]



[a]Supplied to NIWA 25 Jun 2014

Appendix B Test Conditions

Test conditions and dilutions for sample 2682/TP1

Project Name:	Hastings DC Effluent Bioassays: 2021–2022	**Project Number**	HDC22202
Test Material:	Hastings District Council 1-2/11/2021	**Reference Toxicant:**	Zinc sulphate
Dilution Water:	0.2 µm filtered offshore seawater from Pacific Ocean		

	Algae	**Bivalve–wedge shell**	**Bivalve–blue mussel embryos**
Test Initiation:	4/11/2021	4/11/2021	3/11/2021
Reference Method:	US EPA (1987) modified with Environment Canada (1992)	Adapted from Roper & Hickey (1994)	Williams & Hall (1999b)
Test Protocol:	NIWA SOP 14.1 NIWA (1996)	NIWA SOP 58.0 NIWA (2013)	NIWA SOP 21.2 (2008)
Test Organisms:	*Minutocellus polymorphus*	*Macomona liliana*	*Mytilus galloprovincialis*
Source:	Lab culture (500), imported from Bigelow Laboratories, USA	Manukau Harbour, Wiroa Island control site	Coromandel Harbour
Organisms/Container:	10,000 cells mL^{-1}	10	600 fertilised embryos
Test Concentrations	Control, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%
Test Duration:	48 hours	96 hours	48 hours
Replicates:	10 for controls, 5 for treatments	5 for controls, 3 for treatments	10 for controls, 5 for treatments
Sample pre-treatment:	0.45 µm filtration	Brine added to adjust salinity	Brine added to adjust salinity
Salinity:	26‰	34 ± 2‰	34 ± 2‰
Brine:	Nil	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection
Test Chambers:	96 well sterile microplates	55 ml polystyrene beakers	16x100 mm glass tubes
Lighting:	Continuous overhead lighting	Complete darkness	16:8 light dark
Temperature:	25 ± 1°C	20 ± 1°C	20 ± 1°C
Aeration:	Nil	Nil	Nil
Chemical Data:	Initial salinity	Initial and final salinity, final pH, temperature, dissolved oxygen	Initial and final salinity, temperature, dissolved oxygen, pH
Effect Measured:	Growth inhibition	Survival and morbidity (survival, reburial)	Abnormal embryo development
Zn sensitivity current test; long term mean (EC_{50}±2sd):	0.01; 0.009 (0.001–0.02) mg Zn L^{-1} (n=20)	Survival 2.1; Reburial 1.8; 3.6 (1.2–6.0) mg L^{-1} Zn^{2+} (n=20) (survival); 1.8 (0.6–2.9) mg L^{-1} Zn^{2+} (n=20) (reburial)	0.16; 0.17 (0.14–0.2) mg Zn L^{-1} (n=20)
Test Acceptability:	Control coefficient of variation within 20%; at least 16x cell growth increase in controls.	At least 90% survival in control and less than 10% morbidity in control reburial	80% of control embryos normally developed
Method Detection Limit (MDL):	12.4% reduction relative to controls	4.1% reduction relative to controls	5.1% reduction relative to controls
Percent Minimum Significant Difference (PMSD):	5.5%	Survival 10.6% Reburial 12.6%	7.0%
Test Acceptability Compliance:	**Achieved**	**Achieved**	**Achieved**

Appendix C Statistics

Algae

CETIS Analytical Report

Report Date: 09 Nov-21 09:25 (p 1 of 2)
Test Code/ID: 2682/TP1 MP7 / 08-4401-6962

Phytoplankton Growth Inhibition Test **NIWA Ecotoxicology**

Analysis ID:	12-0519-5043	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	09 Nov-21 9:23	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	DE40AB597432C85E6826E81A0A2BB7D4	**Editor ID:**	
Batch ID:	17-6017-2526	**Test Type:**	Cell Growth	**Analyst:**	A Albert
Start Date:	04 Nov-21	**Protocol:**	NIWA (1996)	**Diluent:**	Offshore seawater
Ending Date:	06 Nov-21	**Species:**	Minutocellus polymorphus	**Brine:**	Not Applicable
Test Length:	48h	**Taxon:**		**Source:**	CCMP Bigelow Laboratory f **Age:**
Sample ID:	16-5152-1153	**Code:**	2682/TP1 MP7	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	02 Nov-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	03 Nov-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.0625*	18	---	0	13	Exact	0.0186	Significant Effect
		0.125*	15	---	0	13	Exact	0.0027	Significant Effect
		0.25*	15	---	0	13	Exact	0.0027	Significant Effect
		0.5	26	---	0	13	Exact	0.3969	Non-Significant Effect
		1*	15	---	0	13	Exact	0.0027	Significant Effect
		2*	15	---	0	13	Exact	0.0027	Significant Effect
		4*	15	---	0	13	Exact	0.0027	Significant Effect
		8*	15	---	0	13	Exact	0.0027	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.853E+13	2.316E+12	8	581.6	<1.0E-05	Significant Effect
Error	1.633E+11	3.982E+09	41			
Total	1.869E+13		49			

ANOVA Assumptions Tests

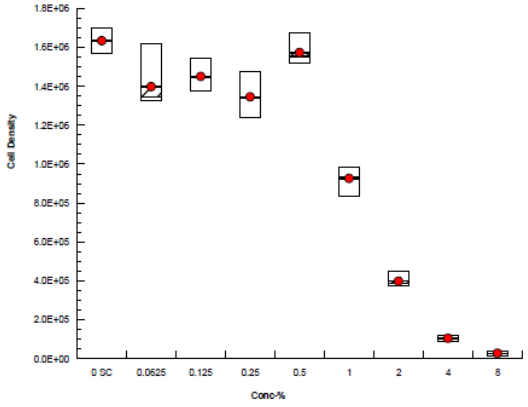
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	27.33	20.09	0.0006	Unequal Variances
	Levene Equality of Variance Test	2.214	2.98	0.0461	Equal Variances
	Mod Levene Equality of Variance Test	1.029	3.106	0.4342	Equal Variances
Distribution	Anderson-Darling A2 Test	1.017	3.878	0.0113	Normal Distribution
	D'Agostino Kurtosis Test	2.89	2.576	0.0039	Non-Normal Distribution
	D'Agostino Skewness Test	3.329	2.576	0.0009	Non-Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	19.43	9.21	6.0E-05	Non-Normal Distribution
	Kolmogorov-Smirnov D Test	0.135	0.1453	0.0234	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9215	0.9367	0.0027	Non-Normal Distribution

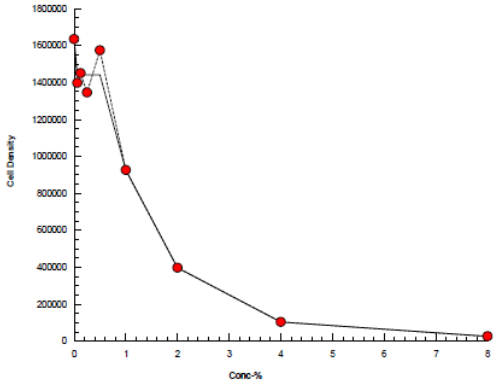
Cell Density Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	1.634E+6	1.602E+6	1.666E+6	1.636E+6	1.567E+6	1.701E+6	1.428E+4	2.76%	0.00%
0.0625		5	1.398E+6	1.245E+6	1.551E+6	1.344E+6	1.325E+6	1.616E+6	5.506E+4	8.81%	14.47%
0.125		5	1.450E+6	1.362E+6	1.538E+6	1.443E+6	1.374E+6	1.547E+6	3.165E+4	4.88%	11.25%
0.25		5	1.345E+6	1.241E+6	1.450E+6	1.341E+6	1.242E+6	1.476E+6	3.765E+4	6.26%	17.67%
0.5		5	1.574E+6	1.490E+6	1.657E+6	1.553E+6	1.517E+6	1.674E+6	3.004E+4	4.27%	3.69%
1		5	9.262E+5	8.577E+5	9.948E+5	9.352E+5	8.371E+5	9.866E+5	2.469E+4	5.96%	43.32%
2		5	3.979E+5	3.573E+5	4.386E+5	3.849E+5	3.705E+5	4.526E+5	1.463E+4	8.22%	75.65%
4		5	1.045E+5	8.470E+4	1.243E+5	1.010E+5	8.584E+4	1.229E+5	7.131E+3	15.26%	93.61%
8		5	2.730E+4	1.592E+4	3.868E+4	2.520E+4	1.484E+4	3.740E+4	4.099E+3	33.58%	98.33%

Cell Density Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	1.651E+6	1.594E+6	1.617E+6	1.567E+6	1.582E+6	1.622E+6	1.701E+6	1.687E+6	1.651E+6	1.670E+6
0.0625		1.344E+6	1.365E+6	1.325E+6	1.616E+6	1.338E+6					
0.125		1.547E+6	1.443E+6	1.374E+6	1.492E+6	1.395E+6					
0.25		1.345E+6	1.476E+6	1.323E+6	1.242E+6	1.341E+6					
0.5		1.607E+6	1.674E+6	1.517E+6	1.553E+6	1.518E+6					
1		9.352E+5	8.371E+5	9.233E+5	9.491E+5	9.866E+5					
2		3.849E+5	3.793E+5	3.705E+5	4.526E+5	4.025E+5					
4		1.229E+5	1.189E+5	9.392E+4	1.010E+5	8.584E+4					
8		3.520E+4	3.740E+4	2.384E+4	2.520E+4	1.484E+4					





Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	84411	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC10	0.05285	0.03887	0.7363	1892	135.8	2573
IC15	0.5448	0.4935	0.588	183.5	170.1	202.6
IC20	0.6169	0.5715	0.6569	162.1	152.2	175
IC25	0.6923	0.6463	0.7303	144.4	136.9	154.7
IC40	0.9404	0.8751	1	106.3	99.99	114.3
IC50	1.175	1.074	1.25	85.12	79.97	93.13

Wedge shell survival

CETIS Analytical Report

Report Date: 09 Dec-21 12:51 (p 1 of 3)
Test Code/ID: 2682/TP1 MAC / 18-1096-6187

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	05-4567-7367	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	09 Dec-21 12:48	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	7A3B3A466FF81B355E63B52606FEDC36	**Editor ID:**	
Batch ID:	03-0337-9403	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	04 Nov-21	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	08 Nov-21	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	18-4572-0801	**Code:**	2682/TP1 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	02 Nov-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	03 Nov-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	2	5	3.162	50	0.1003	10.56%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	27	---	1	11	Exact	1.0000	Non-Significant Effect
		0.5	22.5	---	2	11	Exact	1.0000	Non-Significant Effect
		1	27	---	1	11	Exact	1.0000	Non-Significant Effect
		2	18	---	2	11	Exact	1.0000	Non-Significant Effect
		5*	6	---	0	11	Exact	0.0245	Significant Effect
		10	7.5	---	1	11	Exact	0.0979	Non-Significant Effect
		20*	6	---	0	11	Exact	0.0245	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.27289	0.181841	7	21.64	<1.0E-05	Significant Effect
Error	0.193228	0.0084012	23			
Total	1.46611		30			

ANOVA Assumptions Tests

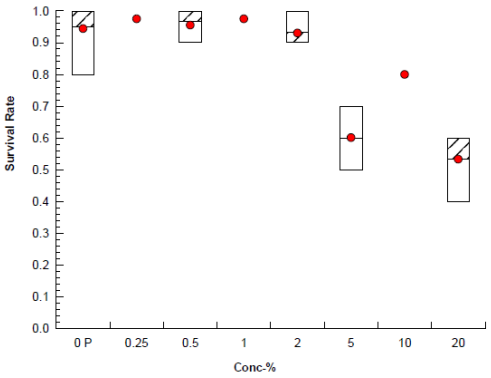
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test				Indeterminate
	Levene Equality of Variance Test	4.888	3.539	0.0017	Unequal Variances
	Mod Levene Equality of Variance Test	0.4949	4.026	0.8248	Equal Variances
Distribution	Anderson-Darling A2 Test	1.111	3.878	0.0066	Non-Normal Distribution
	D'Agostino Kurtosis Test	0.7852	2.576	0.4323	Normal Distribution
	D'Agostino Skewness Test	1.94	2.576	0.0524	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	4.38	9.21	0.1119	Normal Distribution
	Kolmogorov-Smirnov D Test	0.2024	0.1825	0.0023	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.9117	0.9056	0.0143	Normal Distribution

Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	0.9500	0.8994	1.0000	1.0000	0.8000	1.0000	0.0224	7.44%	0.00%
0.25		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-5.26%
0.5		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	-1.75%
1		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	-5.26%
2		3	0.9333	0.7899	1.0000	0.9000	0.9000	1.0000	0.0333	6.19%	1.75%
5		3	0.6000	0.3516	0.8484	0.6000	0.5000	0.7000	0.0577	16.67%	36.84%
10		3	0.8000	0.7995	0.8005	0.8000	0.8000	0.8000	0.0000	0.00%	15.79%
20		3	0.5333	0.2465	0.8202	0.6000	0.4000	0.6000	0.0667	21.65%	43.86%

Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	9/10	10/10	8/10	9/10	9/10	10/10	10/10	10/10	10/10	10/10
0.25		10/10	10/10	10/10							
0.5		10/10	9/10	10/10							
1		10/10	10/10	10/10							
2		9/10	9/10	10/10							
5		5/10	6/10	7/10							
10		8/10	8/10	8/10							
20		4/10	6/10	6/10							



Linear Regression Options

Model Name	Link Function	Threshold Option	Thresh	PMSD	Optimize	Pooled	Het Corr	Weighted
Log-Normal (Probit)	η=inv Φ[π]	Control Threshold	6.68E-07	0.02%	Yes	No	No	Yes

Regression Summary

Iters	LL	AICc	BIC	Mu	Sigma	Cov	R2	F Stat	P-Value	Decision(α:5%)
18	-23.65	54.38	57.07	1.351506	0.7862305	-0.039753	1	6.001	0.0020	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
LC5	1.144	0.4149	1.992	87.44	50.19	241
LC10	2.208	1.076	3.464	45.3	28.87	92.95
LC15	3.441	1.969	5.226	29.06	19.13	50.78
LC20	4.896	3.064	7.533	20.43	13.28	32.64
LC25	6.625	4.322	10.68	15.09	9.366	23.14
LC40	14.2	9.041	29.24	7.042	3.42	11.06
LC50	22.46	13.35	56.6	4.451	1.767	7.49

Wedge shell reburial

CETIS Analytical Report

Report Date: 09 Nov-21 10:09 (p 1 of 6)
Test Code/ID: 2682/TP1 MAC / 18-1096-6187

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	01-1802-4191	**Endpoint:**	Eff. Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	09 Nov-21 10:07	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	D5533F1AF1842FC01731E12CC0CC46A6	**Editor ID:**	
Batch ID:	03-0337-9403	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	04 Nov-21	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	08 Nov-21	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	18-4572-0801	**Code:**	2682/TP1 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	02 Nov-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	03 Nov-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	2	5	3.162	50	0.1198	12.61%

Bonferroni Adj t Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	-0.3561	2.651	0.187	11	CDF	1.0000	Non-Significant Effect
		0.5	1.76	2.651	0.187	11	CDF	0.3207	Non-Significant Effect
		1	-0.3561	2.651	0.187	11	CDF	1.0000	Non-Significant Effect
		2	1.86	2.651	0.187	11	CDF	0.2649	Non-Significant Effect
		5*	6.824	2.651	0.187	11	CDF	<1.0E-05	Significant Effect
		10*	5.351	2.651	0.187	11	CDF	6.9E-05	Significant Effect
		20*	9.727	2.651	0.187	11	CDF	<1.0E-05	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.73854	0.248362	7	21.74	<1.0E-05	Significant Effect
Error	0.262755	0.0114241	23			
Total	2.00129		30			

ANOVA Assumptions Tests

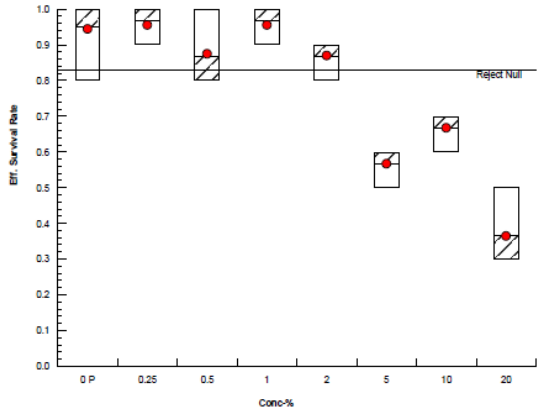
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	3.241	18.48	0.8619	Equal Variances
	Levene Equality of Variance Test	1.843	3.539	0.1269	Equal Variances
	Mod Levene Equality of Variance Test	0.1512	4.026	0.9914	Equal Variances
Distribution	Anderson-Darling A2 Test	1.477	3.878	0.0002	Non-Normal Distribution
	D'Agostino Kurtosis Test	0.1695	2.576	0.8654	Normal Distribution
	D'Agostino Skewness Test	0.548	2.576	0.5837	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.3291	9.21	0.8483	Normal Distribution
	Kolmogorov-Smirnov D Test	0.2207	0.1825	0.0005	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.9189	0.9056	0.0221	Normal Distribution

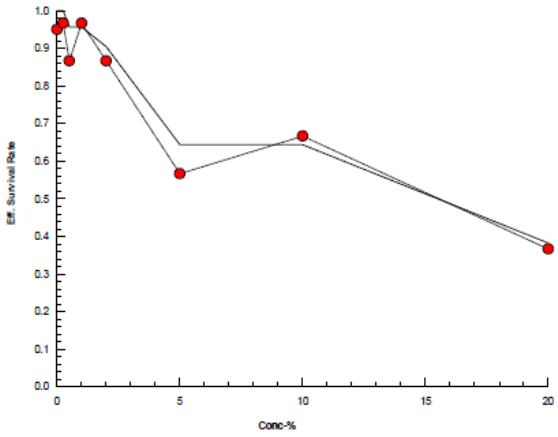
Eff. Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	0.9500	0.8994	1.0000	1.0000	0.8000	1.0000	0.0224	7.44%	0.00%
0.25		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	-1.75%
0.5		3	0.8667	0.5798	1.0000	0.8000	0.8000	1.0000	0.0667	13.32%	8.77%
1		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	-1.75%
2		3	0.8667	0.7232	1.0000	0.9000	0.8000	0.9000	0.0333	6.66%	8.77%
5		3	0.5667	0.4232	0.7101	0.6000	0.5000	0.6000	0.0333	10.19%	40.35%
10		3	0.6667	0.5232	0.8101	0.7000	0.6000	0.7000	0.0333	8.66%	29.82%
20		3	0.3667	0.0798	0.6535	0.3000	0.3000	0.5000	0.0667	31.49%	61.40%

Eff. Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	9/10	10/10	8/10	9/10	9/10	10/10	10/10	10/10	10/10	10/10
0.25		10/10	9/10	10/10							
0.5		8/10	8/10	10/10							
1		9/10	10/10	10/10							
2		9/10	8/10	9/10							
5		5/10	6/10	6/10							
10		6/10	7/10	7/10							
20		3/10	5/10	3/10							





Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	LC50	95% LCL	95% UCL	TU	95% LCL	95% UCL
Control Threshold	0.05	38.26%	1.165566	0.0723446	14.64	10.49	20.43	6.83	4.895	9.531

Blue mussel

CETIS Analytical Report

Report Date: 30 Nov-21 08:23 (p 1 of 2)
Test Code/ID: 2682/TP1 MyG / 12-8849-6256

Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

Analysis ID:	17-4295-4951	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	30 Nov-21 8:22	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	E56E9C60765EB31B4B9938C0F83D1434	**Editor ID:**	
Batch ID:	10-6326-7660	**Test Type:**	Development	**Analyst:**	S Bell
Start Date:	03 Nov-21	**Protocol:**	NIWA (2008)	**Diluent:**	Seawater
Ending Date:	05 Nov-21	**Species:**	Mytilus galloprovincialis	**Brine:**	Frozen Coastal Seawater
Test Length:	48h	**Taxon:**		**Source:**	Coromandel **Age:**
Sample ID:	05-8907-3007	**Code:**	2682/TP1 MyG	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	02 Nov-21	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	03 Nov-21	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	<0.25	0.25	---	>400	0.06265	7.03%

Bonferroni Adj t Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.25*	2.64	2.385	0.093	13	CDF	0.0281	Significant Effect
		0.5*	5.582	2.385	0.093	13	CDF	1.7E-05	Significant Effect
		1*	15.64	2.385	0.093	13	CDF	<1.0E-05	Significant Effect
		2*	27.86	2.385	0.093	13	CDF	<1.0E-05	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4.64639	1.1616	4	229.9	<1.0E-05	Significant Effect
Error	0.126309	0.0050523	25			
Total	4.7727		29			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	6.238	13.28	0.1821	Equal Variances
	Levene Equality of Variance Test	2.185	4.177	0.1000	Equal Variances
	Mod Levene Equality of Variance Test	1.855	4.369	0.1561	Equal Variances
Distribution	Anderson-Darling A2 Test	0.3541	3.878	0.4667	Normal Distribution
	D'Agostino Kurtosis Test	0.02674	2.576	0.9787	Normal Distribution
	D'Agostino Skewness Test	0.4477	2.576	0.6543	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.2012	9.21	0.9043	Normal Distribution
	Kolmogorov-Smirnov D Test	0.1096	0.1853	0.4632	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9715	0.9031	0.5805	Normal Distribution

Proportion Normal Summary

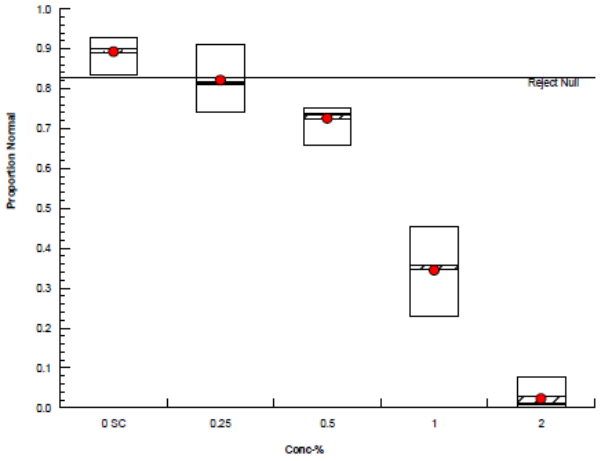
Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	0.8910	0.8710	0.9109	0.9000	0.8333	0.9293	0.0088	3.13%	0.00%
0.25		5	0.8170	0.7412	0.8929	0.8119	0.7395	0.9100	0.0273	7.48%	8.30%
0.5		5	0.7247	0.6768	0.7726	0.7358	0.6571	0.7525	0.0172	5.32%	18.66%
1		5	0.3470	0.2372	0.4567	0.3564	0.2300	0.4554	0.0395	25.48%	61.06%
2		5	0.0296	0.0000	0.0711	0.0100	0.0000	0.0792	0.0150	112.99%	96.68%

Angular (Corrected) Transformed Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	1.2360	1.2050	1.2680	1.2490	1.1500	1.3020	0.0138	3.53%	0.00%
0.25		5	1.1340	1.0300	1.2370	1.1220	1.0350	1.2660	0.0374	7.37%	8.31%
0.5		5	1.0190	0.9667	1.0720	1.0310	0.9453	1.0500	0.0189	4.14%	17.58%
1		5	0.6275	0.5104	0.7445	0.6398	0.5002	0.7408	0.0422	15.03%	49.25%
2		5	0.1517	0.0299	0.2735	0.1002	0.0503	0.2853	0.0439	64.65%	87.73%

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	88/101	91/101	90/101	90/100	85/102	93/102	90/99	88/102	90/100	92/99
0.25		82/101	88/119	91/100	81/101	83/101					
0.5		69/105	78/106	79/106	74/101	76/101					
1		46/101	36/101	29/99	40/100	23/100					
2		8/101	1/100	2/41	0/99	1/100					



Linear Regression Options

Model Name	Link Function	Threshold Option	Thresh	PMSD	Optimize	Pooled	Het Corr	Weighted
Log-Normal (Probit)	η=inv Φ[π]	Control Threshold	0.131563	3.34%	Yes	No	Yes	Yes

Regression Summary

Iters	LL	AICc	BIC	Mu	Sigma	Cov	R2	F Stat	P-Value	Decision(α:5%)
13	-95.85	198.6	201.9	-0.075754	0.224392	0.0015894	0.9754	8.274	0.0017	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	0.359	0.2832	0.4262	278.5	234.6	353.1
EC10	0.4332	0.3544	0.5017	230.8	199.3	282.1
EC15	0.4917	0.412	0.5606	203.4	178.4	242.7
EC20	0.5437	0.4641	0.6127	183.9	163.2	215.5
EC25	0.5928	0.5135	0.6617	168.7	151.1	194.7
EC40	0.7369	0.6599	0.807	135.7	123.9	151.5
EC50	0.8399	0.7635	0.9139	119.1	109.4	131

Appendix D Hill Laboratories results and bioassay physico-chemistry

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	NIWA Corporate	**Lab No:**	2757375	SPv1
Contact:	Anathea Albert C/- NIWA Corporate PO Box 11115 Hillcrest Hamilton 3251	**Date Received:** **Date Reported:** **Quote No:** **Order No:** **Client Reference:** **Submitted By:**	05-Nov-2021 10-Nov-2021 51353 307713 Anathea Albert	

Sample Type: Aqueous						
Sample Name:		2682/TP1 03-Nov-2021				
Lab Number:		2757375.1				
Total Ammoniacal-N	g/m³	17.2	-	-	-	-
Total Sulphide	g/m³	0.31	-	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m³	1
Total Sulphide Trace	In-line distillation, segmented flow colorimetry. APHA 4500-S^{2-} E (modified) 23rd ed. 2017.	0.002 g/m³	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 09-Nov-2021 and 10-Nov-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Table D-1: Water quality measures from the blue mussel test. Shaded values are outside test range and mav affect the results at that concentration.

Date	Time	Sample	Concentration (%)	Temp (°C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
3/11/2021	0h	Control	0	18	8.1	8.0	106	35
		TP1	0.25	19	8.2	7.7	102	36
			16	18	7.8	7.7	102	35
5/11/2021	48h	Control	0	21	8.0	7.2	99	34
		TP1	0.25	20	8.1	7.1	96	35
			0.5	20	8.1	7.1	96	35
			1	20	8.1	7.0	95	35
			2	20	8.1	6.9	93	35
			4	21	8.1	6.6	91	35
			8	21	8.0	5.8	80	35
			16	21	7.9	4.0	55	35

Table D-2: Water quality measures from the wedge shell test. Shaded values are outside test range and may affect the results at that concentration.

Date	Time	Sample	Concentration (%)	Temp (°C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
4/11/2021	0 hour	Control	0	20	8.1	7.5	102	35
		TP1	0.25	20	8.2	7.6	103	35
			20	20	8.0	7.4	100	35
8/11/2021	96 hour	Control	0	20	8.1	7.1	96	35
		TP1	0.25	20	8.2	7.2	98	41
			0.5	20	8.2	7.2	98	36
			1	20	8.2	7.2	98	36
			2	20	8.1	7.2	98	36
			5	20	8.1	7.0	95	35
			10	20	8.1	6.9	93	36
			20	20	8.1	6.7	91	36

Quarterly Whole Effluent Toxicity testing for East Clive Wastewater Treatment Plant

Prepared for Hastings District Council

March 2022

Climate, Freshwater & Ocean Science

Prepared by:
Anathea Albert

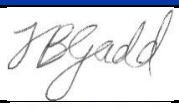
For any information regarding this report please contact:

Anathea Albert
Ecotoxicology Lab Services Manager
Ecotoxicology
+64-7-856 1723

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

NIWA CLIENT REPORT No: 2022048HN
Report date: March 2022
NIWA Project: HDC22202

Quality Assurance Statement		
	Reviewed by:	Jennifer Gadd
	Formatting checked by:	Carli Nolan
	Approved for release by:	Michael Bruce

Contents

Tables

Executive summary

NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of a treated effluent sample from East Clive Wastewater Treatment Plant to determine resource consent compliance. The sample, collected 17-18 January 2022, was tested with three marine organisms, a marine alga (*Minutocellus polymorphus* – 48-hour chronic growth test), and two bivalve species: wedge shell (*Macomona liliana* – 96-hour acute survival and burial test) and blue mussel (*Mytilus galloprovincialis* – 48-hour chronic embryo development test). The sample was also analysed for ammoniacal nitrogen and total sulfide.

This report documents the results of the toxicity testing. The algae, wedge shell and blue mussel tests met their respective test acceptability criteria based on control performance.

The algae, wedge shell and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 71-fold from both the blue mussel and algae tests. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent so no further action is required.

1 Introduction

East Clive Wastewater Treatment Plant treats both industrial and domestic wastewater and the treated effluent is discharged through an ocean outfall into Hawke Bay. NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of effluent from the East Clive Wastewater Treatment Plant for compliance with Hawke Bay Regional Council (HBRC) resource consent CD130214W condition 15. The effluent sample was tested with three organisms, a marine alga (*Minutocellus polymorphus* 48-hour chronic growth test), and 2 bivalve species: wedge shell (*Macomona liliana* 96-hour acute survival and burial test) and blue mussel (*Mytilus galloprovincialis* 48-hour chronic embryo development test).

Condition 15 states that there shall be no statistically detectable difference in toxicity between a water sample taken from uncontaminated near shore water (from a location to be approved by Hawke's Bay Regional Council[1]), and treated wastewater when diluted 200-times with that water. No toxicity is defined as a no-toxicity dilution less than 200-fold. If the no-toxicity dilution is greater than 200-fold, the following three conditions must be examined:[2]

1. No more than one test species with a TEC[3] < 0.5% effluent in any given quarter.
2. No more than one consecutive incidence of TEC < 0.25% effluent within any given species between quarters.
3. EC_{20}[4] (chronic tests) and LC_{10} (acute tests) for all tests shall be greater than 0.5% effluent.

[1] Dilution water is 0.2 µm filtered offshore seawater collected by NIWA.
[2] These conditions interpret the flow chart in Appendix A describing the HBRC consent supplied to NIWA 25 Jun 2014.
[3] TEC=threshold effect concentration
[4] EC_x = dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an X% effect on the test organisms.

2 Methods

2.1 Samples

A 2 L, single use, food grade high density polyethylene (HDPE) container was supplied by NIWA to HDC for collection of the 24 h composite effluent sample. The sample was collected by HDC staff on 17-18 January 2022 and a subsample was collected for total sulfide at the same time in a bottle supplied by Hill Laboratories. On arrival at NIWA Hamilton on 19 January 2022 the effluent sample was assigned a unique sample code (2682/TP2) and the physicochemical parameters measured. The effluent was subsampled for ammoniacal nitrogen and remaining sample was stored in the dark at 4°C until toxicity testing commenced. The samples for ammoniacal nitrogen and total sulfide were sent to Hill Laboratories for analysis.

2.2 Toxicity testing methods

Tests were completed according to NIWA Standard Operating Procedures (SOP):

- NIWA SOP 14.1–Marine algae chronic toxicity for *Minutocellus polymorphus.*
- NIWA SOP 58.0–Marine bivalve acute toxicity for *Macomona liliana.*
- NIWA SOP 21.2–Marine bivalve chronic toxicity for *Mytilus galloprovincialis.*

A summary of test conditions and test acceptability information specified in each of the SOP manuals is provided in Appendix B.

2.3 Sample dilutions

Each test included a range of sample dilutions. The diluent for the algae, wedge shell and blue mussel tests was NIWA's offshore seawater. The sample was adjusted to the required test salinities, as specified by the standard operating procedures. For the wedge shell and blue mussel test, the effluent sample was adjusted to the test salinity of 34 ppt using brine (made from frozen 0.2 µm filtered offshore seawater water) and tested at a maximum concentration of 20% effluent and 16% effluent respectively. For the algal test, the sample was adjusted to the required test salinity of 26 ppt using NIWA's offshore seawater for a maximum concentration of 32% effluent.

2.4 Reference toxicant

A reference toxicant test using zinc was undertaken concurrently using standard test procedures to measure the sensitivity and condition of the organisms in the current test. This is part of the quality control procedures and allows comparability between laboratory test results undertaken at different times by comparing results to the known sensitivity of the test organism to zinc (NIWA, unpublished long-term database). NIWA uses zinc for all species as a reference toxicant because of the large amount of available toxicity data. Zinc was considered the "most suitable reference toxicant" by Environment Canada (1990) for its solubility, stability and shelf-life. The zinc sulfate stock concentration was validated by chemical analysis (Hill Laboratories).

2.5 Test acceptability criteria

Each test has criteria that must be met for the test to be considered acceptable (Appendix B). For the alga test the increase in cell density in the control water must be greater than 16-fold and the coefficient of variation in the control replicates must be less than 20%. For the wedge shell test there must be at least 90% survival in control and less than 10% morbidity in reburial control. For the blue mussel test the control embryos must have at least 80% mean normal development.

2.6 Method detection limit

The method detection limit is a measure of the natural variability associated with each test calculated from the NIWA long-term database of test results. If the percent effect is smaller than the method detection limit, then the effect may be due to natural variability in the test response—in this event, for compliance purposes, the NOEC and LOEC would be corrected to the concentrations at which the percent effect is greater than the method detection limit. The current method detection limits were calculated February 2021.

2.7 Statistics

Statistical analyses were completed using CETIS v1.9.7.7 (Comprehensive Environmental Toxicity Information System) by Tidepool Scientific.

3 Results

Results are summarized in this section (Tables 3-1 and 3-2). Raw data and detailed results from the statistical analyses are provided for all tests in Appendix C and chemistry results are provided in Appendix D.

Table 3-1: Measurements of municipal wastewater 24-hour composite sample after arrival at NIWA (19 January 2022) and results from analyses at Hill Laboratories.

Sample ID	NIWA Lab ID	pH	Temp (°C)	Salinity (ppt)	Total NH_4-N (mg L^{-1})	Total Sulfide (S^{2-}) (mg L^{-1})
HDC 17-18/01/2022	2682/TP2	6.2	1.9	0.8	19.4	1.6

Table 3-2: Summary of key toxicity metrics for the test organisms exposed to HDC effluent collected 17-18 January 2022. Full results are provided in Appendix C.

Organism	EC_{10} [a] %	EC_{20} [a] %	EC_{50} [a] %	NOEC [b] %	LOEC [b] %	TEC [b] %	No-Toxicity dilution [c]	Complies Y/N [d]
Algae	1.4	1.9	4.7 (3.4–5.7)	1.0	2.0	**1.4**	71 x	**Y**
Wedge shell reburial [e]	-	-	>20.0	20.0	>20.0	**>20**	<5 x	**Y**
Wedge shell survival	-	-	>20.0	20.0	>20.0	**>20**	<5 x	**Y**
Blue mussel	1.7	1.9	2.4 (2.3–2.5)	1.0 [f]	2.0 [f]	**1.4** [f]	71 x	**Y**

[a] EC_x= dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an effect on X% of test organisms. Values in parentheses indicate the 95% confidence intervals, [b] NOEC=No observed effect concentration, LOEC=Lowest observed effect concentration, TEC=threshold effect concentration (Geometric mean of NOEC and LOEC), [c] No-toxicity dilution is calculated as (1/TEC*100), [d] Bold indicates value used for compliance, [e] 60-minute reburial results (morbidity), [f]Adjusted for the method detection limit.

3.1 Algae – cell growth inhibition

The chronic algal growth test achieved the test acceptability criteria with a 120-fold increase in mean control cell density after 48 hours and a coefficient of variation (CV) < 20% (CV = 5%).

There was a statistically significant, 21% decrease in algal cell density at a concentration of 2.0% effluent (Appendix C), resulting in a LOEC of 2.0% and a NOEC of 1.0%. The no-toxicity dilution of 71-fold is within the compliance threshold of maximum 200-fold dilution.

3.2 Bivalve – wedge shell survival and morbidity

The acute wedge shell test uses a sub-lethal endpoint (reburial, termed 'morbidity') to assess adverse effects on the test organisms because classification of juvenile bivalves into either live or recently dead is difficult to determine accurately. The reburial test is undertaken following 96 hours exposure to the effluent solutions and is a more sensitive and accurate endpoint than survival for this test species.

The wedge shell test achieved the test acceptability criterion with 100% survival and 100% reburial for the control treatments.

The pH, dissolved oxygen and salinity were in the acceptable range for the test (Appendix D, Table D–2). There was no difference between mean survival and reburial in control (100%) and brine control (100%) replicates (data not shown).

There was no statistically significant decrease in survival or reburial at any effluent test concentration (maximum tested was 20% effluent), resulting in a no-toxicity dilution of <5-fold which is within the compliance threshold of maximum 200-fold dilution.

3.3 Bivalve - Blue Mussel embryo development

The chronic embryo development test achieved the test acceptability criterion of at least 80% normal embryo development in the controls (mean 94%). Salinity and pH were in the acceptable range for the test (Appendix D, Table D-1). Dissolved oxygen (DO) was in the acceptable range for the test (>4.0 mg L^{-1} at pH 8, 20°C) at all concentrations where normal embryo development was greater than 0%. The brine solution did not affect normal embryo development at concentrations used in this test (data not shown).

There was a statistically significant effect, a 4.7% decrease in normal embryo development, at 1% effluent (Table 3-2), (Appendix C). The 4.7% decrease in normal embryo development was not greater than the method detection limit of 5.1% so the NOEC and LOEC were adjusted to concentrations at which the percent effect was greater than the method detection limit. For this sample the NOEC and LOEC were adjusted to 1.0% and 2.0% respectively (Table 3-2) resulting in a no-toxicity dilution of 71-fold which is within the compliance threshold of maximum 200-fold dilution. There was a statistically significant 25% decrease in normal embryo development at 2% effluent followed by a 96% decrease at 4% effluent.

3.4 Total sulfide

ANZG (2018) default guideline value for un-ionised sulfide: 0.001 mg L^{-1} H_2S.

The subsample for total sulfide was preserved at the time of sample collection. The total sulfide in the effluent sample collected 17-18 January 2022 was 1.6 mg L^{-1} which is equivalent to 0.06 mg L^{-1} of un-ionised sulfide[5], the more toxic form of sulfide in an aquatic ecosystem. The total sulfide concentration of the January 2022 effluent sample is similar to the long-term median value of 1.15 mg L^{-1} total sulfide for all HDC effluent samples analysed since 1992 (n=114).

After applying a 200-fold dilution, the resulting un-ionised sulfide concentration of 0.0003 mg L^{-1} was 3-fold lower than the ANZG (2018) default guideline value of 0.001 mg L^{-1} H_2S. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.5 Ammoniacal-N

ANZG (2018) default guideline value: 0.910 mg L^{-1} ammoniacal-N, pH 8.

The ammoniacal-N concentration in the effluent sample was 19.4 mg L^{-1}, which is similar to the long-term median value of 16.0 mg L^{-1} for all HDC effluent samples analysed since 1992 (n=113).

[5] Calculated as 4.06% of total sulfide at pH 8.0, 20°C, 32.5 ppt (coastal waters) (ANZG 2018).

Applying a 200-fold dilution to the effluent sample resulted in a concentration of 0.1 mg L^{-1} ammoniacal-N, which is 9-fold lower than the ANZG (2018) default guideline value of 0.91 mg L^{-1} (at pH 8) for protection of 95% of marine species. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.6 Reference toxicant

The EC_{50} values for the reference toxicant tests using zinc were within the expected range (± 2 SD of long-term mean) for the algae, wedge shell and blue mussel tests. The results were as follows: algae EC_{50} = 0.01 mg L^{-1} Zn^{2+}, wedge shell survival EC_{50} = 2.2 mg L^{-1} Zn^{2+}, wedge shell reburial, EC_{50} = 1.8 mg L^{-1} Zn^{2+}, blue mussel EC_{50} = 0.14 mg L^{-1} Zn^{2+} (also shown in Appendix B).

Based on chronic NOEC values derived from the zinc sulfate tests, the algae, blue mussels, wedge shell reburial, and wedge shell survival would rank within the 1st, 68th, 82nd and 86th percentiles respectively of the most sensitive test organisms used for derivation of the ANZG (2021) guideline values for zinc in marine waters.

The results from this suite of toxicity tests provide a moderate degree of confidence in assessing the toxic hazard of the sample. However, these sensitivity rankings are specific to zinc and care must be taken when extrapolating these results where other classes of contaminants (e.g., organics) may be present and for protection of all organisms present in a particular receiving water environment (e.g., Hawke's Bay).

4 Compliance Statement

Hawke's Bay Regional Council Resource Consent No. CD130214W condition 15 requires that there be no detectable toxicity at a 200-fold effluent dilution. If there is toxicity at a 200-fold dilution the following conditions must be examined: is there more than one test species with a TEC[6]<0.5% effluent in any given quarter, is there a consecutive incidence of TEC<0.25% effluent within any given species between quarters, are EC_{20} (chronic tests) and LC_{10} (acute tests) for all tests greater than 0.5% effluent?

The algae, wedge shell and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 71-fold from both the blue mussel and algae tests.

For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent so no further action is required (Appendix A).

After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

[6] TEC=threshold effect concentration

5 References

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

ANZG (2021) Toxicant default guideline values for aquatic ecosystem protection: Zinc in marine water. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. CC BY 4.0. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

Environment Canada (1990) *Guidance document for control of toxicity test precision using reference toxicants.* No. EPS 1/RM12. Conservation and Protection, Environment Canada: 90.

NIWA (2013) Standard Operating Procedure Number 58. *Macomona liliana* 96-h Acute Toxicity Test Procedure. Hamilton, New Zealand, *NIWA Client Report:* 35.

NIWA (1996) Standard Operating Procedure Number *14.1*: Marine algal microplate method. Hamilton, New Zealand. *NIWA Client Report*: 13.

NIWA (2008) Standard Operating Procedure 21.2: Marine blue mussel embryo (Mytilus galloprovincialis). Short-term Chronic Toxicity Test Protocol. Hamilton, New Zealand, *NIWA Client Report*: 41.

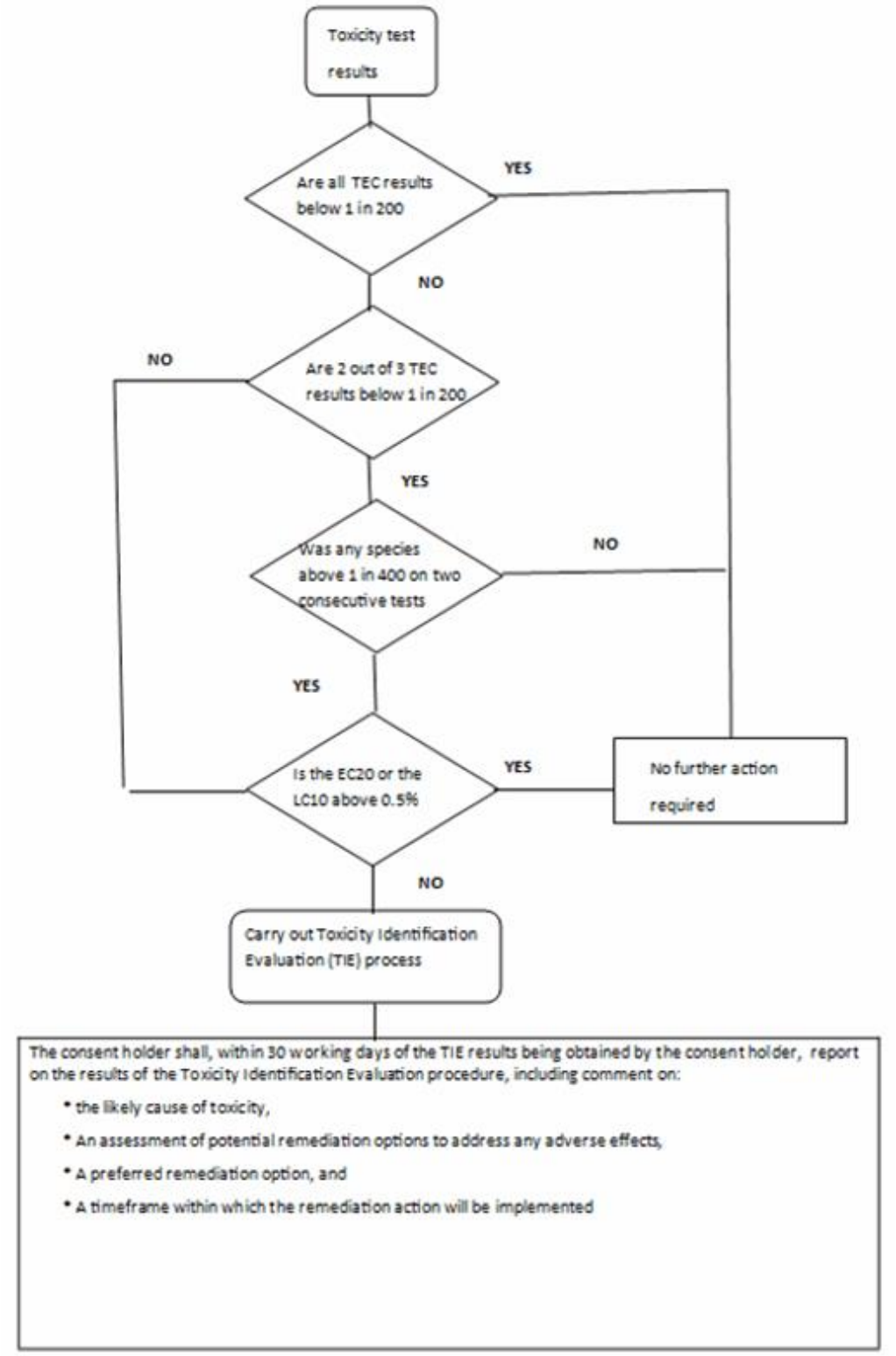
Roper, D.S., Hickey, C.W. (1994) Behavioural responses of the marine bivalve *Macomona liliana* exposed to copper- and chlordane-dosed sediments. *Marine Biology*, 118: 673–680.

Tidepool (2000-2020) CETIS™ Comprehensive Environmental Toxicity Information System. *CETIS Users Guide v.1.9.7.7* Tidepool Scientific Software, McKinleyville, CA, USA: 241

USEPA (1987) *Methods for toxicity tests of single substances and liquid complex wastes with marine unicellular algae. EPA-600-8/87/043*. US Environmental Protection Agency, Cincinnati, Ohio.

Williams, E.K., Hall, J.A. (1999) Seasonal and geographic variability in toxicant sensitivity of *Mytilus galloprovincialis* larvae. *Australasian Journal of Ecotoxicology*, 5(1): 1–10.

Appendix A Flow chart describing HBRC consent CD130214W condition 15[a]



[a]Supplied to NIWA 25 Jun 2014

Appendix B Test Conditions

Test conditions and dilutions for sample 2682/TP2

Project Name:	Hastings DC Effluent Bioassays: 2021–2022	**Project Number**	HDC22202
Test Material:	Hastings District Council 17-18/01/2022	**Reference Toxicant:**	Zinc sulphate
Dilution Water:	0.2 µm filtered offshore seawater from Pacific Ocean		

	Algae	**Bivalve–wedge shell**	**Bivalve–blue mussel embryos**
Test Initiation:	19/1/2022	20/1/2022	19/1/2022
Reference Method:	US EPA (1987) modified with Environment Canada (1992)	Adapted from Roper & Hickey (1994)	Williams & Hall (1999b)
Test Protocol:	NIWA SOP 14.1 NIWA (1996)	NIWA SOP 58.0 NIWA (2013)	NIWA SOP 21.2 (2008)
Test Organisms:	*Minutocellus polymorphus*	*Macomona liliana*	*Mytilus galloprovincialis*
Source:	Lab culture (500), imported from Bigelow Laboratories, USA	Manukau Harbour, Wiroa Island control site	Coromandel Harbour
Organisms/Container:	10,000 cells mL^{-1}	10	600 fertilised embryos
Test Concentrations	Control, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0%	Control, 0.25, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%
Test Duration:	48 hours	96 hours	48 hours
Replicates:	10 for controls, 5 for treatments	5 for controls, 3 for treatments	10 for controls, 5 for treatments
Sample pre-treatment:	0.45 µm filtration	Brine added to adjust salinity	Brine added to adjust salinity
Salinity:	26‰	34 ± 2‰	34 ± 2‰
Brine:	Nil	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection
Test Chambers:	96 well sterile microplates	55 ml polystyrene beakers	16x100 mm glass tubes
Lighting:	Continuous overhead lighting	Complete darkness	16:8 light dark
Temperature:	25 ± 1°C	20 ± 1°C	20 ± 1°C
Aeration:	Nil	Nil	Nil
Chemical Data:	Initial salinity	Initial and final salinity, final pH, temperature, dissolved oxygen	Initial and final salinity, temperature, dissolved oxygen, pH
Effect Measured:	Growth inhibition	Survival and morbidity (survival, reburial)	Abnormal embryo development
Zn sensitivity current test; long term mean (EC_{50}±2sd):	0.01; 0.008 (0.001–0.02) mg Zn L^{-1} (n=20)	Survival 2.2; Reburial 1.8; 3.6 (1.2–6.0) mg L^{-1} Zn^{2+} (n=20) (survival); 1.8 (0.7–2.9) mg L^{-1} Zn^{2+} (n=20) (reburial)	0.14; 0.17 (0.13–0.2) mg Zn L^{-1} (n=20)
Test Acceptability:	Control coefficient of variation within 20%; at least 16x cell growth increase in controls.	At least 90% survival in control and less than 10% morbidity in control reburial	80% of control embryos normally developed
Method Detection Limit (MDL):	12.4% reduction relative to controls	4.1% reduction relative to controls	5.1% reduction relative to controls
Percent Minimum Significant Difference (PMSD):	5.5%	Survival 10.6% Reburial 12.6%	7.0%
Test Acceptability Compliance:	**Achieved**	**Achieved**	**Achieved**

Appendix C Statistics

Algae

CETIS Analytical Report

Report Date: 03 Mar-22 11:10 (p 1 of 2)
Test Code/ID: 2682/TP2 MP7 / 11-1914-0774

Phytoplankton Growth Inhibition Test — **NIWA Ecotoxicology**

Analysis ID:	03-7483-6503	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	03 Mar-22 11:09	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	F553D4F32C4085931A4814FF38C4726A	**Editor ID:**	
Batch ID:	14-4596-0326	**Test Type:**	Cell Growth	**Analyst:**	A Albert
Start Date:	19 Jan-22	**Protocol:**	NIWA (1996)	**Diluent:**	Offshore seawater
Ending Date:	21 Jan-22	**Species:**	Minutocellus polymorphus	**Brine:**	Not Applicable
Test Length:	48h	**Taxon:**		**Source:**	CCMP Bigelow Laboratory f **Age:**
Sample ID:	11-8859-7159	**Code:**	2682/TP2 MP7	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	18 Jan-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	19 Jan-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Untransformed	C > T	1	2	1.414	100	75440	6.27%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.0625	23	---	0	22	Exact	0.1826	Non-Significant Effect
		0.125	36	---	0	23	Exact	0.2532	Non-Significant Effect
		0.25	88	---	0	23	Exact	1.0000	Non-Significant Effect
		0.5	82	---	0	23	Exact	1.0000	Non-Significant Effect
		1	54	---	0	23	Exact	1.0000	Non-Significant Effect
		2*	15	---	0	23	Exact	0.0002	Significant Effect
		4*	15	---	0	23	Exact	0.0002	Significant Effect
		8*	15	---	0	23	Exact	0.0002	Significant Effect
		16*	15	---	0	23	Exact	0.0002	Significant Effect
		32*	15	---	0	23	Exact	0.0002	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.284E+13	1.284E+12	10	400	<1.0E-05	Significant Effect
Error	1.861E+11	3.209E+09	58			
Total	1.302E+13		68			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	42.79	23.21	<1.0E-05	Unequal Variances
	Levene Equality of Variance Test	3.263	2.643	0.0021	Unequal Variances
	Mod Levene Equality of Variance Test	2.573	2.706	0.0138	Equal Variances
Distribution	Anderson-Darling A2 Test	0.606	3.878	0.1164	Normal Distribution
	D'Agostino Kurtosis Test	2.37	2.576	0.0178	Normal Distribution
	D'Agostino Skewness Test	1.475	2.576	0.1402	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	7.795	9.21	0.0203	Normal Distribution
	Kolmogorov-Smirnov D Test	0.09501	0.1243	0.1209	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9665	0.952	0.0610	Normal Distribution

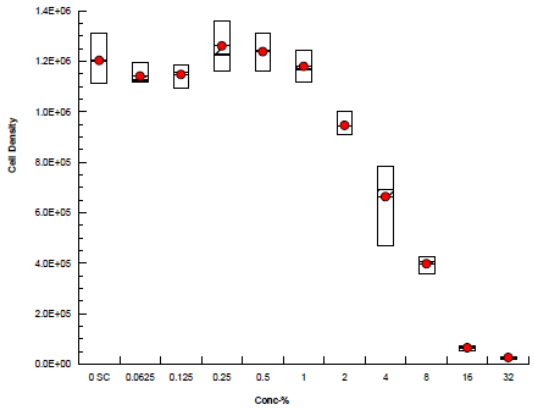
Cell Density Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	20	1.203E+6	1.177E+6	1.230E+6	1.202E+6	1.110E+6	1.310E+6	1.262E+4	4.69%	0.00%
0.0625		4	1.141E+6	1.080E+6	1.201E+6	1.125E+6	1.116E+6	1.197E+6	1.899E+4	3.33%	5.18%
0.125		5	1.147E+6	1.102E+6	1.193E+6	1.158E+6	1.095E+6	1.185E+6	1.645E+4	3.21%	4.64%
0.25		5	1.261E+6	1.158E+6	1.363E+6	1.227E+6	1.160E+6	1.358E+6	3.703E+4	6.57%	-4.77%
0.5		5	1.238E+6	1.170E+6	1.306E+6	1.245E+6	1.163E+6	1.312E+6	2.446E+4	4.42%	-2.88%
1		5	1.179E+6	1.111E+6	1.248E+6	1.168E+6	1.116E+6	1.245E+6	2.462E+4	4.67%	1.97%
2		5	9.456E+5	9.009E+5	9.903E+5	9.438E+5	9.110E+5	1.001E+6	1.610E+4	3.81%	21.41%
4		5	6.631E+5	5.158E+5	8.105E+5	6.924E+5	4.703E+5	7.820E+5	5.307E+4	17.89%	44.89%
8		5	3.975E+5	3.657E+5	4.293E+5	4.066E+5	3.585E+5	4.243E+5	1.146E+4	6.45%	66.96%
16		5	6.433E+4	5.639E+4	7.228E+4	6.594E+4	5.472E+4	7.158E+4	2.862E+3	9.95%	94.65%
32		5	2.549E+4	2.074E+4	3.025E+4	2.588E+4	2.004E+4	2.990E+4	1.713E+3	15.02%	97.88%

Cell Density Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	1.224E+6	1.216E+6	1.152E+6	1.260E+6	1.175E+6	1.208E+6	1.246E+6	1.302E+6	1.268E+6	1.197E+6
		1.246E+6	1.167E+6	1.207E+6	1.110E+6	1.174E+6	1.137E+6	1.310E+6	1.133E+6	1.139E+6	1.194E+6
0.0625		1.128E+6	1.116E+6	1.197E+6	1.122E+6						
0.125		1.158E+6	1.174E+6	1.185E+6	1.126E+6	1.095E+6					
0.25		1.358E+6	1.333E+6	1.227E+6	1.225E+6	1.160E+6					
0.5		1.312E+6	1.253E+6	1.215E+6	1.163E+6	1.245E+6					
1		1.245E+6	1.142E+6	1.226E+6	1.168E+6	1.116E+6					
2		1.001E+6	9.438E+5	9.110E+5	9.564E+5	9.165E+5					
4		6.458E+5	6.924E+5	4.703E+5	7.820E+5	7.251E+5					
8		4.066E+5	4.113E+5	4.243E+5	3.867E+5	3.585E+5					
16		6.594E+4	6.754E+4	7.158E+4	5.472E+4	6.188E+4					
32		2.990E+4	2.588E+4	2.796E+4	2.004E+4	2.368E+4					

Graphics



Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	749027	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC10	1.365	1.137	1.493	73.28	66.97	87.94
IC15	1.625	1.437	1.783	61.55	56.1	69.61
IC20	1.913	1.703	2.148	52.27	46.55	58.73
IC25	2.244	2.01	2.587	44.56	38.65	49.74
IC40	3.496	2.888	4.615	28.61	21.67	34.62
IC50	4.729	3.375	5.748	21.14	17.4	29.63

Wedge shell survival

CETIS Analytical Report

Report Date: 03 Mar-22 11:00 (p 4 of 6)
Test Code/ID: 2682/TP2 MAC / 12-0323-3853

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	11-1137-0844	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	03 Mar-22 11:00	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:	03 Mar-22 10:50	**MD5 Hash:**	1A7BEA160EE06A688D76A042134235EE	**Editor ID:**	001-024-732-2
Batch ID:	20-8549-8827	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	20 Jan-22	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	24 Jan-22	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	16-9815-9756	**Code:**	2682/TP2 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	18 Jan-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	19 Jan-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	20	>20	---	5	0.04232	4.23%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	21	---	1	11	Exact	1.0000	Non-Significant Effect
		0.5	21	---	1	11	Exact	1.0000	Non-Significant Effect
		1	21	---	1	11	Exact	1.0000	Non-Significant Effect
		2	16	---	1	11	Exact	1.0000	Non-Significant Effect
		5	21	---	1	11	Exact	1.0000	Non-Significant Effect
		10	21	---	1	11	Exact	1.0000	Non-Significant Effect
		20	21	---	1	11	Exact	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0079964	0.0011423	7	1.484	0.2221	Non-Significant Effect
Error	0.0177062	0.0007698	23			
Total	0.0257026		30			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test				Indeterminate
	Levene Equality of Variance Test	23.74	3.539	<1.0E-05	Unequal Variances
	Mod Levene Equality of Variance Test	2.095	4.026	0.1045	Equal Variances
Distribution	Anderson-Darling A2 Test	9.741	3.878	<1.0E-05	Non-Normal Distribution
	D'Agostino Kurtosis Test	4.584	2.576	<1.0E-05	Non-Normal Distribution
	D'Agostino Skewness Test	4.311	2.576	1.6E-05	Non-Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	39.59	9.21	<1.0E-05	Non-Normal Distribution
	Kolmogorov-Smirnov D Test	0.4677	0.1825	<1.0E-05	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.3927	0.9056	<1.0E-05	Non-Normal Distribution

Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
0.25		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
0.5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
1		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
2		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	3.33%
5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
10		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
20		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%

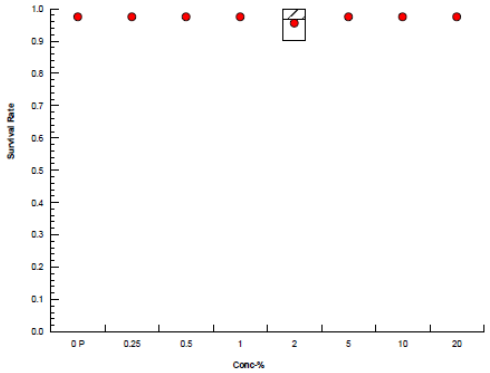
Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.25		1.0000	1.0000	1.0000							
0.5		1.0000	1.0000	1.0000							
1		1.0000	1.0000	1.0000							
2		1.0000	0.9000	1.0000							
5		1.0000	1.0000	1.0000							
10		1.0000	1.0000	1.0000							
20		1.0000	1.0000	1.0000							

Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
0.25		10/10	10/10	10/10							
0.5		10/10	10/10	10/10							
1		10/10	10/10	10/10							
2		10/10	9/10	10/10							
5		10/10	10/10	10/10							
10		10/10	10/10	10/10							
20		10/10	10/10	10/10							

Graphics



Wedge shell reburial

CETIS Analytical Report

Report Date: 03 Mar-22 11:00 (p 1 of 6)
Test Code/ID: 2682/TP2 MAC / 12-0323-3853

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	09-4444-9876	**Endpoint:**	Eff. Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	03 Mar-22 11:00	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:	03 Mar-22 10:50	**MD5 Hash:**	0C51E5DE42567DC3CDCD94913508E583	**Editor ID:**	001-024-732-2
Batch ID:	20-8549-8827	**Test Type:**	Survival-Reburial	**Analyst:**	A Albert
Start Date:	20 Jan-22	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	24 Jan-22	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	16-9815-9756	**Code:**	2682/TP2 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	18 Jan-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	19 Jan-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	20	>20	---	5	0.07755	7.75%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Pooled Controls		0.25	16	---	1	11	Exact	1.0000	Non-Significant Effect
		0.5	21	---	1	11	Exact	1.0000	Non-Significant Effect
		1	21	---	1	11	Exact	1.0000	Non-Significant Effect
		2	16	---	1	11	Exact	1.0000	Non-Significant Effect
		5	16	---	1	11	Exact	1.0000	Non-Significant Effect
		10	16	---	1	11	Exact	1.0000	Non-Significant Effect
		20	21	---	1	11	Exact	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0372154	0.0053165	7	1.063	0.4177	Non-Significant Effect
Error	0.115081	0.0050035	23			
Total	0.152297		30			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test				Indeterminate
	Levene Equality of Variance Test	17	3.539	<1.0E-05	Unequal Variances
	Mod Levene Equality of Variance Test	1.59	4.026	0.2087	Equal Variances
Distribution	Anderson-Darling A2 Test	3.63	3.878	<1.0E-05	Non-Normal Distribution
	D'Agostino Kurtosis Test	2.533	2.576	0.0113	Normal Distribution
	D'Agostino Skewness Test	2.952	2.576	0.0032	Non-Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	15.13	9.21	0.0005	Non-Normal Distribution
	Kolmogorov-Smirnov D Test	0.371	0.1825	<1.0E-05	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.7733	0.9056	1.7E-05	Non-Normal Distribution

Eff. Survival Rate Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Pooled	10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
0.25		3	0.9333	0.6465	1.0000	1.0000	0.8000	1.0000	0.0667	12.37%	6.67%
0.5		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
1		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%
2		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	3.33%
5		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	3.33%
10		3	0.9667	0.8232	1.0000	1.0000	0.9000	1.0000	0.0333	5.97%	3.33%
20		3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.00%	0.00%

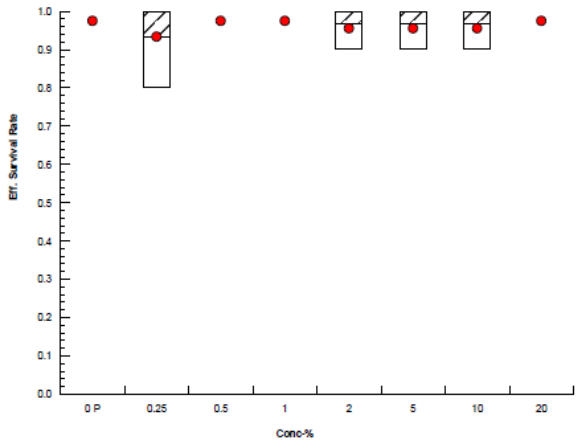
Eff. Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.25		0.8000	1.0000	1.0000							
0.5		1.0000	1.0000	1.0000							
1		1.0000	1.0000	1.0000							
2		1.0000	0.9000	1.0000							
5		0.9000	1.0000	1.0000							
10		0.9000	1.0000	1.0000							
20		1.0000	1.0000	1.0000							

Eff. Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Pooled	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
0.25		8/10	10/10	10/10							
0.5		10/10	10/10	10/10							
1		10/10	10/10	10/10							
2		10/10	9/10	10/10							
5		9/10	10/10	10/10							
10		9/10	10/10	10/10							
20		10/10	10/10	10/10							

Graphics



Blue mussel

CETIS Analytical Report

Report Date: 03 Mar-22 10:45 (p 1 of 2)
Test Code/ID: 2682/TP2 MyG / 13-9022-3846

Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

Analysis ID:	03-9112-3422	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	03 Mar-22 10:44	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	5ED78464E06E007A9991FF13B9404FA5	**Editor ID:**	
Batch ID:	04-8805-3684	**Test Type:**	Development	**Analyst:**	M Mohsin
Start Date:	19 Jan-22	**Protocol:**	NIWA (2008)	**Diluent:**	Seawater
Ending Date:	21 Jan-22	**Species:**	Mytilus galloprovincialis	**Brine:**	Frozen Coastal Seawater
Test Length:	48h	**Taxon:**		**Source:**	Coromandel **Age:**
Sample ID:	05-1322-7725	**Code:**	2682/TP2 MyG	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	18 Jan-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	19 Jan-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	0.5	1	0.7071	200	0.04237	4.51%
	Adjusted for the method detection limit	**1.0**	**2.0**	**1.414**			

Bonferroni Adj t Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.25	0.001565	2.473	0.069	13	CDF	1.0000	Non-Significant Effect
		0.5	0.6744	2.473	0.069	13	CDF	1.0000	Non-Significant Effect
		1*	3.035	2.473	0.069	13	CDF	0.0132	Significant Effect
		2*	12	2.473	0.069	13	CDF	<1.0E-05	Significant Effect
		4*	34.35	2.473	0.082	11	CDF	<1.0E-05	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	3.56381	0.712762	5	278.4	<1.0E-05	Significant Effect
Error	0.0691191	0.00256	27			
Total	3.63293		32			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	5.473	15.09	0.3609	Equal Variances
	Levene Equality of Variance Test	1.045	3.785	0.4118	Equal Variances
	Mod Levene Equality of Variance Test	0.7207	3.988	0.6149	Equal Variances
Distribution	Anderson-Darling A2 Test	0.8933	3.878	0.0225	Normal Distribution
	D'Agostino Kurtosis Test	0.3641	2.576	0.7158	Normal Distribution
	D'Agostino Skewness Test	1.97	2.576	0.0488	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	4.015	9.21	0.1343	Normal Distribution
	Kolmogorov-Smirnov D Test	0.1383	0.1772	0.1084	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9266	0.9104	0.0280	Normal Distribution

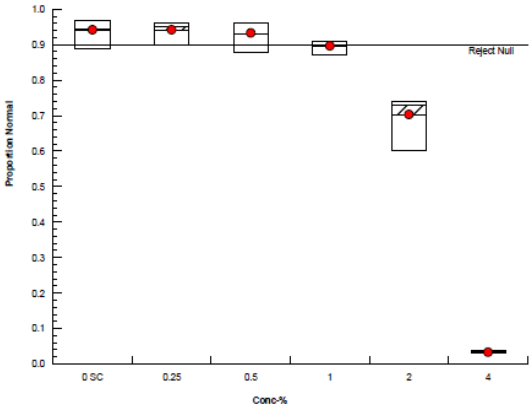
Proportion Normal Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	0.9399	0.9222	0.9576	0.9450	0.8889	0.9700	0.0078	2.63%	0.00%
0.25		5	0.9400	0.9083	0.9717	0.9500	0.9000	0.9600	0.0114	2.71%	-0.01%
0.5		5	0.9300	0.8888	0.9712	0.9300	0.8800	0.9600	0.0148	3.57%	1.05%
1		5	0.8960	0.8752	0.9168	0.9000	0.8700	0.9100	0.0075	1.87%	4.67%
2		5	0.7020	0.6283	0.7757	0.7300	0.6000	0.7400	0.0265	8.45%	25.31%
4		3	0.0333	0.0190	0.0477	0.0300	0.0300	0.0400	0.0033	17.32%	96.45%

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	88/99	91/100	95/100	94/100	96/100	94/100	95/100	97/100	93/100	96/100
0.25		90/100	95/100	96/100	93/100	96/100					
0.5		93/100	96/100	96/100	88/100	92/100					
1		91/100	89/100	90/100	91/100	87/100					
2		74/100	60/100	74/100	70/100	73/100					
4		3/100	3/100	4/100							

Graphics



Linear Regression Options

Model Name	Link Function	Threshold Option	Thresh	PMSD	Optimize	Pooled	Het Corr	Weighted
Log-Normal (Probit)	η=inv Φ[π]	Control Threshold	0.070537	1.08%	Yes	No	No	Yes

Regression Summary

Iters	LL	AICc	BIC	Mu	Sigma	Cov	R2	F Stat	P-Value	Decision(α:5%)
9	-81.45	169.7	173.4	0.3844039	0.1217013	-0.098241	0.9909	3.126	0.0422	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	1.528	1.426	1.617	65.43	61.85	70.12
EC10	1.692	1.598	1.775	59.1	56.34	62.59
EC15	1.812	1.724	1.892	55.17	52.87	58.02
EC20	1.914	1.829	1.991	52.24	50.22	54.66
EC25	2.006	1.924	2.082	49.85	48.03	51.97
EC40	2.257	2.178	2.337	44.3	42.78	45.91
EC50	2.423	2.34	2.513	41.27	39.79	42.73

Appendix D Hill Laboratories results and bioassay physico-chemistry

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	NIWA Corporate	**Lab No:**	2832396	SPv1
Contact:	Anathea Albert	**Date Received:**	19-Jan-2022	
	C/- NIWA Corporate	**Date Reported:**	24-Jan-2022	
	PO Box 11115	**Quote No:**	51353	
	Hillcrest	**Order No:**	11309446	
	Hamilton 3251	**Client Reference:**		
		Submitted By:	Anathea Albert	

Sample Type: Aqueous

Sample Name:		TP2 19-Jan-2022				
Lab Number:		2832396.1				
Total Ammoniacal-N	g/m³	19.4	-	-	-	-
Total Sulphide	g/m³	1.55	-	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m³	1
Total Sulphide Trace	In-line distillation, segmented flow colorimetry. APHA 4500-S^{2-} E (modified) 23rd ed. 2017.	0.002 g/m³	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 20-Jan-2022 and 24-Jan-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Table D-1: Water quality measures from the blue mussel test. Shaded values are outside test range and may affect the results at that concentration.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
19/01/2022	0h	Control	0	20	8.1	7.3	99	35
		TP2	0.25	21	8.1	7.3	101	35
			16	21	7.8	7.0	97	35
21/01/2022	48h	Control	0	21	8.2	7.4	102	35
		TP2	0.25	21	8.1	7.2	99	35
			0.5	21	8.1	7.2	99	35
			1	21	8.1	7.2	99	35
			2	20	8.1	7.2	98	35
			4	20	8.1	6.5	88	35
			8	20	8.0	5.1	69	35
			16	20	7.9	2.1	28	36

Table D-2: Water quality measures from the wedge shell test.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
20/01/2022	0 hour	Control	0	20	8.1	7.6	103	34
		TP2	0.25	20	8.2	7.5	102	35
			20	20	8.1	7.3	99	35
24/01/2022	96 hour	Control	0	22	8.3	7.6	105	37
		TP2	0.25	22	8.3	7.4	102	36
			0.5	22	8.3	7.5	103	35
			1	22	8.3	7.6	105	35
			2	22	8.3	7.6	105	35
			5	22	8.3	7.4	102	35
			10	22	8.3	7.4	102	35
			20	22	8.3	7.1	98	36

Quarterly Whole Effluent Toxicity testing for East Clive Wastewater Treatment Plant

Prepared for Hastings District Council

June 2022

Climate, Freshwater & Ocean Science

27 June 2022 2.54 pm

Prepared by:
Anathea Albert

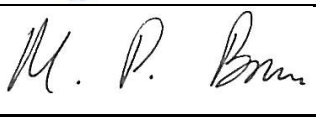
For any information regarding this report please contact:

Anathea Albert
Ecotoxicology Lab Services Manager
Ecotoxicology
+64 7 856 1723

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

NIWA CLIENT REPORT No: 2022166HN
Report date: June 2022
NIWA Project: HDC22202

Quality Assurance Statement		
	Reviewed by:	Jennifer Gadd
	Formatting checked by:	Carole Evans
	Approved for release by:	Michael Bruce

Contents

Tables

Executive summary

NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of a treated effluent sample from East Clive Wastewater Treatment Plant to determine resource consent compliance. The sample, collected 1-2 May 2022, was tested with three marine organisms: a marine alga (*Minutocellus polymorphus* – 48-hour chronic growth test), and two bivalve species - wedge shell (*Macomona liliana* – 96-hour acute survival and burial test) and blue mussel (*Mytilus galloprovincialis* – 48-hour chronic embryo development test). The sample was also analysed for ammoniacal nitrogen (ammoniacal-N) and total sulfide.

This report documents the results of the toxicity testing. The algae, wedge shell, and blue mussel tests met their respective test acceptability criteria based on control performance.

The algae, wedge shell, and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 141-fold from both the blue mussel test. After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent so no further action is required.

1 Introduction

East Clive Wastewater Treatment Plant treats both industrial and domestic wastewater and the treated effluent is discharged through an ocean outfall into Hawke Bay. NIWA was engaged by Hastings District Council (HDC) to undertake quarterly Whole Effluent Toxicity (WET) testing of effluent from the East Clive Wastewater Treatment Plant for compliance with Hawke Bay Regional Council (HBRC) resource consent CD130214W condition 15. The effluent sample was tested with three organisms, a marine alga (*Minutocellus polymorphus* 48-hour chronic growth test), and 2 bivalve species: wedge shell (*Macomona liliana* 96-hour acute survival and burial test) and blue mussel (*Mytilus galloprovincialis* 48-hour chronic embryo development test).

Condition 15 states that there shall be no statistically detectable difference in toxicity between a water sample taken from uncontaminated near-shore water (from a location to be approved by Hawke's Bay Regional Council[1]), and treated wastewater when diluted 200-times with that water. No toxicity is defined as a no-toxicity dilution less than 200-fold. If the no-toxicity dilution is greater than 200-fold, the following three conditions must be examined:[2]

1. No more than one test species with a TEC[3] < 0.5% effluent in any given quarter.
2. No more than one consecutive incidence of TEC < 0.25% effluent within any given species between quarters.
3. EC_{20}[4] (chronic tests) and LC_{10} (acute tests) for all tests shall be greater than 0.5% effluent.

[1] Dilution water is 0.2 µm filtered offshore seawater collected by NIWA.
[2] These conditions interpret the flow chart in Appendix A describing the HBRC consent supplied to NIWA 25 Jun 2014.
[3] TEC=threshold effect concentration
[4] EC_x = dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an X% effect on the test organisms.

2 Methods

2.1 Samples

A 2 L, single-use, food-grade high density polyethylene (HDPE) container was supplied by NIWA to HDC for collection of the 24 h composite effluent sample. The sample was collected by HDC staff on 1-2 May 2022 and a subsample was collected for total sulfide at the same time in a bottle supplied by Hill Laboratories. On arrival at NIWA Hamilton on 3 May 2022 the effluent sample was assigned a unique sample code (2682/TP3) and the physicochemical parameters measured. The effluent was subsampled for ammoniacal nitrogen (ammoniacal-N) and remaining sample was stored in the dark at 4°C until toxicity testing commenced. The samples for ammoniacal-N and total sulfide were sent to Hill Laboratories for analysis.

2.2 Toxicity testing methods

Tests were completed according to NIWA Standard Operating Procedures (SOP):

- NIWA SOP 14.1–Marine algae chronic toxicity for *Minutocellus polymorphus.*
- NIWA SOP 58.0–Marine bivalve acute toxicity for *Macomona liliana.*
- NIWA SOP 21.2–Marine bivalve chronic toxicity for *Mytilus galloprovincialis.*

A summary of test conditions and test acceptability information specified in each of the SOP manuals is provided in Appendix B.

2.3 Sample dilutions

Each test included a range of sample dilutions. The diluent for the algae, wedge shell, and blue mussel tests was NIWA's offshore seawater. The sample was adjusted to the required test salinities, as specified by the standard operating procedures. For the wedge shell and blue mussel test, the effluent sample was adjusted to the test salinity of 34 ppt using brine (made from frozen 0.2 µm filtered offshore seawater water) and tested at a maximum concentration of 20% effluent and 16% effluent respectively. For the algal test, the sample was adjusted to the required test salinity of 26 ppt using NIWA's offshore seawater for a maximum concentration of 32% effluent.

2.4 Reference toxicant

A reference toxicant test using zinc was undertaken concurrently using standard test procedures to measure the sensitivity and condition of the organisms in the current test. This is part of the quality control procedures and allows comparability between laboratory test results undertaken at different times by comparing results to the known sensitivity of the test organism to zinc (NIWA, unpublished long-term database). The zinc stock concentration was validated by chemical analysis (Hill Laboratories).

2.5 Test acceptability criteria

Each test has criteria that must be met for the test to be considered acceptable (Appendix B). For the alga test the increase in cell density in the control water must be greater than 16-fold and the coefficient of variation in the control replicates must be less than 20%. For the wedge shell test there must be at least 90% survival in control and less than 10% morbidity in reburial control. For the blue mussel test the control embryos must have at least 80% mean normal development.

2.6 Method detection limit

The method detection limit is a measure of the natural variability associated with each test calculated from the NIWA long-term database of test results. If the percent effect is smaller than the method detection limit, then the effect may be due to natural variability in the test response—in this event, for compliance purposes, the NOEC and LOEC would be corrected to the concentrations at which the percent effect is greater than the method detection limit. The current method detection limits were calculated February 2021.

2.7 Statistics

Statistical analyses were completed using CETIS v1.9.7.7 (Comprehensive Environmental Toxicity Information System) by Tidepool Scientific.

3 Results

Results are summarized in this section (Tables 3-1 and 3-2). Raw data and detailed results from the statistical analyses are provided for all tests in Appendix C and chemistry results are provided in Appendix D.

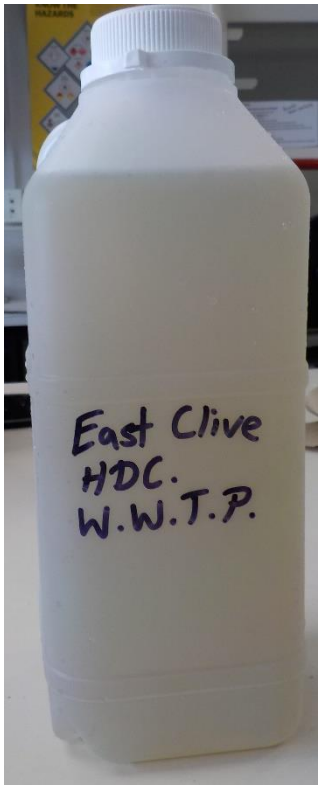


Figure 3-1: East Clive sample on arrival 3/5/2022.

3.1 Sample

On arrival the sample was well packed and the temperature was measured as 1.2°C. Although the sampling protocol was to completely fill the bottle, there was an airspace in the sample container, visible in Figure 3-1, either it was not filled completely or may have leaked in transit. If volatiles are present in the sample they can escape into an airspace.

Table 3-1: Measurements of municipal wastewater 24-hour composite sample after arrival at NIWA (3 May 2022) and results from analyses at Hill Laboratories.

Sample ID	NIWA Lab ID	pH	Temp (°C)	Salinity (ppt)	Ammoniacal-N (mg L^{-1})	Total Sulfide (S^{2-}) (mg L^{-1})
HDC 1-2/5/2022	2682/TP3	7.8	20	0.5	14.7	0.4

Table 3-2: Summary of key toxicity metrics for the test organisms exposed to HDC effluent collected 1-2 May 2022. Full results are provided in Appendix C.

Organism	EC_{10} [a] %	EC_{20} [a] %	EC_{50} [a] %	NOEC [b] %	LOEC [b] %	TEC [b] %	No-Toxicity dilution [c]	Complies Y/N [d]
Algae	8.0	10.0	14.8 (13.1–16.7)	8	16.0	**11.3**	8.8 x	**Y**
Wedge shell reburial [e]	-	-	>20.0	20.0	>20.0	**>20**	<5 x	**Y**
Wedge shell survival	-	-	>20.0	20.0	>20.0	**>20**	<5 x	**Y**
Blue mussel	1.5	2.3	5.1 (4.8–5.5)	0.5 [f]	1.0 [f]	**0.7** [f]	141 x	**Y**

[a] EC_x= dilution required to have an effect on X% of the test organisms. The lower the EC_x the greater the toxicity, indicating that a higher dilution was required to cause an effect on X% of test organisms. Values in parentheses indicate the 95% confidence intervals, [b] NOEC=No observed effect concentration, LOEC=Lowest observed effect concentration, TEC=threshold effect concentration (Geometric mean of NOEC and LOEC), [c] No-toxicity dilution is calculated as (1/TEC*100), [d] Bold indicates value used for compliance, [e] 60-minute reburial results (morbidity), [f]Adjusted for the method detection limit.

3.2 Algae – cell growth inhibition

The chronic algal growth test achieved the test acceptability criteria with a 149-fold increase in mean control cell density after 48 hours and a coefficient of variation (CV) < 20% (CV = 12.5%). The lowest five concentrations were grown on a separate microplate from the highest five concentrations to avoid volatile effects on growth in control wells and the control values used in the statistical analyses are from the plate with the low concentrations.

There was a statistically significant, 55% decrease in algal cell density at a concentration of 16% effluent (Appendix C), resulting in a LOEC of 16% and a NOEC of 8%. The no-toxicity dilution of 9-fold is within the compliance threshold of maximum 200-fold dilution.

3.3 Bivalve – wedge shell survival and morbidity

The acute wedge shell test uses a sub-lethal endpoint (reburial, termed 'morbidity') to assess adverse effects on the test organisms because classification of juvenile bivalves into either live or recently dead is difficult to determine accurately. The reburial test is undertaken following 96 hours exposure to the effluent solutions and is a more sensitive and accurate endpoint than survival for this test species.

The wedge shell test achieved the test acceptability criterion with 100% survival and 98% reburial for the control treatments. Salinity, pH and dissolved oxygen (DO) were in the acceptable range for the test (Appendix D, Table D–2). There was no significant difference between mean survival and reburial in control (100%) and brine control (100%) replicates (data not shown).

There was no statistically significant decrease in survival or reburial at any effluent test concentration (maximum tested was 20% effluent), resulting in a no-toxicity dilution of <5-fold which is within the compliance threshold of maximum 200-fold dilution.

3.4 Bivalve - Blue Mussel embryo development

The chronic embryo development test achieved the test acceptability criterion of at least 80% normal embryo development in the controls (mean 93%). Salinity, pH and DO were in the acceptable range for the test (Appendix D, Table D-1). The brine solution did not affect normal embryo development at concentrations used in this test (data not shown).

There was a statistically significant 3.7% decrease in normal embryo development, at 0.5% effluent (

Table 3-2), (Appendix C). The 3.7% decrease in normal embryo development was not greater than the method detection limit of 5.1% so the LOEC was adjusted to the concentration at which the percent effect was greater than the method detection limit. For this sample the NOEC and LOEC were adjusted to 0.5% and 1.0% respectively (Table 3-2) resulting in a no-toxicity dilution of 141-fold which is within the compliance threshold of maximum 200-fold dilution. There was a statistically significant 6.2% decrease in normal embryo development at 1% effluent.

3.5 Total sulfide

ANZG (2018) default guideline value for un-ionised sulfide: 0.001 mg L^{-1} H_2S.

The subsample for total sulfide was preserved at the time of sample collection. The total sulfide in the effluent sample collected 1-2 May 2022 was 0.4 mg L^{-1} which is equivalent to 0.01 mg L^{-1} of un-ionised sulfide[5], the more toxic form of sulfide in an aquatic ecosystem. The total sulfide concentration of the May 2022 effluent sample is 3-fold lower than the long-term median value of 1.14 mg L^{-1} total sulfide for all HDC effluent samples analysed since 1992 (n=115).

After applying a 200-fold dilution, the resulting un-ionised sulfide concentration of 0.00008 mg L^{-1} was 13-fold lower than the ANZG (2018) default guideline value of 0.001 mg L^{-1} H_2S. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.6 Ammoniacal-N

ANZG (2018) default guideline value: 0.910 mg L^{-1} ammoniacal-N, pH 8.

The ammoniacal-N concentration in the effluent sample was 14.7 mg L^{-1}, which is similar to the long-term median value of 16.0 mg L^{-1} for all HDC effluent samples analysed since 1992 (n=114). Applying a 200-fold dilution to the effluent sample resulted in a concentration of 0.07 mg L^{-1} ammoniacal-N, which is 12-fold lower than the ANZG (2018) default guideline value of 0.91 mg L^{-1} (at pH 8) for protection of 95% of marine species. Full results from the analysis of the effluent sample by Hill Laboratories are provided in Appendix D.

3.7 Reference toxicant

The EC_{50} values for the reference toxicant tests using zinc were within the expected range (± 2 SD of long-term mean) for the algae, wedge shell and blue mussel tests. The results were as follows: algae EC_{50} = 0.01 mg L^{-1} Zn^{2+}, wedge shell survival EC_{50} = 2.8 mg L^{-1} Zn^{2+}, wedge shell reburial, EC_{50} = 1.0 mg L^{-1} Zn^{2+}, blue mussel EC_{50} = 0.17 mg L^{-1} Zn^{2+} (also shown in Appendix B).

Based on chronic NOEC values derived from the zinc sulfate tests, the algae, blue mussels, wedge shell reburial, and wedge shell survival would rank within the 1st, 68th, 68th and 87th percentiles respectively of the most sensitive test organisms used for derivation of the ANZG (2021) guideline values for zinc in marine waters.

The results from this suite of toxicity tests provide a moderate degree of confidence in assessing the toxic hazard of the sample.

[5] Calculated as 4.06% of total sulfide at pH 8.0, 20°C, 32.5 ppt (coastal waters) (ANZG 2018).

However, these sensitivity rankings are specific to zinc and care must be taken when extrapolating these results where other classes of contaminants (e.g., organics) may be present and for protection of all organisms present in a particular receiving water environment (e.g., Hawke's Bay).

4 Compliance Statement

Hawke's Bay Regional Council Resource Consent No. CD130214W condition 15 requires that there be no detectable toxicity at a 200-fold effluent dilution. If there is toxicity at a 200-fold dilution the following conditions must be examined: is there more than one test species with a TEC[6]<0.5% effluent in any given quarter, is there a consecutive incidence of TEC<0.25% effluent within any given species between quarters, and are EC_{20} (chronic tests) and LC_{10} (acute tests) for all tests greater than 0.5% effluent?

The algae, wedge shell and blue mussel tests did not show detectable toxicity at a 200-fold dilution. The highest no-toxicity dilution was 141-fold from the blue mussel test.

For the effluent sample in this quarter, no species had a TEC < 0.5% effluent, no species had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC_{10} (acute) or EC_{20} (chronic) greater than 0.5% effluent so no further action is required (Appendix A).

After application of the 200-fold dilution used for the 'no toxicity' criterion, the concentration of ammoniacal-N and total sulfide in the sample did not exceed ANZG (2018) default guideline values for 95% protection of species.

[6] TEC=threshold effect concentration

5 References

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

ANZG (2021) Toxicant default guideline values for aquatic ecosystem protection: Zinc in marine water. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. CC BY 4.0. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

Environment Canada (1990) *Guidance document for control of toxicity test precision using reference toxicants.* No. EPS 1/RM12. Conservation and Protection, Environment Canada: 90.

NIWA (2013) Standard Operating Procedure Number 58. *Macomona liliana* 96-h Acute Toxicity Test Procedure. Hamilton, New Zealand, *NIWA Client Report:* 35.

NIWA (1996) Standard Operating Procedure Number *14.1*: Marine algal microplate method. Hamilton, New Zealand. *NIWA Client Report*: 13.

NIWA (2008) Standard Operating Procedure 21.2: Marine blue mussel embryo (Mytilus galloprovincialis). Short-term Chronic Toxicity Test Protocol. Hamilton, New Zealand, *NIWA Client Report*: 41.

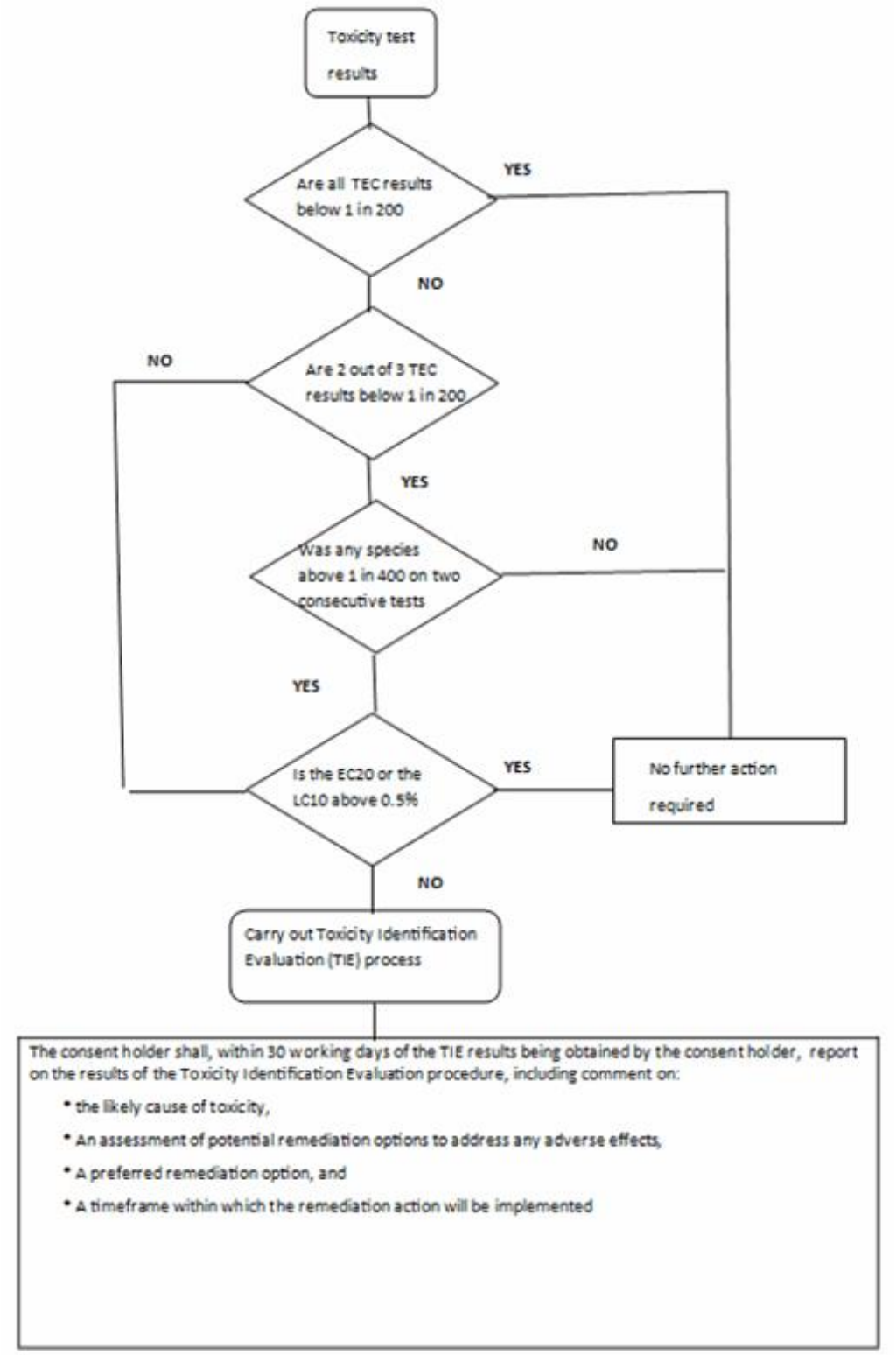
Roper, D.S., Hickey, C.W. (1994) Behavioural responses of the marine bivalve *Macomona liliana* exposed to copper- and chlordane-dosed sediments. *Marine Biology*, 118: 673–680.

Tidepool (2000-2020) CETIS™ Comprehensive Environmental Toxicity Information System. *CETIS Users Guide v.1.9.7.7* Tidepool Scientific Software, McKinleyville, CA, USA: 241

USEPA (1987) *Methods for toxicity tests of single substances and liquid complex wastes with marine unicellular algae. EPA-600-8/87/043*. US Environmental Protection Agency, Cincinnati, Ohio.

Williams, E.K., Hall, J.A. (1999) Seasonal and geographic variability in toxicant sensitivity of *Mytilus galloprovincialis* larvae. *Australasian Journal of Ecotoxicology*, 5(1): 1–10.

Appendix A Flow chart describing HBRC consent CD130214W condition 15[a]



[a]Supplied to NIWA 25 Jun 2014

Appendix B Test Conditions

Test conditions and dilutions for sample 2682/TP3

Project Name:	Hastings DC Effluent Bioassays: 2021–2022	**Project Number**	HDC22202
Test Material:	Hastings District Council 1-2/05/2022	**Reference Toxicant:**	Zinc sulphate
Dilution Water:	0.2 µm filtered offshore seawater from Pacific Ocean		

	Algae	**Bivalve–wedge shell**	**Bivalve–blue mussel embryos**
Reference Method:	US EPA (1987) modified with Environment Canada (1992)	Adapted from Roper & Hickey (1994)	Williams & Hall (1999b)
Test Protocol:	NIWA SOP 14.1 NIWA (1996)	NIWA SOP 58.0 NIWA (2013)	NIWA SOP 21.2 (2008)
Test Organisms:	*Minutocellus polymorphus*	*Macomona liliana*	*Mytilus galloprovincialis*
Source:	Lab culture (500), imported from Bigelow Laboratories, USA	Manukau Harbour, Wiroa Island control site	Coromandel Harbour
Organisms/Container:	10,000 cells mL^{-1}	10	600 fertilised embryos
Test Concentrations	Control, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0%	Control, 0.25, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0%	Control, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0%
Test Duration:	48 hours	96 hours	48 hours
Replicates:	10 for controls, 5 for treatments	5 for controls, 3 for treatments	10 for controls, 5 for treatments
Sample pre-treatment:	0.45 µm filtration	Brine added to adjust salinity	Brine added to adjust salinity
Salinity:	26‰	34 ± 2‰	34 ± 2‰
Brine:	Nil	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection	Filtered (0.2 µm) offshore seawater, frozen and thawed for brine collection
Test Chambers:	96 well sterile microplates	55 ml polystyrene beakers	16x100 mm glass tubes
Lighting:	Continuous overhead lighting	Complete darkness	16:8 light dark
Temperature:	25 ± 1°C	20 ± 1°C	20 ± 1°C
Aeration:	Nil	Nil	Nil
Chemical Data:	Initial salinity	Initial and final salinity, final pH, temperature, dissolved oxygen	Initial and final salinity, temperature, dissolved oxygen, pH
Effect Measured:	Growth inhibition	Survival and morbidity (survival, reburial)	Abnormal embryo development
Zn sensitivity current test; long term mean (EC_{50}±2sd):	0.01; 0.01 (0.001–0.03) mg Zn L^{-1} (n=20)	Survival 2.8; Reburial 1.0; 3.6 (1.3–5.8) mg L^{-1} Zn^{2+} (n=20) (survival); 1.8 (0.6–2.9) mg L^{-1} Zn^{2+} (n=20) (reburial)	0.17; 0.17 (0.14–0.2) mg Zn L^{-1} (n=20)
Test Acceptability:	Control coefficient of variation within 20%; at least 16x cell growth increase in controls.	At least 90% survival in control and less than 10% morbidity in control reburial	80% of control embryos normally developed
Method Detection Limit (MDL):	12.4% reduction relative to controls	4.1% reduction relative to controls	5.1% reduction relative to controls
Percent Minimum Significant Difference (PMSD):	12.7%	Survival not calculated Reburial not calculated	2.9%
Test Acceptability Compliance:	**Achieved**	**Achieved**	**Achieved**

Appendix C Statistics

Algae

CETIS Analytical Report

Report Date: 11 May-22 15:23 (p 1 of 3)
Test Code/ID: 2682/TP3 MP7 / 16-5165-0746

Phytoplankton Growth Inhibition Test — **NIWA Ecotoxicology**

Analysis ID:	12-9314-7174	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 15:22	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	033B9598E3F031388328F126400BAA71	**Editor ID:**	
Batch ID:	14-2278-6664	**Test Type:**	Cell Growth	**Analyst:**	A Albert
Start Date:	04 May-22	**Protocol:**	NIWA (1996)	**Diluent:**	Offshore seawater
Ending Date:	06 May-22	**Species:**	Minutocellus polymorphus	**Brine:**	Not Applicable
Test Length:	48h	**Taxon:**		**Source:**	CCMP Bigelow Laboratory f **Age:**
Sample ID:	07-5003-7608	**Code:**	2682/TP3 MP7	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Log10(X+1)	C > T	8	16	11.31	12.5	188900	12.70%

Wilcoxon/Bonferroni Adj Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.0625	30	---	0	13	Exact	1.0000	Non-Significant Effect
		0.125	40	---	0	13	Exact	1.0000	Non-Significant Effect
		0.25	27	---	0	13	Exact	0.6460	Non-Significant Effect
		0.5	45	---	0	13	Exact	1.0000	Non-Significant Effect
		1	45	---	0	13	Exact	1.0000	Non-Significant Effect
		2	65	---	0	13	Exact	1.0000	Non-Significant Effect
		4	57	---	0	13	Exact	1.0000	Non-Significant Effect
		8	26	---	0	13	Exact	0.4962	Non-Significant Effect
		16*	15	---	0	13	Exact	0.0033	Significant Effect
		32*	15	---	0	13	Exact	0.0033	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	7.29948	0.729948	10	500.4	<1.0E-05	Significant Effect
Error	0.0714805	0.0014588	49			
Total	7.37096		59			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	25.98	23.21	0.0038	Unequal Variances
	Levene Equality of Variance Test	3.427	2.706	0.0018	Unequal Variances
	Mod Levene Equality of Variance Test	2.606	2.814	0.0158	Equal Variances
Distribution	Anderson-Darling A2 Test	0.387	3.878	0.3932	Normal Distribution
	D'Agostino Kurtosis Test	0.717	2.576	0.4733	Normal Distribution
	D'Agostino Skewness Test	0.2749	2.576	0.7834	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.5897	9.21	0.7446	Normal Distribution
	Kolmogorov-Smirnov D Test	0.09651	0.1331	0.1690	Normal Distribution
	Shapiro-Wilk W Normality Test	0.984	0.9459	0.6175	Normal Distribution

001-024-732-2 CETIS™ v1.9.7.7 Analyst:_____ QA:_____

Phytoplankton Growth Inhibition Test **NIWA Ecotoxicology**

Analysis ID:	12-9314-7174	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 15:22	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	033B9598E3F031388328F126400BAA71	**Editor ID:**	

Cell Density Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	1.487E+6	1.354E+6	1.620E+6	1.477E+6	1.247E+6	1.812E+6	5.862E+4	12.47%	0.00%
0.0625		5	1.357E+6	1.325E+6	1.388E+6	1.362E+6	1.318E+6	1.379E+6	1.131E+4	1.86%	8.77%
0.125		5	1.464E+6	1.378E+6	1.549E+6	1.466E+6	1.373E+6	1.562E+6	3.077E+4	4.70%	1.57%
0.25		5	1.340E+6	1.289E+6	1.391E+6	1.329E+6	1.300E+6	1.383E+6	1.833E+4	3.06%	9.91%
0.5		5	1.493E+6	1.391E+6	1.594E+6	1.488E+6	1.413E+6	1.598E+6	3.652E+4	5.47%	-0.39%
1		5	1.523E+6	1.415E+6	1.630E+6	1.499E+6	1.445E+6	1.667E+6	3.865E+4	5.68%	-2.40%
2		5	1.944E+6	1.855E+6	2.033E+6	1.944E+6	1.839E+6	2.026E+6	3.212E+4	3.69%	-30.74%
4		5	1.713E+6	1.548E+6	1.877E+6	1.754E+6	1.564E+6	1.883E+6	5.921E+4	7.73%	-15.18%
8		5	1.319E+6	1.159E+6	1.478E+6	1.324E+6	1.184E+6	1.498E+6	5.748E+4	9.75%	11.31%
16		5	6.742E+5	5.761E+5	7.722E+5	6.965E+5	5.628E+5	7.500E+5	3.532E+4	11.72%	54.66%
32		5	8.816E+4	7.273E+4	1.036E+5	9.128E+4	7.402E+4	1.010E+5	5.560E+3	14.10%	94.07%

Log10(X+1) Transformed Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	6.169	6.132	6.207	6.169	6.096	6.258	0.01668	12.19%	0.00%
0.0625		5	6.132	6.122	6.143	6.134	6.12	6.139	0.003664	1.89%	8.16%
0.125		5	6.165	6.14	6.19	6.166	6.138	6.194	0.009113	4.69%	0.99%
0.25		5	6.127	6.11	6.143	6.124	6.114	6.141	0.005929	3.05%	9.33%
0.5		5	6.173	6.144	6.203	6.173	6.15	6.204	0.01059	5.46%	-0.95%
1		5	6.182	6.152	6.212	6.176	6.16	6.222	0.01077	5.55%	-2.97%
2		5	6.288	6.268	6.309	6.289	6.265	6.307	0.007218	3.72%	-31.55%
4		5	6.233	6.191	6.274	6.244	6.194	6.275	0.01505	7.76%	-15.68%
8		5	6.119	6.066	6.171	6.122	6.073	6.175	0.01878	9.69%	11.05%
16		5	5.826	5.761	5.891	5.843	5.75	5.875	0.02347	12.13%	54.62%
32		5	4.942	4.864	5.019	4.96	4.869	5.004	0.02793	14.46%	94.08%

Cell Density Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	1.340E+6	1.538E+6	1.485E+6	1.470E+6	1.247E+6	1.363E+6	1.812E+6	1.328E+6	1.771E+6	1.517E+6
0.0625		1.379E+6	1.348E+6	1.378E+6	1.318E+6	1.362E+6					
0.125		1.481E+6	1.437E+6	1.373E+6	1.466E+6	1.562E+6					
0.25		1.383E+6	1.300E+6	1.329E+6	1.304E+6	1.383E+6					
0.5		1.416E+6	1.549E+6	1.488E+6	1.413E+6	1.598E+6					
1		1.473E+6	1.445E+6	1.499E+6	1.529E+6	1.667E+6					
2		1.944E+6	1.839E+6	1.920E+6	2.026E+6	1.992E+6					
4		1.564E+6	1.883E+6	1.593E+6	1.754E+6	1.769E+6					
8		1.380E+6	1.498E+6	1.184E+6	1.208E+6	1.324E+6					
16		6.250E+5	5.628E+5	7.364E+5	6.965E+5	7.500E+5					
32		7.402E+4	9.832E+4	9.128E+4	7.625E+4	1.010E+5					

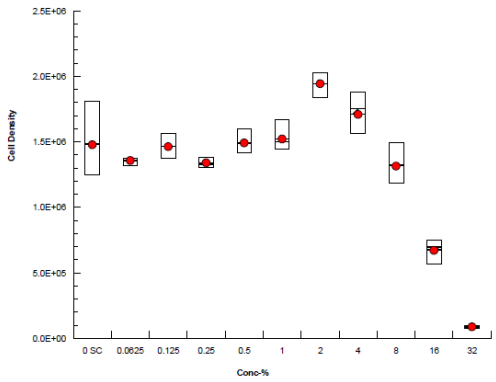
Phytoplankton Growth Inhibition Test **NIWA Ecotoxicology**

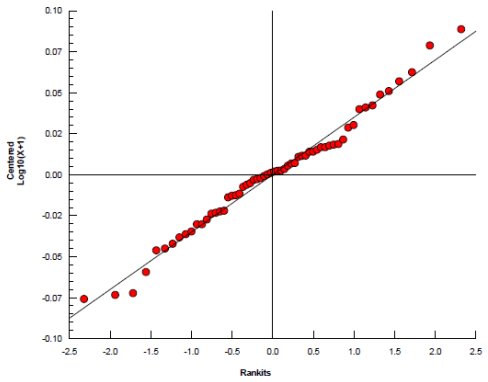
Analysis ID:	12-9314-7174	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 15:22	**Analysis:**	Nonparametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	033B9598E3F031388328F126400BAA71	**Editor ID:**	

Log10(X+1) Transformed Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	6.127	6.187	6.172	6.167	6.096	6.135	6.258	6.123	6.248	6.181
0.0625		6.139	6.13	6.139	6.12	6.134					
0.125		6.17	6.158	6.138	6.166	6.194					
0.25		6.141	6.114	6.124	6.115	6.141					
0.5		6.151	6.19	6.173	6.15	6.204					
1		6.168	6.16	6.176	6.185	6.222					
2		6.289	6.265	6.283	6.307	6.299					
4		6.194	6.275	6.202	6.244	6.248					
8		6.14	6.175	6.073	6.082	6.122					
16		5.796	5.75	5.867	5.843	5.875					
32		4.869	4.993	4.96	4.882	5.004					

Graphics





Phytoplankton Growth Inhibition Test NIWA Ecotoxicology

Analysis ID:	16-7940-6841	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 15:22	**Analysis:**	Nonlinear Regression (NLR)	**Status Level:**	1
Edit Date:		**MD5 Hash:**	033B9598E3F031388328F126400BAA71	**Editor ID:**	
Batch ID:	14-2278-6664	**Test Type:**	Cell Growth	**Analyst:**	A Albert
Start Date:	04 May-22	**Protocol:**	NIWA (1996)	**Diluent:**	Offshore seawater
Ending Date:	06 May-22	**Species:**	Minutocellus polymorphus	**Brine:**	Not Applicable
Test Length:	48h	**Taxon:**		**Source:**	CCMP Bigelow Laboratory f **Age:**
Sample ID:	07-5003-7608	**Code:**	2682/TP3 MP7	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Non-Linear Regression Options

Model Name and Function	Weighting Function	PTBS Function	X Trans	Y Trans
3P Log-Logistic: μ=α/[1+[x/δ]^γ]	Normal [ω=1]	Off [μ*=μ]	None	None

Regression Summary

Iters	LL	AICc	BIC	Adj R2	PMSD	Thresh	Optimize	F Stat	P-Value	Decision(α:5%)
13	-727.8	1462	1468	0.8468	3.73%	1531000	Yes	15.44	0.0000	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	6.444	---	8.316	15.52	12.02	---
IC10	7.958	3.541	9.896	12.57	10.11	28.24
IC15	9.07	5.993	11.03	11.03	9.065	16.69
IC20	10.01	7.437	11.96	9.992	8.361	13.45
IC25	10.86	8.602	12.78	9.212	7.828	11.62
IC40	13.2	11.46	15.01	7.574	6.663	8.722
IC50	14.81	13.14	16.68	6.754	5.995	7.609

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)
α	1531000	28480	1474000	1588000	53.74	<1.0E-05	Significant Parameter
γ	3.539	0.7628	2.012	5.067	4.64	2.1E-05	Significant Parameter
δ	14.81	0.8971	13.01	16.6	16.5	<1.0E-05	Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Model	1.169E+14	3.895E+13	3	1094	<1.0E-05	Significant Effect
Lack of Fit	1.453E+12	1.817E+11	8	15.44	<1.0E-05	Significant Lack-of-Fit
Pure Error	5.765E+11	1.176E+10	49			
Residual	2.03E+12	3.561E+10	57			

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Variance	Mod Levene Equality of Variance	1.948	2.084	0.0674	Equal Variances
Distribution	Anderson-Darling A2 Test	1.912	2.492	<1.0E-05	Non-Normal Distribution
	Shapiro-Wilk W Normality Test	0.9086	0.9605	0.0003	Non-Normal Distribution

Wedge shell survival

CETIS Analytical Report

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	15-9042-8729	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 14:45	**Analysis:**	STP 2xK Contingency Tables	**Status Level:**	1
Edit Date:		**MD5 Hash:**	5B52FB63AD45DE0CD1DA6A5F8D998D5	**Editor ID:**	
Batch ID:	00-6543-5055	**Test Type:**	Survival-Reburial	**Analyst:**	Ecotox Team
Start Date:	05 May-22	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	09 May-22	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	06-2877-7394	**Code:**	2682/TP3 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU
Untransformed	C > T	20	>20	---	5

Fisher Exact/Bonferroni-Holm Test

Control	vs	Conc-%	Test Stat	P-Type	P-Value	Decision(α:5%)
SW Control		0.25	0.1377	Exact	0.9636	Non-Significant Effect
		0.5	1.0000	Exact	1.0000	Non-Significant Effect
		1	1.0000	Exact	1.0000	Non-Significant Effect
		2	1.0000	Exact	1.0000	Non-Significant Effect
		5	1.0000	Exact	1.0000	Non-Significant Effect
		10	0.3750	Exact	1.0000	Non-Significant Effect
		20	1.0000	Exact	1.0000	Non-Significant Effect

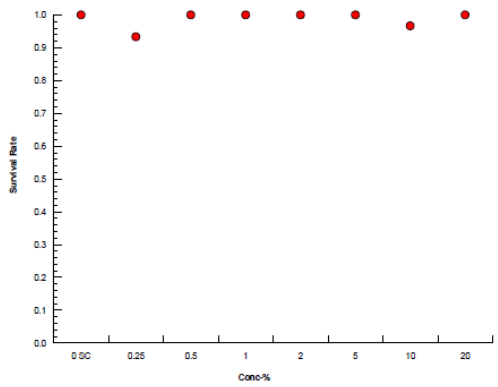
Survival Rate Frequencies

Conc-%	Code	NR	R	NR + R	Prop NR	Prop R	%Effect
0	SC	50	0	50	1.0000	0.0000	0.00%
0.25		28	2	30	0.9333	0.0667	6.67%
0.5		30	0	30	1.0000	0.0000	0.00%
1		30	0	30	1.0000	0.0000	0.00%
2		30	0	30	1.0000	0.0000	0.00%
5		30	0	30	1.0000	0.0000	0.00%
10		29	1	30	0.9667	0.0333	3.33%
20		30	0	30	1.0000	0.0000	0.00%

Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	SC	10/10	10/10	10/10	10/10	10/10
0.25		10/10	10/10	8/10		
0.5		10/10	10/10	10/10		
1		10/10	10/10	10/10		
2		10/10	10/10	10/10		
5		10/10	10/10	10/10		
10		9/10	10/10	10/10		
20		10/10	10/10	10/10		

Graphics



Wedge shell reburial

CETIS Analytical Report

Report Date: 11 May-22 14:47 (p 1 of 4)
Test Code/ID: 2682/TP3 MAC / 11-9923-5807

Macomona 96 h survival and reburial test — **NIWA Ecotoxicology**

Analysis ID:	18-8902-7176	**Endpoint:**	Eff. Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-22 14:45	**Analysis:**	STP 2xK Contingency Tables	**Status Level:**	1
Edit Date:		**MD5 Hash:**	29065A3217991EC2BA11FE25511FCF34	**Editor ID:**	
Batch ID:	00-6543-5055	**Test Type:**	Survival-Reburial	**Analyst:**	Ecotox Team
Start Date:	05 May-22	**Protocol:**	NIWA (1995)	**Diluent:**	Offshore seawater
Ending Date:	09 May-22	**Species:**	Macomona liliana	**Brine:**	Frozen Coastal Seawater
Test Length:	96h	**Taxon:**		**Source:**	Client Supplied **Age:**
Sample ID:	06-2877-7394	**Code:**	2682/TP3 MAC	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	48h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU
Untransformed	C > T	20	>20	---	5

Fisher Exact/Bonferroni-Holm Test

Control	vs	Conc-%	Test Stat	P-Type	P-Value	Decision(α:5%)
SW Control		0.25	0.0257	Exact	0.1541	Non-Significant Effect
		0.5	0.1457	Exact	0.5827	Non-Significant Effect
		1	0.1457	Exact	0.5827	Non-Significant Effect
		2	0.3141	Exact	0.3141	Non-Significant Effect
		5	0.0629	Exact	0.3146	Non-Significant Effect
		10*	0.0037	Exact	0.0260	Significant Effect
		20	0.1457	Exact	0.5827	Non-Significant Effect

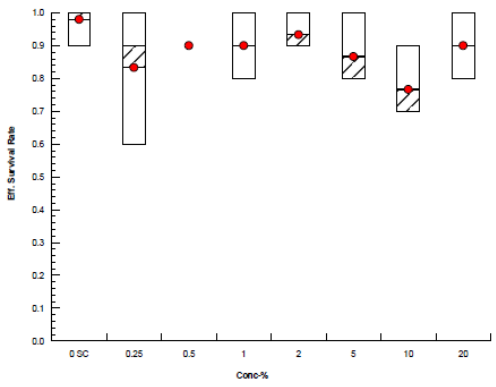
Eff. Survival Rate Frequencies

Conc-%	Code	NR	R	NR + R	Prop NR	Prop R	%Effect
0	SC	49	1	50	0.9800	0.0200	0.00%
0.25		25	5	30	0.8333	0.1667	14.97%
0.5		27	3	30	0.9000	0.1000	8.16%
1		27	3	30	0.9000	0.1000	8.16%
2		28	2	30	0.9333	0.0667	4.76%
5		26	4	30	0.8667	0.1333	11.56%
10		23	7	30	0.7667	0.2333	21.77%
20		27	3	30	0.9000	0.1000	8.16%

Eff. Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	SC	10/10	10/10	10/10	9/10	10/10
0.25		9/10	10/10	6/10		
0.5		9/10	9/10	9/10		
1		9/10	8/10	10/10		
2		10/10	9/10	9/10		
5		8/10	8/10	10/10		
10		7/10	9/10	7/10		
20		9/10	8/10	10/10		

Graphics



Blue mussel

CETIS Analytical Report

Report Date: 15 Jun-22 16:54 (p 1 of 3)
Test Code/ID: 2682/TP3 MyG / 13-3671-9997

Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

Analysis ID:	20-1150-2818	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	15 Jun-22 16:53	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	7B8F80BAFB4498845AB0ED660172A943	**Editor ID:**	
Batch ID:	00-7453-9482	**Test Type:**	Development	**Analyst:**	Ecotox Team
Start Date:	04 May-22	**Protocol:**	NIWA (2008)	**Diluent:**	Seawater
Ending Date:	06 May-22	**Species:**	Mytilus galloprovincialis	**Brine:**	Frozen Coastal Seawater
Test Length:	48h	**Taxon:**		**Source:**	Coromandel **Age:**
Sample ID:	15-3195-4620	**Code:**	2682/TP3 MyG	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	MSDu	PMSD
Angular (Corrected)	C > T	0.25	0.5	0.3536	400	0.02734	2.93%

Bonferroni Adj t Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
SW Control		0.25	0.5579	2.571	0.055	13	CDF	1.0000	Non-Significant Effect
		0.5*	3.092	2.571	0.055	13	CDF	0.0132	Significant Effect
		1*	4.834	2.571	0.055	13	CDF	8.2E-05	Significant Effect
		2*	8.834	2.571	0.055	13	CDF	<1.0E-05	Significant Effect
		4*	23.05	2.571	0.055	13	CDF	<1.0E-05	Significant Effect
		8*	34.29	2.571	0.055	13	CDF	<1.0E-05	Significant Effect
		16*	46.12	2.571	0.055	13	CDF	<1.0E-05	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.30793	0.758276	7	498.2	<1.0E-05	Significant Effect
Error	0.0563198	0.0015222	37			
Total	5.36425		44			

ANOVA Assumptions Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variance	Bartlett Equality of Variance Test	9.163	18.48	0.2412	Equal Variances
	Levene Equality of Variance Test	1.873	3.167	0.1023	Equal Variances
	Mod Levene Equality of Variance Test	0.6081	3.304	0.7445	Equal Variances
Distribution	Anderson-Darling A2 Test	0.6822	3.878	0.0749	Normal Distribution
	D'Agostino Kurtosis Test	0.4457	2.576	0.6558	Normal Distribution
	D'Agostino Skewness Test	0.02761	2.576	0.9780	Normal Distribution
	D'Agostino-Pearson K2 Omnibus Test	0.1994	9.21	0.9051	Normal Distribution
	Kolmogorov-Smirnov D Test	0.1106	0.1529	0.1743	Normal Distribution
	Shapiro-Wilk W Normality Test	0.967	0.9308	0.2244	Normal Distribution

Proportion Normal Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	0.9321	0.9115	0.9527	0.9400	0.8800	0.9600	0.0091	3.10%	0.00%
0.25		5	0.9280	0.9118	0.9442	0.9200	0.9200	0.9500	0.0058	1.40%	0.44%
0.5		5	0.8980	0.8876	0.9084	0.9000	0.8900	0.9100	0.0037	0.93%	3.66%
1		5	0.8740	0.8498	0.8982	0.8800	0.8500	0.9000	0.0087	2.23%	6.23%
2		5	0.8120	0.7775	0.8465	0.8000	0.7900	0.8600	0.0124	3.42%	12.88%
4		5	0.5340	0.4951	0.5729	0.5200	0.5000	0.5800	0.0140	5.86%	42.71%
8		5	0.3000	0.2638	0.3362	0.2900	0.2700	0.3400	0.0130	9.72%	67.81%
16		5	0.1040	0.0693	0.1387	0.0900	0.0800	0.1500	0.0125	26.85%	88.84%

Bivalve Larval Survival and Development Test NIWA Ecotoxicology

Analysis ID:	20-1150-2818	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	15 Jun-22 16:53	**Analysis:**	Parametric-Multiple Comparison	**Status Level:**	1
Edit Date:		**MD5 Hash:**	7B8F80BAFB4498845AB0ED660172A943	**Editor ID:**	

Angular (Corrected) Transformed Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	SC	10	1.3120	1.2720	1.3520	1.3230	1.2170	1.3690	0.0177	4.26%	0.00%
0.25		5	1.3000	1.2670	1.3330	1.2840	1.2840	1.3450	0.0119	2.04%	0.91%
0.5		5	1.2460	1.2290	1.2630	1.2490	1.2330	1.2660	0.0062	1.12%	5.04%
1		5	1.2090	1.1720	1.2450	1.2170	1.1730	1.2490	0.0132	2.44%	7.87%
2		5	1.1230	1.0770	1.1690	1.1070	1.0950	1.1870	0.0165	3.28%	14.39%
4		5	0.8195	0.7804	0.8585	0.8054	0.7854	0.8657	0.0141	3.84%	37.54%
8		5	0.5793	0.5399	0.6186	0.5687	0.5464	0.6225	0.0142	5.47%	55.85%
16		5	0.3264	0.2718	0.3810	0.3047	0.2868	0.3977	0.0197	13.47%	75.12%

Proportion Normal Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	0.9400	0.9600	0.9300	0.9500	0.9400	0.9600	0.9600	0.9000	0.8800	0.9010
0.25		0.9200	0.9200	0.9500	0.9300	0.9200					
0.5		0.9000	0.9100	0.8900	0.9000	0.8900					
1		0.8800	0.8600	0.9000	0.8800	0.8500					
2		0.8600	0.8100	0.8000	0.8000	0.7900					
4		0.5200	0.5500	0.5800	0.5000	0.5200					
8		0.3400	0.2800	0.3200	0.2700	0.2900					
16		0.1100	0.0900	0.1500	0.0900	0.0800					

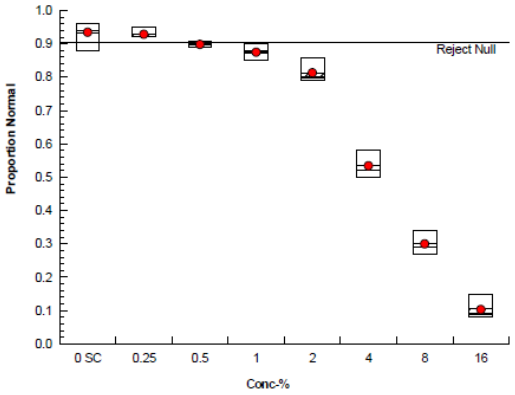
Angular (Corrected) Transformed Detail

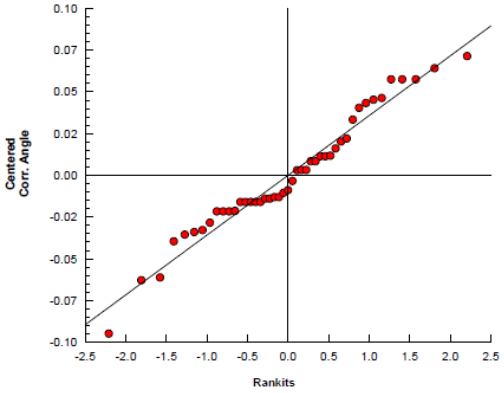
Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	1.3230	1.3690	1.3030	1.3450	1.3230	1.3690	1.3690	1.2490	1.2170	1.2510
0.25		1.2840	1.2840	1.3450	1.3030	1.2840					
0.5		1.2490	1.2660	1.2330	1.2490	1.2330					
1		1.2170	1.1870	1.2490	1.2170	1.1730					
2		1.1870	1.1200	1.1070	1.1070	1.0950					
4		0.8054	0.8355	0.8657	0.7854	0.8054					
8		0.6225	0.5576	0.6013	0.5464	0.5687					
16		0.3381	0.3047	0.3977	0.3047	0.2868					

Proportion Normal Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	SC	94/100	96/100	93/100	95/100	94/100	96/100	96/100	90/100	88/100	91/101
0.25		92/100	92/100	95/100	93/100	92/100					
0.5		90/100	91/100	89/100	90/100	89/100					
1		88/100	86/100	90/100	88/100	85/100					
2		86/100	81/100	80/100	80/100	79/100					
4		52/100	55/100	58/100	50/100	52/100					
8		34/100	28/100	32/100	27/100	29/100					
16		11/100	9/100	15/100	9/100	8/100					

Graphics


Reject Null
Proportion Normal
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 SC
0.25
0.5
1
2
4
8
16
Conc-%


Centered Corr. Angle
0.10
0.07
0.05
0.02
0.00
-0.02
-0.05
-0.07
-0.10
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
Rankits

CETIS Analytical Report

Report Date: 15 Jun-22 16:54 (p 1 of 3)
Test Code/ID: 2682/TP3 MyG / 13-3671-9997

Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

Analysis ID:	15-7087-3830	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	15 Jun-22 16:53	**Analysis:**	Linear Regression (GLM)	**Status Level:**	1
Edit Date:		**MD5 Hash:**	7B8F80BAFB4498845AB0ED660172A943	**Editor ID:**	
Batch ID:	00-7453-9482	**Test Type:**	Development	**Analyst:**	Ecotox Team
Start Date:	04 May-22	**Protocol:**	NIWA (2008)	**Diluent:**	Seawater
Ending Date:	06 May-22	**Species:**	Mytilus galloprovincialis	**Brine:**	Frozen Coastal Seawater
Test Length:	48h	**Taxon:**		**Source:**	Coromandel **Age:**
Sample ID:	15-3195-4620	**Code:**	2682/TP3 MyG	**Project:**	Effluent Characterization (Quarterly)
Sample Date:	03 May-22	**Material:**	POTW Effluent	**Source:**	Client Supplied
Receipt Date:	04 May-22	**CAS (PC):**		**Station:**	Hastings DC Outfall
Sample Age:	24h	**Client:**	Hastings District Council		

Linear Regression Options

Model Name	Link Function	Threshold Option	Thresh	PMSD	Optimize	Pooled	Het Corr	Weighted
Log-Normal (Probit)	η=inv Φ[π]	Control Threshold	0.075746	1.27%	Yes	No	No	Yes

Regression Summary

Iters	LL	AICc	BIC	Mu	Sigma	Cov	R2	F Stat	P-Value	Decision(α:5%)
8	-110.6	227.7	232.6	0.7107331	0.4070005	-0.008851	0.9953	3.265	0.0153	Significant Lack-of-Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	1.1	0.9216	1.278	90.93	78.22	108.5
EC10	1.546	1.334	1.754	64.69	57.02	74.95
EC15	1.945	1.711	2.173	51.42	46.02	58.45
EC20	2.334	2.083	2.578	42.84	38.79	48
EC25	2.73	2.465	2.988	36.63	33.47	40.56
EC40	4.052	3.748	4.354	24.68	22.97	26.68
EC50	5.137	4.794	5.492	19.47	18.21	20.86

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	Test Stat	P-Value	Decision(α:5%)
Intercept	-1.746	0.08852	-1.92	-1.573	-19.73	<1.0E-05	Significant Parameter
Slope	2.457	0.1097	2.242	2.672	22.4	<1.0E-05	Significant Parameter
Threshold	0.07575	0.006011	0.06396	0.08753	12.6	<1.0E-05	Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Model	6863	3432	2	4641	<1.0E-05	Significant Effect
Lack of Fit	9.507	1.901	5	3.265	0.0153	Significant Lack-of-Fit
Pure Error	21.55	0.5824	37			
Residual	31.06	0.7395	42			

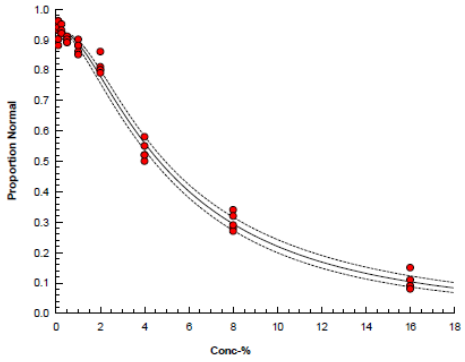
Residual Analysis

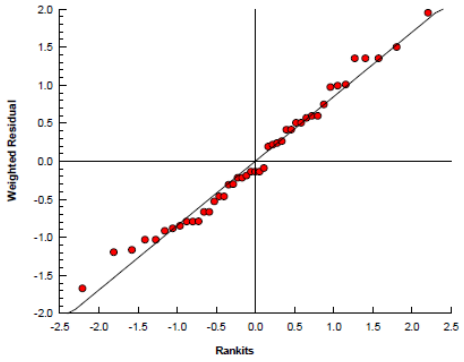
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Model Fit	Likelihood Ratio GOF Test	31.72	58.12	0.8757	Non-Significant Heterogeneity
	Pearson Chi-Sq GOF Test	31.06	58.12	0.8930	Non-Significant Heterogeneity
Variance	Bartlett Equality of Variance Test	8.586	14.07	0.2838	Equal Variances
	Mod Levene Equality of Variance	0.5099	2.334	0.8197	Equal Variances
Distribution	Anderson-Darling A2 Test	0.4025	2.492	0.3623	Normal Distribution
	Shapiro-Wilk W Normality Test	0.9769	0.9498	0.5001	Normal Distribution
Overdispersion	Tarone C(α) BinOverdispersion Te	1.492	1.645	0.0679	Non-Significant Overdispersion

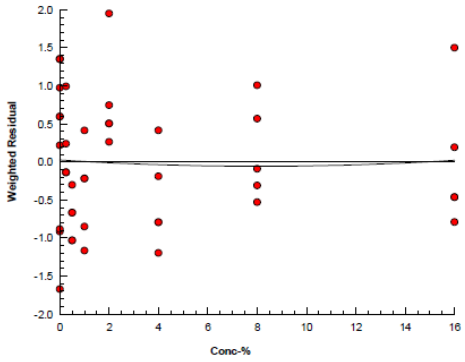
Bivalve Larval Survival and Development Test — **NIWA Ecotoxicology**

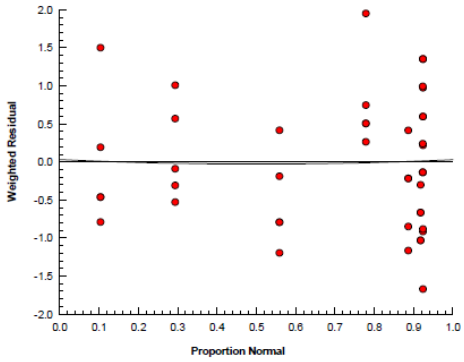
Analysis ID:	15-7087-3830	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.9.7
Analyzed:	15 Jun-22 16:53	**Analysis:**	Linear Regression (GLM)	**Status Level:**	1
Edit Date:		**MD5 Hash:**	7B8F80BAFB4498845AB0ED660172A943	**Editor ID:**	

Graphics — Log-Normal: inv Φ[π]=α+β·log[x]









Appendix D Hill Laboratories results and bioassay physico-chemistry

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	NIWA Corporate	**Lab No:**	2975577	SPv1
Contact:	Anathea Albert	**Date Received:**	03-May-2022	
	C/- NIWA Corporate	**Date Reported:**	09-May-2022	
	PO Box 11115	**Quote No:**	51353	
	Hillcrest	**Order No:**	U311870	
	Hamilton 3251	**Client Reference:**		
		Submitted By:	Anathea Albert	

Sample Type: Aqueous

Sample Name:		TP3 03-Apr-2022				
Lab Number:		2975577.1				
Total Ammoniacal-N	g/m³	14.7	-	-	-	-
Total Sulphide	g/m³	0.39 #1	-	-	-	-

Analyst's Comments

#1 Severe matrix interferences required that a dilution be performed prior to analysis of this sample, resulting in a detection limit higher than that normally achieved for the Total Sulphide analysis.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m³	1
Total Sulphide Trace	In-line distillation, segmented flow colorimetry. APHA 4500-S^{2-} E (modified) 23rd ed. 2017.	0.002 g/m³	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 06-May-2022 and 09-May-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Kim Harrison MSc
Client Services Manager - Environmental

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Table D-1: Water quality measures from the blue mussel test. All values are within the acceptable range for the test.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
4/05/2022	0h	Control	0	20	8.1	7.3	99	34
		TP3	0.25	20	8.2	7.3	99	34
			16	20	8.1	7.2	98	34
6/05/2022	48h	Control	0	21	8.1	7.4	102	34
		TP3	0.25	21	8.1	6.7	92	34
			0.5	21	8.1	6.8	94	34
			1	21	8.1	6.8	94	34
			2	21	8.1	6.7	92	34
			4	21	8.1	6.7	92	34
			8	21	8.1	6.4	88	34
			16	21	8.1	6.1	84	34

Table D-2: Water quality measures from the wedge shell test. All values are within the acceptable range for the test.

Date	Time	Sample	Concentration (%)	Temp (^{o}C)	pH	DO (mg L^{-1})	DO (%)	Salinity (ppt)
5/05/2022	0 hour	Control	0	20	8.0	7.6	103	34
		TP3	0.25	20	8.1	7.3	99	34
			20	20	8.1	7.5	102	34
9/02/2022	96 hour	Control	0	20	8.2	7.1	96	33
		TP3	0.25	20	8.2	7.0	95	33
			0.5	20	8.2	7.0	95	33
			1	20	8.2	7.0	95	33
			2	20	8.2	7.0	95	33
			5	20	8.2	7.0	95	33
			10	20	8.3	6.9	93	33
			20	20	8.3	6.8	92	34

Appendix E Diffuser Inspection and Maintenance Report

HDC WASTEWATER OUTFALL DIFFUSER MAINTENANCE

REPORT NUMBER: HDCWODM02 281121

HASTINGS DISTRICT COUNCIL

17- 29 NOVEMBER – 2 DECEMBER 2021

HASTINGS, NEW ZEALAND

Reviewed	Released
.....	.....
Matua Moeke Superintendent and Projects Consultant	Lana Stevens Wellington Regional Business and Operations Manager

1. OVERVIEW

New Zealand Diving and Salvage (NZDS) was engaged by Hastings District Council (HDC) under contract HDC CON2019018 to conduct an inspection, maintenance and reactive works on the Clive Wastewater Outfall. This operational attendance commenced on the 17th of November through to the 2nd of December 2021.

The visibility throughout these operations were average and varied from approximately 0 – 2m.

2. SCOPE OF WORKS

Under this PEP, NZDS has been engaged for works by Hastings District Council in agreement of the following scope as outlined within HDC CON2019018 and the subsequent agreed reactive works (variations):

1. Annual Inspection and Maintenance
    a) Check and record condition of overall pipeline and the various components of the operational diffuser section.
    b) Check the general condition of the PE diffuser pipeline by running a hand along the pipeline feeling for any damage such as caused by trawl board impact or net entanglement.
    c) Check the embedment of the ballast blocks and the general condition of the blocks and the piles. Feel for free span suspensions and block rotation about the pipeline axis using an inclinometer if required.
    d) Check the anodes on the pipeline half clamps and the piles, check random half clamp bolts for tightness.
    e) Check the condition and operation of the diffuser duckbill valves. Open the duckbills and probe inside the duckbills with a rod to check for possible obstructions or sediment build-up inside the diffuser pipeline. Check anodes on the duckbill valve flange. Check the integrity of attachment of the duckbills and protection surrounds. Note and record the level of the seabed relative to each of the duckbill valve centres along the pipeline.
    f) Check the condition and burial of the original deteriorated FRP diffuser pipeline left to the side (northwest) of the new diffuser pipeline. Where exposed, measure the position relative to the operational diffuser and assess security / stability.
    g) Check the condition of the steel wye piece, check clamp bolts for tightness and look / feel for leaks along flange connections and seals to concrete pipeline.
    h) In coordination with the WWTP operations for flow shutdown and flushing, remove the end blind flange of the diffuser and check for material build up. Flush the diffuser out the open end for a minimum period of 2 hours and a maximum of 8 hours, observe material, colour, and change in discharge over flushing period. Reinstate the blind flange. Plant shutdown required.

i) Check the cathodic potential of steel elements protected by sacrificial anodes relative to a silver/silver chloride - reference electrode stab probe unit carried by the diver. The diver handheld probe is connected to a voltmeter on the surface support vessel. The steel is protected if the potential is -800mV relative to the reference electrode.

2. Replacement of any anodes on steel components that are 60% or more depleted.

3. Condition of the outfall aluminium marker buoys, chains and blocks shall be checked, and any repairs or replacement work identified. Anodes are also to be installed on the marker float chains (aluminium MA1.5kg at approximate intervals of 3 – 4m spacings starting from the top down, four (4) on each chain). These anodes will be drilled and bolted through the chain link with a long bolt and heavy washer. These are not to be installed where they will become buried in silt / sand / mud as they need to remain in the water between the surface and the sea floor.

4. Provide inspection and maintenance report. Prepare an inspection report for each annual inspection that as a minimum covers the following items:

a) Tabulated measurements of distance from seabed to duckbill valve centreline for each duckbill port.
b) Measurements of ballast blocks embedment above seabed, rotation angle and pile stickup above the ballast blocks.
c) Notes on the operation of each duckbill, condition of components, and any repairs required or made.
d) Note any loose bolts identified, tightened and which fittings these were.
e) Tabulate details of the anodes replaced, with reference number, weight of removed anode and calculated average loss (kg/year), photographs of the anodes removed, confirmed weight of new anode. Confirm if there are 4kg anodes present on the pipeline string joint flange and backing rings on the PE flange. If not, this is to be advised as soon as possible as these will need to be installed as per the as-build drawings. This is to be communicated to NZDS Operational Representatives should an anomaly be found (no anodes installed).
f) Flushing observations including any debris, scale and colour of sediment and duration of discolouration.
g) Note condition or any issues with the abandoned diffuser pipeline in accordance with monitoring noted in resource consent CL1501760a, condition 13.
h) Photos or video where visibility permits of key features, general condition and any issues identified.

5. Additional Items

a) Check suspended areas as outlined in 2020 annual inspection.
b) Recover sample of accumulated sludge in diffuser prior to flushing – to be completed while end plate is off and prior to pump starting the flush. Material to be recovered from

the top of the interior pipe as soon as end plate removed. Samples recovered to be transported by HDC on the day of flushing.

6. Reactive Maintenance or Repair (Variations)
   a) Installation of wye seal.
   b) Retro-fit #58 diffuser cone. This was identified as missing from previous inspection, the cause is unknown.
   c) Install stainless steel repair band at the first concrete join inshore of the Wye to eliminate leak found at the first concrete pipe join.
   d) Mooring inspection and replacement. As required due to wear of mooring components.
   e) General inspection of the concrete pipeline inshore of the Wye.

3. RESULTS

The below details are a summary of the results table in section four of this report.

a. Pipe Condition

The overall condition of the diffuser section was found to be good with no damage found during the survey. An abandoned fishing net was located at #47, this was recovered to the surface and recorded. Fishing nets are a risk to divers especially when there is limited visibility as their inherent design is to catch/entangle. To eliminate the risk, we remove all nets when they are found. There were two (2) nets found on this attendance. One being on the surface with floats, this net was able to be lifted and moved safely out of the area. The second net was located on the pipe/seabed at block #57 this net had no floats. The net had been drifting underwater for an unknown amount of time and had come into contact with the pipe. Divers spent some time safely removing and recovering the net to the surface and was disposed of onshore, this caused minor delay to the program.

b. Ballast Blocks

The ballast blocks were inspected and pile heights were measured. Thirty three (33) blocks were recorded to be suspended on the piles above the seabed. Eleven (11) blocks had scouring at the edges but were supported in the centre underneath. Ballast block #4 was measured with an inclinometer, the rotation is 12.8 degrees. All other ballast blocks appeared to be level.

c. Anodes

All the ballast block clamp anodes were inspected, the depletion range was found to be 30 – 90%. Diffuser port anodes were also inspected and on average had an approximate depletion of 10 – 40%. Thirty two (32) anodes were identified as 30 – 50% depleted, it is expected these anodes will require changing next year. As anodes deplete the rate at which this happens increase due to the mass and surface area reduces. All pile anodes were inspected and had an approximate depletion range between 30 – 100%. This led into an extensive anode replacement programme. In total fifty two (52) pile anodes were replaced and fifty (50) block clamp anodes were replaced. The bolts on the block half clamps were randomly checked and of which some

were loose, these were retightened. During the next attendance checking of all bolts will be added into the inspection program. All anodes over 60% depleted were replaced as instructed. The anodes replaced are tabulated in the inventory spreadsheet. Anodes were all labelled and weighed. Cathodic protection (CP) readings were taken after new anodes were installed. Backing ring anodes were observed to be secure and in place, anode depletion is estimated at 10 – 15%.

d. Diffuser Ports

All diffuser port duckbills were checked and appeared secure and were flowing. There was hard growth in some of the diffuser ports, this was removed. All ports were found to have good consistent flow. All duckbills were sighted to be above the seabed.

e. Disused FRP Pipe

The old FRP diffuser section which runs parallel to the active diffuser section was inspected from the inshore end which is directly in line with the active diffuser section flange. The 14.5 m section of the old FRP diffuser section appears to have settled into the seabed. The seabed is now at 3 and 9 o'clock along this length. The end of the broken piece is now 500mm below the FRP diffuser section. The position of the broken piece remains the same as 2019 and is stable.
The ballast block could not be found and assumed buried. The diver did not notice any suspension of the FRP section while travelling offshore as stated previously. The old FRP section is 1.5m from the new section of diffuser at block #5. The remaining section of the surveyed old FRP pipeline appeared to be undamaged with medium hard growth. A fishing net was found tangled between the two (2) pipelines at block #57, this net was removed as stated above. Seabed levels were reasonably consistent at approximately the 9 and 3 o'clock positions. The distance between the two (2) pipelines varied with random measurements taken along the length these are in the survey table.

f. WYE

The steel wye piece and ballast block clamp were inspected. A leak approximately the same as that observed during the last inspection conducted in 2020 was observed. This was between the 3 and 6 o'clock positions on the inshore sealing surface. This leak had a heavy flow with a noticeable plume on the surface.

g. Flushing

The end plate was removed, and a 'plug' was observed in the end of the pipe behind the end plate. This plug was on the surface, it was tan in colour with patches of red. The plug was observed to break up into smaller pieces on the surface and dispersed. A sample was taken from inside the pipe at the top as required. There was a build-up observed approximately 100mm thick around the internal circumference of pipe. After this sample was taken HDC increased flow to begin the flushing. At this point debris was observed floating on the surface and described as 'small black chunks' which surfaced with the plume and quickly dispersed. At 10:37 a second sample was taken from the water column. The plume steadily increased but changed from black to a dark brown and floating debris continuing to surface. 11:07 a third sample was obtained.

11:20 only a very small amount of flotsam was observed. 11:48 the plume had lightened to turbid brown and at 12:00 the samples were handed over to HDC. The flushing was competed at 14:30 and the end plate was re-secured. The plume at stage was found to be “turbid”.

h. Seabed Levels

Seabed levels and ballast block protrusion from the seabed was measured at each ballast block. In accordance with Stantec guidelines. The diffuser ports were measured from the centre to the seabed. All results were recorded and are on the attached spreadsheet.

i. Cathodic Protection

The cathodic protection (CP) of steel elements were tested using a hand-held testing probe unit and recorded. Most elements were above 720mv. The anodes were inspected and are in place, the depletion was estimated at 30 – 100%. This led to a lengthy anode replacement project. All up one hundred and two (102) anodes were replaced. The readings are shown on the marked-up drawings below and spreadsheet. All steel components had adequate CP readings after the anodes were replaced.

Reactive Maintenance Results

a. Installation of WYE Seal

The WYE end plate was removed to reduce the pressure inside the pipe during the seal installation. There were no sediment/debris found inside the WYE, the old FRP section inside the WYE does not appear to have moved.

The prefabricated WYE piece sealing rings, gasket clamps and gasket, were successfully installed. The void behind the rings packed with the rope to create a backing and temp seal. The rope was installed as a backer for the UA, this also stopped any pressure/suction issues while the UA was installed and cured. The SIKA UA was inserted by hand leaving no gaps, this was then smoothed off. The gasket was glued to the bottom half shell, this was lowered into place and secured. The gasket was then joined, with the top half shell securing it into place.

The 3-part compression clamp was then installed and bolted down. This completed the assembly. The WYE end plate was reinstalled three (3) days later (due to operational requirements) this allowed enough time to cure correctly. The assembly was then inspected, at the time of inspection no leaks were found. There was also no longer any visible surface plume on the surface.

b. Replacement of Diffuser Cone at #58

The diffuser cone at #58 has been retrofitted using stainless steel ratchet straps fabricated brackets to secure the cone to the pipe. The diffuser is now protected by this cone. No excavation was required. The diffuser is central to the cone.

c. Installation of Warner Stainless Repair Band with Rubber Backing at Join #1

Upon inspection of the wye divers noticed a leak at join #1. A plume was seen/felt coming from the 6 o'clock position. A premade stainless-steel repair-band made from 2204S/S was installed and tightened around this leak a minor misalignment of the pipe join created a small gap at the 6 o'clock inshore edge, there was no leak observed, however UA was inserted to ensure completed seal. No further discharge was noted after install. The join had to be excavated 400mm below the pipe and thirty (30) sandbags were placed under the pipe to help support this area.

d. Mooring Replacement

Both moorings were recovered to the surface for inspection.
The offshore moorings were in poor condition, with the tackles 80% depleted in places. Anodes were heavily depleted or missing. All terminal tackle has been replaced on both buoys.
See below table:

Offshore Mooring

Block	1.2m x 1.2m with 32mm staple in good condition
Chain	22m of 18mm black chain
Anodes	4 x 1.5kg aluminium, bolted to welded tabs, 10mm with double nuts
Swivel	18mm swivel to suit
Shackles	18mm shackles to suit x 3, welded
Signage	In good condition
Light	Working
Radar deflector	In place
Float	In good condition

Inshore Mooring

Block	1.2m x 0.3 with cast chain and lifting eye
Chain	16m of 18mm black chain, 6m of 50mm stud
Anodes	4 x 1.5kg aluminium, bolted to welded tabs, 10mm with double nuts
Swivel	18mm swivel to suit
Shackles	18mm shackles to suit x 3, welded
Signage	In good condition
Light	Working
Radar deflector	None
Float	In good condition

e. Inspection Inshore of the Wye

An inspection was performed from the wye inshore. A leak was identified at the join immediately inshore of the wye support clamp, at join #1. Inshore of this no additional leaks were identified. The survey covered an approximate distance of eighty (80) metres, at this point the pipe

becomes buried and could not be followed any further by the divers. This is calculated with a distance between joins of 2.5metres. Thirty one (31) joins were checked. There are various issues with the pipeline joins, which included protruding gasket, joins missing gaskets and bulging gaskets, but no further leaks were identified during the survey. The sand level varied from 6 o'clock position at the start of the survey to the 12 o'clock position at the survey finish point.
A table of results is included.

f. Installation of Anodes

The survey identified several anodes that had reached more than 60% depletion. The depletion percentage according to the diver varied between 30 – 100% depletion. As a result of this all anodes that were estimated to be 60% or more were replaced, this totalled fifty (50) block anodes and fifty-two (52) pile anodes. All CP readings were more than 0.8mV or higher after installation. A table of what was replaced has been included along with the weights of the depleted anodes removed.

4. RESULTS TABLE

On the following page, tables detail the collected data during this attendance.

HDC Outfall Survey - 30572 17 November 2021

Note – Blocks are either marked as - suspended which is measured seabed to bottom of block
- Exposed which is pile guide to seabed
- Flush means flush with the top of the pile guide

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
150m HDPE Pipe String #1											
START (INSHORE DIFFUSER SECTION)											
24 BOLTS HOLES (FLANGE)				**10%**				**IS 0.881 OS 0.886**			**No Leaks - Bolts Secured**
SADDLE BLOCK #0				30% Sth		N 780mm S 620mm	N 40% S 20%	Clamp N 1.030 S 1.039	Exposed Nth 450mm Sth 180mm	No	
24 BOLTS HOLES (STUB FLANGE)		0						IS1.030 OS 1.029			
SADDLE BLOCK #1		2.5		10% Nth		N 850mm S 710	N 30% S 20%	Clamp .842 N .963 S .987	Nth = Flush Sth = Flush	No	
DIFFUSER #1	2.5m Spacing	3.75	South		Blanked				Flush		
DIFFUSER #2		6.25	North		Blanked				100mm		
SADDLE BLOCK #2		7.5		90%		No Piles	No	Clamp Old 1.024 New 1.006	Nth = Flush Sth = Flush	Replaced	
DIFFUSER #3	2.5m Spacing	8.75	South		Blanked				250mm		
DIFFUSER #4		11.25	North	10%	Good				200mm		
SADDLE BLOCK #3		12.5				No Piles	No	Clamp 1.017 New 1.006	Exposed Nth = 380mm Sth = 640		

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #5	2.5m Spacing	13.75	South	20%	Good				500mm		
DIFFUSER #6		16.25	North	10%	Good				500mm		
SADDLE BLOCK #4		17.5		75% Nth		No Piles	No	TBZ 1.040 Clamp .340 New 1.009	Exposed Sth 400mm Suspended Nth 20mm	Replaced	Block Rotated 12.8 Degrees
DIFFUSER #7	2.5m Spacing	18.75	South	10%	Good				950mm		
DIFFUSER #8		21.25	North	10%	Good				850mm		
SADDLE BLOCK #5		22.5		80%		N 815mm S 880mm	N 70% S 80%	Clamp .374 New 1.021 N .872 New .917 S .936 New .906	Both Suspended Nth 270mm Sth 200mm	Replaced	
DIFFUSER #9	2.5m Spacing	23.75	South	20%	Good				950mm		
DIFFUSER #10		26.25	North	10%	Good				750mm		
SADDLE BLOCK #6		27.5		80%		N 780mm	N 90%	Clamp 1.020 N .898	Both Sides Suspended Nth 450mm Sth 180mm	Replaced	
DIFFUSER #11	2.5m Spacing	28.75	South	30%	Good				900mm		Removed Mussel Growth
DIFFUSER #12		31.25	North	30%	Good				850mm		
SADDLE BLOCK #7		32.5		80% Nth		S 840mm	90%	Clamp .350 New 1.024 S New .885	Both Suspended Nth 400mm Sth 800mm	Replaced	
DIFFUSER #13	2.5m Spacing	33.75	South	40%	Good				1100mm		
DIFFUSER #14		36.25	North	30%	Good				950mm		
SADDLE BLOCK #8		37.5		80% Nth		N 740mm	100%	Clamp .370 New 1.035 N New .884	Exposed 800mm Sth 380mm	Replaced	
DIFFUSER #15	2.5m Spacing	38.75	South	40%	Good				1150mm		
DIFFUSER #16		41.25	North	40%	Good				800mm		

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
SADDLE BLOCK #9		42.5		70%		S 1000mm	100%	Clamp .390 New 1.030 S New .909	Both Suspended Nth 250mm Sth 550mm	Replaced	
DIFFUSER #17	2.5m Spacing	43.75	South	30%	Good				830mm		
DIFFUSER #18		46.25	North	20%	Good				570mm		
SADDLE BLOCK #10		47.5		70%		N 1140mm	90%	Clamp New 1.005 N New .881	Both Suspended Nth 250mm Sth 50mm	Replaced	
DIFFUSER #19	2.5m Spacing	48.75	South	30%	Good				560mm		
DIFFUSER #20		51.25	North	20%	Good				500mm		
SADDLE BLOCK #11		52.5		60%		S 1050mm	90%	Clamp .745 New 1.009 S .912 New .830	Exposed Nth 750mm Sth 620mm	Replaced	
DIFFUSER #21	2.5m Spacing	53.75	South	30%	Good				500mm		
DIFFUSER #22		56.25	North	20%	Good				540mm		
SADDLE BLOCK #12		57.5		70%		N 920mm	90%	Clamp .371 New 1.009 N .874 New .893	Nth Suspended 430mm Exposed Sth 500mm	Replaced	
DIFFUSER #23	2.5m Spacing	58.75	South	30%	Good				560mm		
DIFFUSER #24		61.25	North	40%	Good				480mm		Old Pipe 1.8m Away
SADDLE BLOCK #13		62.5		60%		S 870mm	10%	Clamp .401 New 1.021 S .960	Exposed Nth 750mm Sth 630mm	1 Clamp Anode Replaced	
DIFFUSER #25	2.5m Spacing	63.75	South	20%	Good				560mm		
DIFFUSER #26		66.25	North	30%	Good				740mm		
SADDLE BLOCK #14		67.5		70%		N 820mm	90%	Clamp .425 New .995 N .801 New .931	Nth Suspended 440mm Sth Suspended 160mm	Replaced	
DIFFUSER #27	2.5m Spacing	68.75	South	40%	Good				620mm		

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #28		71.25	North	30%	Good				850mm		
SADDLE BLOCK #15		72.5		50%		S 730mm	80%	Clamp .414 New 1.033 S .906 New .895	Exposed Nth 320mm Sth Suspended 610mm	Replaced	
DIFFUSER #29	2.5m Spacing	73.75	South	40%	Good				750mm		Mussels Removed
DIFFUSER #30		76.25	North	40%	Good				1000mm		
SADDLE BLOCK #16		77.5		60%		N 760mm	20%	Clamp .501 New 1.024 N .937	Nth Suspended 630mm Sth Suspended 210mm	1 Clamp Anode Replaced	Clamp Tightened Half Turn Sth Side. Half Turn Nth Side 1 Bolt
DIFFUSER #31	2.5m Spacing	78.75	South	40%	Good				780mm		
DIFFUSER #32		81.25	North	40%	Good				1000mm		
SADDLE BLOCK #17		82.5		60%		S 870mm	100%	Clamp 1.033 New 1.033 S New .893	Nth Suspended 330mm Sth Suspended 760mm	Replaced	
DIFFUSER #33	2.5m Spacing	83.75	South	40%	Good				880mm		
DIFFUSER #34		86.25	North	30%	Good				940mm		
SADDLE BLOCK #18		87.5		60%		N 1280mm	100%	Clamp 1.038 New 1.021 N New .934	Nth Suspended 770mm Sth Suspended 240mm	Replaced	
DIFFUSER #35	2.5m Spacing	88.75	South	40%	Good				770mm		
DIFFUSER #36		91.25	North	50%	Good				900mm		
SADDLE BLOCK #19		92.5		50%		S 970mm	100%	Clamp 1.033 New 1.019 S New .897	Nth Suspended= 310mm Sth Suspended 520mm	Replaced	
DIFFUSER #37	2.5m Spacing	93.75	South	50%	Good				780mm		
DIFFUSER #38		96.25	North	50%	Good				510mm		

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
SADDLE BLOCK #20		97.5		60%		N 960mm	90%	Clamp 1.034 New 1.023 N .850 New .904	Nth Suspended 780mm Sth Suspended 200mm	Replaced	
DIFFUSER #39	2.5m Spacing	98.75	South	10%	Good				800mm		Soft Growth
DIFFUSER #40		101.25	North	15%	Good				900mm		Soft Growth
SADDLE BLOCK #21		102.5		60%		S 960mm	80%	Clamp .530 New 1.023 S New .914	Nth Suspended 450mm Sth Suspended 450mm Fully Suspended Block	Replaced	1 Turn On Nth Is Bolt Os 3 X 1/4 Turns, Sth Bolt Os 1/2 Turn
DIFFUSER #41	2.5m Spacing	103.75	South	10%	Good				800mm		Soft Growth
DIFFUSER #42		106.25	North	10%	Good				900mm		Soft Growth
SADDLE BLOCK #22		107.5		95%		N 900mm	60%	Clamp 1.031 New 1.090 N .871 New .912	Nth Suspended 400mm Sth Suspended 200mm Fully Suspension	Replaced	
DIFFUSER #43	2.5m Spacing	108.75	South	10%	Good				800mm		Soft Growth
DIFFUSER #44		111.25	North	10%	Good				900mm		Soft Growth
SADDLE BLOC+5:74K #23		112.5		55%		S 860mm	65%	Clamp 1.031 New 1.097 S .996 New .939	Nth Suspended 300mm Sth Suspended 300mm Fully Suspension	Replaced	Old Pipe 3m Away
DIFFUSER #45	2.5m Spacing	113.75	South	15%	Good				840Mmm		Soft Growth
DIFFUSER #46		116.25	North	10%	Good				900mm		Soft Growth
SADDLE BLOCK #24		117.5		70%		N 830mm	90%	Clamp 1.033 New 1.099 N New .819	Nth Suspended 500mm Sth Suspended 150mm Fully Suspended	Replaced	Bolts Secured
DIFFUSER #47	2.5m Spacing	118.75	South	20%	Good				800mm		Soft Growth

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #48		121.25	North	10%	Good				620mm		Soft Growth
SADDLE BLOCK #25		122.5		50%		S 820mm	60%	Clamp 1.033 S .974 New .992	Exposed Nth 800mm Sth Scouring 150mm	1 X Pile Anode Only	Bolts Secure
DIFFUSER #49	2.5m spacing	123.75	South	10%	Good				600mm		Soft Growth
DIFFUSER #50		126.25	North	10%	Good				800mm		Soft Growth
SADDLE BLOCK #26		127.5		65%		N 900mm	90%	Clamp 1.027 New .993 N New .981	Nth Suspended 500mm Sth Suspended 40mm Fully Suspended	Replaced	
DIFFUSER #51	2.5m spacing	128.75	South	10%	Good				680mm		4m To Old Pipe
DIFFUSER #52		131.25	North	10%	Good				540mm		Soft Growth
SADDLE BLOCK #27		132.5		60%		S 880mm	50%	Clamp 1.031 New 1.027 S .963	Both Exposed Nth 700mm Sth 800mm	1 X Clamp Anode Only	Bolts Secure
DIFFUSER #53	2.5m spacing	133.75	South	20%	Good				550mm		Soft Growth
DIFFUSER #54		136.25	North	20%	Good				500mm		Soft Growth
SADDLE BLOCK #28		137.5		80%		N 780mm	80%	Clamp .654 New 1.013 N .961 New .982	Nth Scoured 75mm Sth 660mm	Replaced	Nth Bolt 1 X 1/4 Turn, Sth Is Bolt 1/2 Turn
DIFFUSER #55	2.5m spacing	138.75	South	20%	Good				605mm		Soft Growth
DIFFUSER #56		141.25	North	20%	Good				780mm		Soft Growth
SADDLE BLOCK #29		142.5		80%		S 690mm	90%	Clamp .512 New 1.020 S .857 New .997	Nth Suspended 180mm Sth Suspended 350mm Fully Suspension	Replaced	
DIFFUSER #57	2.5m spacing	143.75	South	10%	Good				690mm		Soft Growth

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #58		146.25	North	20%	Good				860mm		New Cone Installed
SADDLE BLOCK #30		147.5		90%		N 670mm S 690mm	N 90% S 90%	Clamp .650 New 1.003 N .936 New .898 S .858 New .911	Nth Suspended 400mm Sth Suspended 450mm Fully Suspended	Replaced	Old Pipe 4m Away
DIFFUSER #59	2.5m Spacing	148.75	South	20%	Good				980mm		Soft Growth
STUB FLANGE		150									
150m HDPE Pipe String #2											
START (OFFSHORE DIFFUSER SECTION)											
24 BOLTS HOLES (STUB FLANGE)		150		15%				Flange Inshore 1.043 Flange Offshore 1.040	Suspended 150mm		41mm Nuts, No Movement In Nuts
DIFFUSER #60		151.25	North	20%	Good				720mm		Soft Growth
SADDLE BLOCK #31		152.5		80%		N 780mm S 750mm	N 80% S 90%	Clamp .651 NEW 1.003 N .938 NEW .908 S .917 NEW .900	Nth Suspended 200mm Sth Suspended 250mm	Replaced	
DIFFUSER #61	2.5m Spacing	153.75	South	10%	Good				900mm		
DIFFUSER #62		156.25	North	10%	Good				650mm		
SADDLE BLOCK #32		157.5		80%		S 840mm	90%	Clamp 1.023 NEW 1.016 S .938 NEW .896	Nth Suspended 250mm Sth 350mm	Replaced	32mm Head Bolts Nth 1 Turn Each, Sth 1 Turn Each
DIFFUSER #63	2.5m Spacing	158.75	South	10%	Good				700mm		Soft Growth
DIFFUSER #64		161.25	North	10%	Good				600mm		Soft Growth

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
SADDLE BLOCK #33		162.5		70%		N 800mm	90%	Clamp 1.022 New 1.035 N .910 New.885	Nth Suspended 250mm Sth Exposed 800mm	Replaced	
DIFFUSER #65	2.5m Spacing	163.75	South	10%	Good				750mm		
DIFFUSER #66		166.25	North	10%	Good				400mm		
SADDLE BLOCK #34		167.5		60%		S 800mm	30%	Clamp 1.018 New 1.037 S .972	Both Exposed Nth 700mm Sth 500mm	1 X Clamp Only Replaced	
DIFFUSER #67	2.5m Spacing	168.75	South	10%	Good				600mm		
DIFFUSER #68		171.25	North	10%	Good				500mm		
SADDLE BLOCK #35		172.5		60%		N 880mm	90%	Clamp .972 New 1.029 N .946 New .954	Nth Suspended 170mm Sth Exposed 750mm	Replaced	
DIFFUSER #69	2.5m Spacing	173.75	South	10%	Good				650		Mussels Cleared
DIFFUSER #70		176.25	North	10%	Good				670		
SADDLE BLOCK #36		177.5		60%		S 900mm	50%	Clamp 1.020 New 1.028 S .920	Nth Suspension 140mm Sth Suspension 200mm	1 X Clamp Anode Replaced	
DIFFUSER #71	2.5m Spacing	178.75	South	10%	Good				900mm		
DIFFUSER #72		181.25	North	10%	Good				550mm		Soft Growth
SADDLE BLOCK #37		182.5		60%		N 800mm	40%	Clamp 1.021 New 1.032 N .968	Nth Suspended 100mm Sth Suspended 200mm	1 X Clamp Anode Replaced	
DIFFUSER #73	2.5m Spacing	183.75	South	10%	Good				700mm		Soft Growth
DIFFUSER #74		186.25	North	10%	Good				500mm		
SADDLE BLOCK #38		187.5		10%		S 770mm	50%	Clamp 1.018 S .972	Both Exposed Nth 400mm Sth 500mm	Not Required	

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #75	2.5m Spacing	188.75	South	10%	Good				650mm		Soft Growth
DIFFUSER #76		191.25	North	10%	Good				700mm		
SADDLE BLOCK #39		192.5		0%		N 850mm	60%	Clamp 1.005 N .976 New .887	Nth Suspended 200mm Sth Suspended 100mm	1 X Pile Anode Only	Old Pipe 7m Away 3/9 Exposed Block Anode Loose
DIFFUSER #77	2.5m Spacing	193.75+3:1292:12112:129	South	10%	Good				600mm		
DIFFUSER #78		196.25	North	10%	Good				650mm		
SADDLE BLOCK #40		197.5		50-60%		S 860mm	80%	Clamp 1.034 New 1.013 S .921 New .954	Nth Scoured 150mm Sth Scoured 190mm	Replaced	
DIFFUSER #79	2.5m Spacing	198.75	South	20%	Good				660mm		
DIFFUSER #80		201.25	North	10%	Good				770mm		
SADDLE BLOCK #41		202.5		40%		N770mm	90%	Clamp 1.045 N .995 New .950	Nth Scoured 280mm Sth Scoured 250mm	1 X Pile Anode Replaced	All Bolts Tight
DIFFUSER #81	2.5m Spacing	203.75	South	20%	Good				770mm		
DIFFUSER #82		206.25	North	10%	Good				500mm		
SADDLE BLOCK #42		207.5		10%		S 740mm	70%	Clamp .830 S .956 New .935	Both Exposed Nth 590mm Sth 540mm	1 X Pile Anode Replaced	
DIFFUSER #83	2.5m Spacing	208.75	South	10%	Good				560mm		
DIFFUSER #84		211.25	North	20%	Good				680mm		Mussel Growth
SADDLE BLOCK #43		212.5		20%		N 750mm S 730mm	N 70% S 100%	Clamp .920 N .9 New .869 S .854 New .903	Nth Scoured 500mm Sth Heavy Scoured 680mm Fully Suspension	2 X Pile Anodes Replaced	
DIFFUSER #85	2.5m Spacing	213.75	South	20%	Good				1250mm		
DIFFUSER #86		216.25	North	20%	Good				800mm		No Internal Sediment

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
SADDLE BLOCK #44		217.5		50%		S 750mm	80%	Clamp .854 S .878 New .922	Nth Scoured 200mm Sth Scoured 200mm	1 X Pile Anode Replaced	
DIFFUSER #87		218.75	south	20%	Good				800mm		
DIFFUSER #88	2.5m Spacing	221.25	North	30%	Good				600mm		
SADDLE BLOCK #45		222.5		10-20%		N 710mm	60%	Clamp .838 N .967 New .960	Nth Scoured 300mm Sth400mm	1 X Pile Anode Replaced	Loose Block Anode
DIFFUSER #89	2.5m Spacing	223.75	South	20%	Good				620mm		
DIFFUSER #90		226.25	North	20%	Good				750mm		
SADDLE BLOCK #46		227.5		10%		S 660mm	40%	Clamp .884 S .908	Nth Scoured 200mm Sth Scoured 250mm	None Required	Loose Block Anode
DIFFUSER #91	2.5m Spacing	228.75	South	40%	Good				750mm		
DIFFUSER #92		231.25	North	10%	Good				680mm		
SADDLE BLOCK #47		232.5		60%		N 850mm	50%	Clamp .964 New 1.022 N .902	Nth Scoured 250mm Sth Scoured 180mm	1 X Clamp Anode Replaced	
DIFFUSER #93	2.5m Spacing	233.75	South	30%	Good				630mm		
DIFFUSER #94		236.25	North	20%	Good				620mm		
SADDLE BLOCK #48		237.5		60%		S 900mm	90%	Clamp 1.071 S .900 New .952	Nth Scoured 150mm Sth Scoured 250mm	1 X Pile Anode Replaced	Could Not Remove Old Anode Due to Nut Damage
DIFFUSER #95	2.5m Spacing	238.75	South	30%	Good				650mm		
DIFFUSER #96		241.25	North	30%	Good				670mm		
SADDLE BLOCK #49		241.5		60%		N 950mm	80%	Clamp 1.028 New 1.016 N .960 New .931	Nth Scoured 170mm Sth Scoured 150mm	Replaced	Could Not Remove Old Anode Due to Nut Damage
DIFFUSER #97	2.5m Spacing	243.75	South	40%	Good				550mm		
DIFFUSER #98		246.25	North	20%	Good				600mm		Mussels Cleared

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
SADDLE BLOCK #50		247.5		60%		S 900mm	80%	Clamp .938 New 1.031 S .907 New .952	Both Exposed Nth 450mm Sth 560mm	Replaced	Sth Bolts 2 Turns Nth Last Bolt Sitting Proud 15mm
DIFFUSER #99	2.5m Spacing	248.75	South	10%	Good				610mm		
DIFFUSER #100		251.25	North	20%	Good				660mm		
SADDLE BLOCK #51		252.5		60%		1090mm	100%	Clamp 1.009 New 1.025 N .946 New.935	Both Exposed Nth 570mm Sth 490mm	Replaced	
DIFFUSER #101	2.5m Spacing	253.75	South	20%	Good				450mm		
DIFFUSER #102		256.25	North	10%	Good				300mm		
SADDLE BLOCK #52		257.5		60%		S 1110mm	30%	Clamp 1.023 New 1.007 S .983	Both Exposed Nth 500mm Sth 400mm	1 X Clamp Anode Replaced	
DIFFUSER #103	2.5m Spacing	258.75	South	10%	Good				200mm		
DIFFUSER #104		261.25	North	40%	Good				330mm		
SADDLE BLOCK #53		262.5		70%		N 1200mm	100%	Clamp .992 New 1.015 N .949 New .979	Both Exposed Nth 650mm Sth 460mm	Replaced	
DIFFUSER #105	2.5m Spacing	263.75	South	10%	Good				410mm		
DIFFUSER #106		266.25	North	20%	Good				460mm		
SADDLE BLOCK #54		267.5		50%		S 1250mm	90%	Clamp 1.033 S .850 New.967	Both Exposed Nth 750mm Sth 750mm	1 X Pile Anode Replaced	
DIFFUSER #107	2.5m Spacing	268.75	South	10%	Good				500mm		
DIFFUSER #108		271.25	North	10%	Good				800mm		Probe Into Diffuser Clear
SADDLE BLOCK #55		272.5		70%		N 1100mm	80%	Clamp 1.021 New 1.005 N .938 New .900	Nth Suspended 370mm Sth Exposed 700mm	Replaced	
DIFFUSER #109	2.5m Spacing	273.75	South	10%	Good				600mm		

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #110		276.25	North	10%	GOOD				750mm		
SADDLE BLOCK #56		277.5		75%		S 1240mm	100%	Clamp 1.017 New 1.007 S New .997	Nth Suspended 200mm Sth Suspended 330mm	1 X Pile Replaced 1 X Clamp Replaced	Mussels Cleared
DIFFUSER #111	2.5m Spacing	278.75	South	10%	Good				650mm		
DIFFUSER #112		281.25	North	10%	Good				650mm		
SADDLE BLOCK #57		282.5		75%		N 1340mm	100%	Clamp .995 NEW .995 N .830 New .849	Nth Suspended 130mm Sth Suspended 120mm	Replaced	Old Pipe Unfound At 10+M, Discarded Net Removed from Pipe
DIFFUSER #113	2.5m Spacing	283.75	South	20%	Good				500mm		
DIFFUSER #114		286.25	North	20%	Good				675mm		
SADDLE BLOCK #58		287.5		90%		S 1320mm	90%	Clamp .525 New 1.011 S .958 New .874	Nth Scoured 120mm Sth Suspended 250mm	Replaced	
DIFFUSER #115	2.5m Spacing	288.75	South	20%	Good				650mm		
DIFFUSER #116		291.25	North	20%	Good				750mm		
SADDLE BLOCK #59		292.5		70%		N 1460mm	90%	Clamp .485 New 1.018 N .820 New .937	Nth Suspended 250mm Sth Suspended 220mm	Replaced	
DIFFUSER #117	2.5m Spacing	293.75	South	10%	Good				550mm		
DIFFUSER #118		296.25	North	20%	Good				800mm		
SADDLE BLOCK #60		297.5		90%		N 1460mm S 1470mm	N 100% S 80%	Clamp .863 New 1.020 N .568 New .904 S .932 New .876	Exposed Nth 660mm Sth Scoured 120mm	Replaced	

LOCATION	SPACING	DISTANCE (metre)	DIFFUSER PLACEMENT (North / South)	ANODE DEPLETION	DIFFUSER FLOW	PILE PROTRUSION FROM TOP OF CONCRETE BLOCK TO TOP OF PILE	PILE ANODE DEPLETION	CATHODIC PROTECTION READINGS	SEABED LEVEL DIFFUSER MEASUREMENTS ARE BELOW	ANODES REPLACED	GENERAL COMMENTS
DIFFUSER #119	2.5m Spacing	298.75	South	20%	Good				550mm		
24 STUB FLANGE (100mm PE End Plate)		300		10%				End plate 1.030	Flush at 6`		All Nuts Present and Tight, No Sign of Leakage.

5. ANODES REPLACED AT 2021 ATTENDANCE

Block #	Pile # and Side	Weight gm - Strap Weigh 60% depleted is <1280g for block anodes	Date Removed
	N5	25	18/11/2021
	S5	78	18/11/2021
	S7	979	18/11/2021
	N8	30	27/11/2021
	S9	80	27/11/2021
	N10	230	27/11/2021
	S11	85	27/11/2021
	N12	360	27/11/2021
	N14	312	27/11/2021
	S15	54	27/11/2021
	S17	0	27/11/2021
	N18	0	27/11/2021
	S19	650	27/11/2021
	N20	30	27/11/2021
	S21	250	27/11/2021
	N22	50	27/11/2021
	S23	50	27/11/2021
	N24	285	27/11/2021
	S25	900	28/11/2021
	N26	0	28/11/2021
	N28	102	28/11/2021
	S29	742	28/11/2021
	S30	323	28/11/2021
	N30	368	28/11/2021
	N31	554	28/11/2021

Block #	Pile # and Side	Weight gm - Strap Weigh 60% depleted is <1280g for block anodes	Date Removed
	S31	266	28/11/2021
	S32	480	28/11/2021
	N33	800	28/11/2021
	S34	204	28/11/2021
	N35	400	28/11/2021
	S36	228	28/11/2021
	N39	800	28/11/2021
	S40	640	28/11/2021
	N41	418	28/11/2021
	S42	957	28/11/2021
	N43	731	28/11/2021
	S47	400	28/11/2021
	N48	612	28/11/2021
	S50	260	21/11/2021
	N51	360	21/11/2021
	N53	300	22/11/2021
	S54	100	22/11/2021
	N55	350	27/11/2021
	S56	152	22/11/2021
	N57	95	22/11/2021
	S58	30	22/11/2021
	N59	258	22/11/2021
	N60	155	22/11/2021
	S60	470	22/11/2021
2		998	18/11/2021
3		837	18/11/2021
4		828	18/11/2021
5		930	18/11/2021
6		918	18/11/2021

Block #	Pile # and Side	Weight gm - Strap Weigh 60% depleted is <1280g for block anodes	Date Removed
7		827	19/11/2021
8		882	19/11/2021
9		978	19/11/2021
10		747	19/11/2021
11		799	19/11/2021
12		1018	19/11/2021
13		578	19/11/2021
14		948	19/11/2021
15		843	27/11/2021
16		1320	27/11/2021
17		1097	27/11/2021
18		1435	27/11/2021
19		1468	27/11/2021
20		1250	27/11/2021
21		1370	27/11/2021
22		1230	27/11/2021
23		1200	27/11/2021
24		1250	27/11/2021
26		488	28/11/2021
27		256	28/11/2021
28		950	28/11/2021
29		956	28/11/2021
30		1270	28/11/2021
31		1070	28/11/2021
32		810	28/11/2021
33		960	28/11/2021
34		952	28/11/2021
35		870	28/11/2021
36		720	28/11/2021

Block #	Pile # and Side	Weight gm - Strap Weigh 60% depleted is <1280g for block anodes	Date Removed
37		1100	28/11/2021
40		780	28/11/2021
47		981	22/11/2021
48		850	22/11/2021
49		796	22/11/2021
50		685	21/11/2021
51		760	21/11/2021
52		875	22/11/2021
53		1136	22/11/2021
55		1000	22/11/2021
56		828	22/11/2021
57		794	22/11/2021
58		788	21/11/2021
59		1045	21/11/2021
60		960	21/11/2021

Table of Available Remaining Anodes for Next Attendance

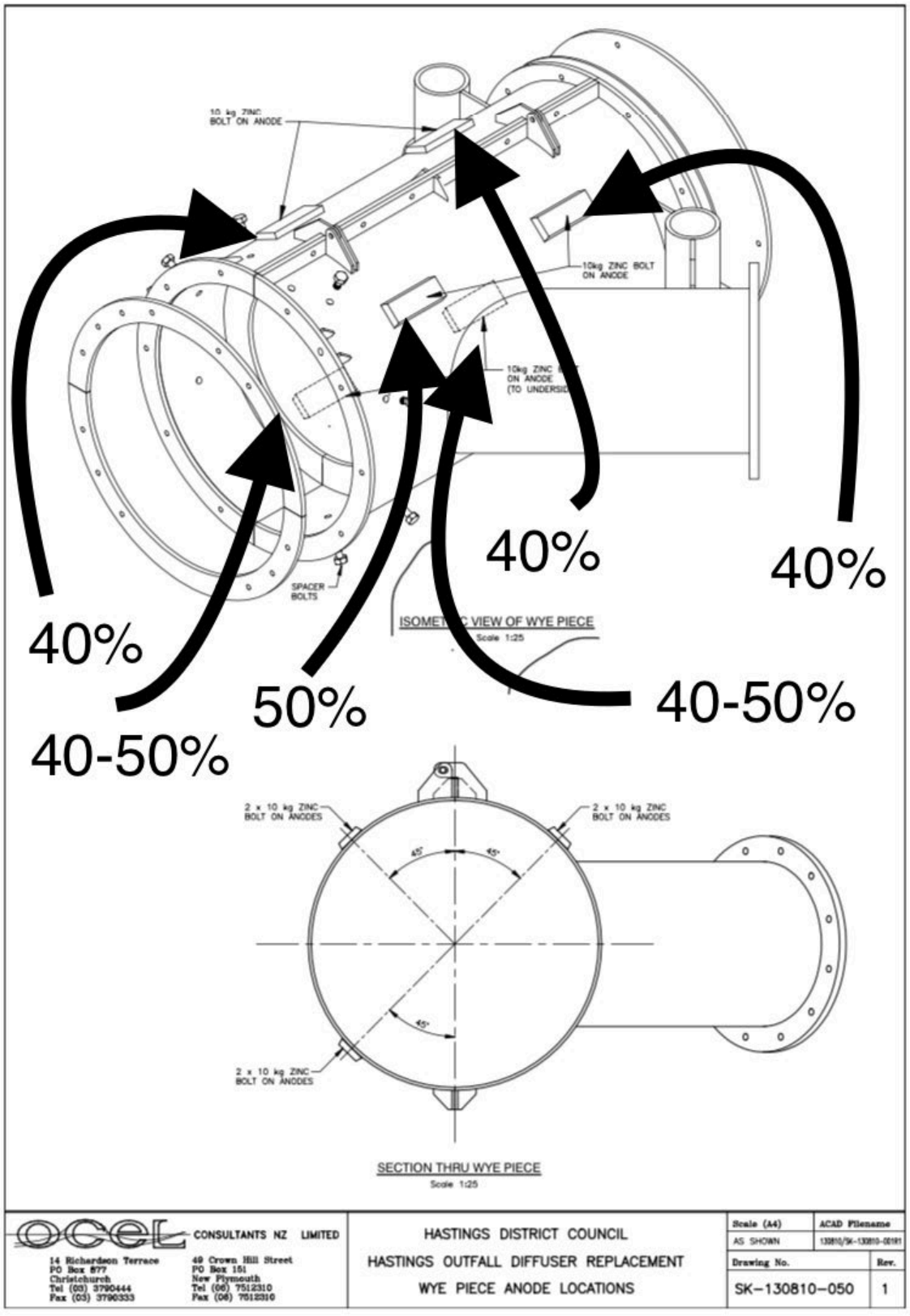
Pile Anodes	13
Pile Brackets	5
Block Anodes	0
WYE Anodes	12
Flange Anodes	1
Diffuser Anodes	24

INSHORE CONCRETE PIPE INSPECTION				
	Seabed Level	Gasket Condition	Sign Of Leaks	Comments
#1	100mm below 6 o'clock	No Sign of Damage	Leak At 7/8 o'clock	
#2	6 o'clock	Gasket Protruding at 12/9 o'clock and 6/3 o'clock	No Sign of Leaks	Threaded Rod at 12 o'clock 300mm Past #2
#3	3/9 o'clock	Appears Good	No Sign of Leaks	Threaded Rod at 12 o'clock 300mm Past #3
#4	5/7 o'clock	Gasket Protruding at 7/9 o'clock	No Sign of Leaks	Threaded Rod at 12 o'clock 300mm Past #4
#5	3/9 o'clock	Appears Good	No Sign of Leaks	
#6	3/9 o'clock	Gasket Protruding at 7/9 o'clock	No Sign of Leaks	
#7	5/7 o'clock	Gasket Bulging at 12 o'clock	No Sign of Leaks	
#8	6 o'clock	Gasket Good	No Sign of Leaks	
#9	5/7 o'clock	Gasket Good	No Sign of Leaks	
#10	6 o'clock	Gasket Good	No Sign of Leaks	
#11	6/9 o'clock	Gasket Good	No Sign of Leaks	
#12	6 o'clock	Gasket Good	No Sign of Leaks	
#13	5/9 o'clock	Gasket Good	No Sign of Leaks	
#14	5/9 o'clock	Gasket Good	No Sign of Leaks	
#15	3/9 o'clock	Gasket Good	No Sign of Leaks	
#16	3/9 o'clock	Gasket Good	No Sign of Leaks	
#17	2/9 o'clock	Gasket Good	No Sign of Leaks	
#18	2/10 o'clock	Gasket Good	No Sign of Leaks	
#19	2/10 o'clock	Gasket Good	No Sign of Leaks	
#20	2/10 o'clock	Gasket Good	No Sign of Leaks	
#21	2/10 o'clock	Gasket Good	No Sign of Leaks	

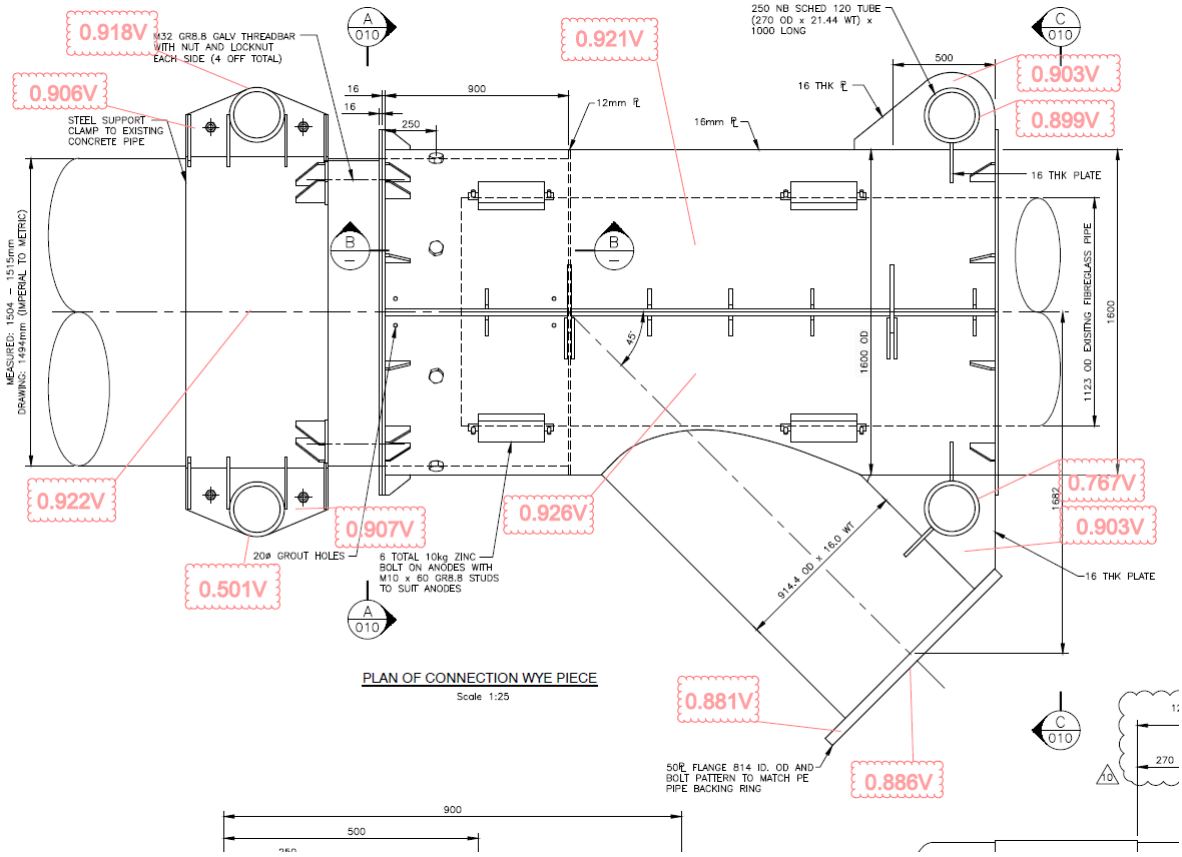
#22	**2/10 o'clock**	**Gasket Good**	**No Sign of Leaks**	
#23	**2/10 o'clock**	**Gasket Good**	**No Sign of Leaks**	
#24	**2/10 o'clock**	**Gasket Good**	**No Sign of Leaks**	
#25	**2/10 o'clock**	**Gasket Good**	**No Sign of Leaks**	
#26	**3/9 o'clock**	**Gasket Missing**	**No Sign of Leaks**	
#27	**2/10 o'clock**	**Gasket Missing**	**No Sign of Leaks**	
#28	**3/9 o'clock**	**Part of Gasket Missing at 12 o'clock**	**No Sign of Leaks**	
#29	**2/10 o'clock**	**Gasket Feels Deteriorated**	**No Sign of Leaks**	
#30	**1/10 o'clock**	**Gasket Protruding from Sand**	**No Sign of Leaks**	
#31	**Buried 200m**	**-**	**-**	

6. DIAGRAMS

WYE Anode Depletion Mark-Up



Wye Anode Depletion Mark-up



7. PHOTOGRAPHS

Image 1: Inshore Nav Buoy

Image 2: Offshore Nav Buoy

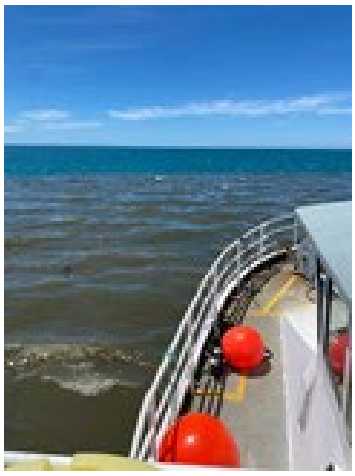


Image 3: Plume During Flushing

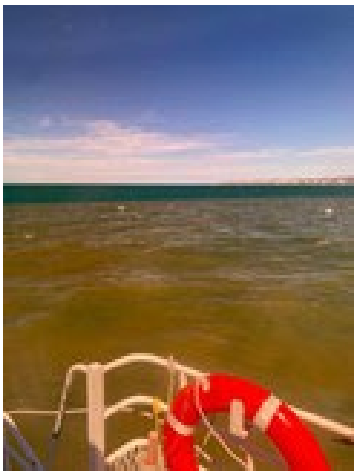


Image 4: Plume During Flushing

Image 5: Replaced Mooring Chain

Image 6: Block Anode Comparison

8. MEDIA

Below is the Dropbox link for the supporting media from this attendance.

https://www.dropbox.com/sh/hqqwogllskdsnn8/AADHmDe7PSBvoii1hDolx3s7a?dl=0

Note: Visibility during the inspection was very poor, under water stills were not captured during this attendance. The audio and video feed from the divers was recorded and provided in the Dropbox link above.

9. RECOMMENDATIONS

- There are nine (9) pile anodes that need replacing and three (3) clamp anodes.
- There are thirty two (32) diffuser anodes that are in the 30 – 50% depletion range. These are likely to need replacing at the next attendance
- Check Wye seal for signs of leaks and degradation
- Check SS band
- Check SS ratchet on the new diffuser cone
- Recover moorings for annual inspection and replace inshore block with new
- Go over all clamp bolts and tighten as required
- Replace all wye anodes

NEW ZEALAND DIVING AND SALVAGE LIMITED

134 GRACEFIELD ROAD, SEAVIEW, LOWER HUTT
PO BOX 30 392, LOWER HUTT, 5040, NEW ZEALAND
P: +64 4 568 2505 | E: nzds@nzds.co.nz | W: www.nzds.co.nz

Appendix F Non-compliance Report – 23 June 2022

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Wastewater Facility	**Lab No:**	3021718 SPv1
Contact:	Wakefield Harland-Baker	**Date Received:**	28-Jun-2022
	C/- Wastewater Facility	**Date Reported:**	05-Jul-2022
	Private Bag 9002	**Quote No:**	
	Hastings 4156	**Order No:**	121611
		Client Reference:	HDC Grab samples 23/6/2022
		Submitted By:	Wakefield Harland-Baker

Sample Type: Aqueous

Sample Name:		Ind GRAB 23-Jun-2022 1:00 pm	Ind GRAB 23-Jun-2022 1:30 pm	IND GRAB 23-Jun-2022 2:00 pm	IND GRAB 23-Jun-2022 2:30 pm	MUD Grab 23-Jun-2022 2:00 pm
Lab Number:		3021718.1	3021718.2	3021718.3	3021718.4	3021718.5
Individual Tests						
Free Ammonia*	g/m^3 at Client Temperature	0.0037	0.0024	0.080	0.097	0.36
pH	pH Units	5.5	5.4	7.0	7.0	7.5
Total Alkalinity	g/m^3 as $CaCO_3$	114	87	210	220	270
Sample Temperature*†	°C	16.0	16.0	16.0	16.0	16.0
Total Ammoniacal-N	g/m^3	31	29	24	26	31
Nitrite-N	g/m^3	< 0.02 #2	< 0.02 #2	< 0.02 #2	< 0.02 #2	< 0.02 #2
Nitrate-N	g/m^3	0.03	0.04	< 0.02	< 0.02	< 0.02
Nitrate-N + Nitrite-N	g/m^3	0.04 #2	0.05 #2	< 0.02 #2	< 0.02 #2	< 0.02 #2
Faecal Coliforms and E. coli profile						
Faecal Coliforms	cfu / 100mL	8,800,000 #1	8,000,000 #1	7,000,000 #1	11,000,000 #1	6,300,000 #1
Escherichia coli	cfu / 100mL	8,700,000 #1	8,000,000 #1	6,900,000 #1	11,000,000 #1	5,200,000 #1

Sample Name:		MUD Grab 23-Jun-2022 2:01 pm				
Lab Number:		3021718.6				
Individual Tests						
Free Ammonia*	g/m^3 at Client Temperature	0.30	-	-	-	-
pH	pH Units	7.5	-	-	-	-
Total Alkalinity	g/m^3 as $CaCO_3$	250	-	-	-	-
Sample Temperature*†	°C	16.0	-	-	-	-
Total Ammoniacal-N	g/m^3	30	-	-	-	-
Nitrite-N	g/m^3	< 0.02 #2	-	-	-	-
Nitrate-N	g/m^3	< 0.02	-	-	-	-
Nitrate-N + Nitrite-N	g/m^3	< 0.02 #2	-	-	-	-
Faecal Coliforms and E. coli profile						
Faecal Coliforms	cfu / 100mL	6,000,000 #1	-	-	-	-
Escherichia coli	cfu / 100mL	5,100,000 #1	-	-	-	-

Analyst's Comments

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

#1 Statistically estimated count based on the theoretical countable range for the stated method.
Please interpret this microbiological result with caution as the sample was >24 hours old on receipt at the lab. The sample is required to reach the laboratory with sufficient time to allow testing to commence within 24 hours of sampling.

#2 Due to the nature of this sample a dilution was performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO2N, NO3N and NOxN analysis.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Free Ammonia*	Calculation from NH4N, pH, Temperature (Calculations based on data for distilled water). ANZECC: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Vol. 2, Chapter 8, Table 8.3.6, October 2000.	0.000010 g/m^3 at Client Temperature	1-6
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-6
pH	pH meter. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-6
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-6
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1-6
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-6
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-6
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-6
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-6
Faecal Coliforms and E. coli profile			
Faecal Coliforms	Membrane Filtration, Count on mFC agar, Incubated at 44.5°C for 22 hours, Confirmation. APHA 9222 D 23rd ed. 2017.	1 cfu / 100mL	1-6
Escherichia coli	Membrane filtration, Count on mFC agar, Incubated at 44.5°C for 22 hours, MUG Confirmation. APHA 9222 I 23rd ed. 2017.	1 cfu / 100mL	1-6

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 28-Jun-2022 and 01-Jul-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix G Peer Review Report

eCoast Marine Consulting and Research
PO Box 151
Raglan 3265
New Zealand
Ph. +64 21 343 717
www.ecoast.co.nz
info@ecoast.co.nz

22 September 2022

Shannon Kendall
Project Manager
Stantec
First Floor, 100 Warren Street South
Hastings 4122
New Zealand

Dear Shannon,

Re: eCoast review of Hastings WWTP Annual Compliance Report

This letter provides a review of the report entitled *Annual Monitoring Report July 2021 – June 2022 for Hastings Wastewater Discharge Resource Consent (No. CD130214W)* and its appendices (A - D) in conjunction with the associated Resource Consent document (CD130214W).

The review is presented by condition below. In summary, apart from a single minor non-compliance for Condition 5, the reporting satisfies all of the requirements of the consent conditions relevant to this review.

Review by condition:

1. This condition has been met.
2. There has been no exceedance of the discharge limit of 2,800 L/s in the reporting period.
3. The report documents that the outfall dimensions and location are correct. There was a reported leak in the wye connection which divers reported as having a "*heavy flow*". However, this connection is "*comparable to the diffuser ports*" (pers. comm., Chunlong Wang, 15 Sept 2022) and hence does not represent non-compliance of this condition. Chunlong Wang also stated that extra words will be added to the final report to clarify this.
4. The report confirms that the diffuser has been designed to the required specification.
5. The report confirms that the wastewater screening requirements have been met apart from one minor non-compliance on 23 June 2022 (summarised in Table 21). Due to this event, Condition 5 has appropriately been assigned a Resource Consent Compliance Status of ***Minor Non-compliance***.
6. The monitoring confirms that the requirements for Final Combined Wastewater (FCW) metal concentrations were met throughout the reporting period.
7. The report confirms that these water quality standards were met, and no adverse effects were observed. The Diffuser Inspection and Maintenance Report – Nov 2021 reports a reasonably conspicuous plume that developed on the surface during flushing. Further comment from HDC relating this to Condition 7(b) confirmed that *the "discoloration was within the immediate vicinity of the diffuser"* (pers. comm., Chunlong Wang, 15 Sept 2022). With respect to condition 7(e) "any significant effects on aquatic life", it is noted that this is restricted to the effluent toxicity testing undertaken by NIWA, with the inference that if this is acceptable, then the whole of the aquatic environment is not being impacted.
8. The monitoring confirms that the Total Oil and Grease (TOG) concentrations in the final combined wastewater were under 200 g/m^3.
9. Inspections were carried out as per this condition. Clearing of blocked ports was undertaken and reported on.

10. The report confirms that maintenance of the outfall and treatment plant were undertaken as required.
11. The meters and monitoring methodology outlined in the report and MOU meet the requirements of this condition.
12. The monitoring methodology and instrumentation standards meet the requirements of this condition.
13. The report states that this condition no longer applies.
14. Total suspended solids, TOG and $cBOD_5$ were appropriately monitored as per this condition. The report notes that the first 5 samples from the 7-day survey starting on 26/04/2022 were not analysed due to a labelling error (Section 2.2.3). The report notes that this does not have an impact on compliance as the annual testing parameters are for reference.
15. The 4 quarterly toxicity reports were all more than 2 months apart, and although there were 2 tests that did not meet the test acceptability, the tests compiled with the decision tree (i.e., they were not in two consecutive quarterly tests), and so compliance was met for this condition:
    - 1st Quarter – collected 27-28 July 2021, report September 2021. All 4 tests complied with the conditions.
    - 2nd Quarter – collected 1-2 November 2020, report December 2021. The algae test had an anomalous concentration response curve at the lower concentrations and a no-toxicity dilution could not be calculated. The wedge shell tests showed statistically significant toxicity at 5% effluent and higher but did not show statistically significant toxicity at a 200-fold dilution (0.5% effluent). Normal blue mussel embryo development was significantly affected at the lowest test concentration (0.25% effluent) resulting in a no toxicity dilution of >400-fold. Based on the decision tree, since no species has had a consecutive incidence of TEC < 0.25% effluent between quarters and all species had EC10 (acute) or EC20 (chronic) greater than 0.5% effluent, "no further action is required".
    - 3rd Quarter – collected 17-18 January 2022, report March 2022. All 4 tests complied with the conditions.
    - 4th Quarter – collected 1-2May 2022, report June 2022. All 4 tests complied with the conditions.

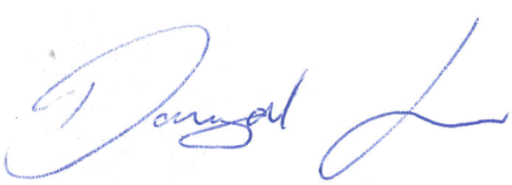
    While this meets compliance in terms of conditions, NIWA point out in each of their quarterly assessments that "The results from this suite of toxicity tests provide a moderate degree of confidence in assessing the toxic hazard of the sample. However, these sensitivity rankings are specific to zinc and care must be taken when extrapolating these results where other classes of contaminants (e.g., organics) may be present and for protection of all organisms present in a particular receiving water environment (e.g., Hawke's Bay)."
16. Transects of water quality variables were taken in accordance with this condition. Measurements of Faecal coliform and Enterococci showed a trend towards higher concentrations with proximity to the outfall on one occasion (2/07/2022) though this trend was not seen in the subsequent three transects. No such trend was observed for any of the other variables.
17. Current measurements were taken as appropriate to this condition.
18. This condition requires a benthic assessment on the 8th year following the granting of the resource consent. This is due 2022/2023 and will be undertaken in January/February 2023. This is consistent with the requirements of the consent.
19. Sediment samples were taken in accordance with this consent. As per the report, only one notable measurement where the consented limits were exceeded was for Total Recoverable Mercury (recorded on 02/11/2021). The report points out that the "*exceedance (one) is below the Condition 19 threshold (two) and does not breach the Condition*". This is an appropriate interpretation of the results.
20. Hills Laboratories is an appropriate institution to use for analysis of samples.
21. The MOU is included in this report (Appendix C) and provides detail around the protocols and methodologies as per this condition.
22. Display of suitable signage is confirmed in the MOU document.
23. A contact has been provided and this condition has been met.

24. The Annual Monitoring Report satisfies the requirements of this condition.
    a) A summary of all monitoring has been provided. Additional monitoring was undertaken for sediment sampling (undertaken quarterly instead of biannually) and for waterborne nutrients in the receiving waters around the outfall (See Section 2.3.2.3). This condition has been met.
    b) Critical analysis of the monitoring results has been presented. This condition has been met.
    c) Critical analysis of the monitoring information in terms of compliance and adverse environmental effects has been presented. This condition has been met.
    d) Trigger values for $cBOD_5$, TSS or flow volume were not exceeded during the reporting period.
    e) A single minor non-compliance event occurred (bypass of $140m^3$ of domestic wastewater past the domestic treatment process on 23/06/2022). The cause of the problem was identified, samples were taken to understand the impact and a report was submitted to HBRC. The draft report states that ***No*** *non-compliance event occurred during this reporting period, July 2021 to June 2022* which would appear to be at odds with the reporting of a minor non-compliant event. HDC have confirmed that this is a typographic error and will be revised (pers. comm., Chunlong Wang, 15 Sept 2022).
    f) Improvement works are summarised in the report as per the condition
    g) While data from previous years of sampling are not provided, the report provides trends in monitored parameters/constituents. As no long-term negative trends were observed, no negative environmental impacts have been reported.
    h) No changes or additions have been recommended to the current consent monitoring programme.
    i) Transitioning from ANZECC (2000) to ANZG (2018) guidelines is appropriate since the latter supersedes the former.
    j) Details of the WWTP open day are provided as per the conditions.
    k) Laboratory test results are provided as per the conditions.

25. The report states that HDC has not received formal notification from HBRC regarding the previous monitoring report (2020/2021). HDC has confirmed (pers. comm., Chunlong Wang, 15 Sept 2022) that the 2020/2021 will be published on the HBC website as soon as possible. It would seem that every effort has been made to include a link to this document and consequently this condition has been met.
26. The open day was held as required and details of the event have been provided in accordance with this condition.
27. This condition relates to the requirements for future years and does not require any action in this report. As such this condition is met.
28. The complaint logging system is in place (though none were received during this reporting period), and this condition has been met.
29. The reporting indicates that this condition has been met. The meeting's minutes could be added as an appendix for completeness.
30. The two unforeseen events were reported to HBRC as per this condition.
31. The one minor non-compliant event that occurred in this reporting period was reported to HBRC as per this condition. Text relating to this condition in Table 21 state that "*there were no non-compliances during this reporting year*". HDC have confirmed that this is a typographic error and will be revised (pers. comm., Chunlong Wang, 15 Sept 2022).
32. The report confirms that detailed monitoring data is available on request where it is not provided in the report.

Please don’t hesitate to contact us if you require any clarifications.

Yours sincerely



Dougal Greer
Director, eCoast
Environmental Scientist

Dr Shaw Mead
Managing Director, eCoast
Environmental Scientist

Appendix H HDC : Tangata Whenua Wastewater Joint Committee Meeting Minutes

Friday, 26 November 2021

Te Hui o Te Kaunihera ā-Rohe o Heretaunga

Administered by HDC - I whakahaeretia e te Kaunihera ā-Rohe o Heretaunga

HDC : Tangata Whenua Wastewater Joint Committee Meeting

Ngā Miniti

Minutes

Te Rā Hui: Meeting date:	**Friday, 26 November 2021**
Te Wāhi: Venue:	**Council Chamber** **Ground Floor** **Civic Administration Building** **Lyndon Road East** **Hastings**
Time start – end:	**10.50am – 12.05pm**

Go to
www.hastingsdc.govt.nz
to see all documents

HASTINGS DISTRICT COUNCIL
207 Lyndon Road East, Hastings 4122 | Private Bag 9002, Hastings 4156
Phone **06 871 5000** | **www.hastingsdc.govt.nz**
TE KAUNIHERA Ā-ROHE O HERETAUNGA

Friday, 26 November 2021

Te Hui o Te Kaunihera ā-Rohe o Heretaunga

Hastings District Council: HDC : Tangata Whenua Wastewater Joint Committee Meeting

Ngā Miniti

Minutes

Te Rārangi Upoko

Table of Contents

Friday, 26 November 2021

Te Hui o Te Kaunihera ā-Rohe o Heretaunga

Hastings District Council: HDC : Tangata Whenua Wastewater Joint Committee Meeting

Ngā Miniti
Minutes

Kua Tae ā-tinana: Present:	**Chair:** Marei Apatu (Chair) Councillor Simon Nixon (Deputy Chair) Councillors Henare O'Keefe, Kevin Watkins and Geraldine Travers (Councillor Alternate) Evelyn Ratima
Kua Tatū: In attendance:	Group Manager: Asset Management - Craig Thew 3 Waters Manager - Brett Chapman Pou Ahurea Matua: Principal Advisor: Relationships, Responsiveness and Heritage – Dr James Graham Wastewater Manager – David Mackenzie Wastewater Treatment Plant Engineer – Wakefield Harland-Baker Democracy & Governance Advisor – Lynne Cox
Ka hiahiatia: As Required:	Mr Mark von Dadelszen, Legal Counsel

Prior to the formal start of the meeting a video was shown as a tribute to the late Peter Paku, acknowledging the contribution he had made to the HDC : Tangata Whenua Wastewater Joint Committee.

The meeting was scheduled to start at 10.30am, but did not formally commence until 10.50am once a quorum was present.

Pou Ahurea Matua: Principal Advisor: Relationships, Responsiveness and Heritage – Dr James Graham opened the meeting with a karakia.

1. APOLOGIES – *NGĀ WHAKAPĀHATANGA*

Councillor Nixon/Councillor O'Keefe

That apologies for absence from Councillor Oli and Tangata Whenua members Joella Brown and Beverley Te Huia be accepted.

Leave of Absence had previously been granted to Councillor Siers.

CARRIED

2. CONFLICTS OF INTEREST - *HE NGĀKAU KŌNATUNATU*

There were no declarations of conflicts of interest.

3. CONFIRMATION OF MINUTES - *TE WHAKAMANA I NGĀ MINITI*

Councillor Watkins/Councillor Nixon

That the minutes of the HDC : Tangata Whenua Wastewater Joint Committee Meeting held Friday 19 February 2021 be confirmed as an accurate record.

CARRIED

4. ANNUAL REPORT 2020/2021

(Document 21/611)

Wastewater Manager, David Mackenzie; 3 Waters Manager, Brett Chapman; and Wastewater Treatment Plant Engineer, Wakefield Harland-Baker all spoke to the report, showed a powerpoint presentation (CG-16-18-00012) and responded to questions from the Committee. Extensive discussion took place regarding the main points in the report.

Councillor Travers/Councillor O'Keefe

That the HDC : Tangata Whenua Wastewater Joint Committee receives the report titled Annual Report 2020/2021 dated 26 November 2021.

CARRIED

5. MINOR ITEMS - *NGĀ TAKE ITI*

There were no additional business items.

6. URGENT ITEMS - *NGĀ TAKE WHAKAHIHIRI*

There were no extraordinary business items.

The Chair, Marei Apatu closed the meeting with a karakia.

_____

The meeting closed at 12.05pm

Confirmed:

Chair:

Date:

CREATING COMMUNITIES

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of belonging. That's why at Stantec, we always **design with community in mind**.

We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

New Zealand offices:
Alexandra, Auckland, Balclutha, Christchurch, Dunedin, Gisborne, Greymouth, Hamilton, Hastings, Napier, Nelson, Palmerston North, Queenstown, Tauranga, Wellington, Whangārei