

Kawakawa Bay Wastewater Treatment Plant
2025-2026 Annual Report

Final - September 2026

Watercare

QUALITY INFORMATION

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REVISION HISTORY

Rev	Revision Date	Name	Position	Signature
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APPROVED

Date	Name	Position	Signature
29/09/2026	Michiel Jonker	Environmental Care Manager	

CONSENT CHANGE AND MONITORING HISTORY

Change type	Description	Effective date	Reference / condition	Reporting / monitoring implications
Management plan update	Kawakawa Bay Wastewater Collection and Treatment System Operation Management Plan updated to reflect current operations	2016		N/A

EXECUTIVE SUMMARY

This report presents the performance, compliance, and monitoring outcomes for the Kawakawa Bay Wastewater Treatment Plant (WWTP) for the period from 1 July 2025 to 30 June 2026. The WWTP, which employs membrane bioreactor technology, continues to operate in accordance with its consents and management plans, providing efficient wastewater treatment while adhering to consent conditions.

Key findings of the annual report include:

- Compliance performance: The plant has maintained full compliance (Category 1) with all relevant consents throughout the reporting period, including discharges to land and air, stormwater management, and effluent quality.
- Effluent discharge: Daily discharge volumes remained well within the maximum consent limit of 800 m^3/day, with an average discharge of 81 m^3/day. The irrigation to the Glen Forest effluent irrigation field was carried out in compliance with all conditions, and no effluent was discharged to the Rautawa Stream during this period.
- Effluent quality: Regular monitoring demonstrated that effluent quality parameters, including faecal coliforms and ammoniacal nitrogen, remained within consented limits.
- Environmental impact: Monitoring of the receiving environment, including the Rautawa Stream and Effluent Disposal Fields was undertaken in 2026 and results of both assessments determined there were no significant adverse effects as a result of the irrigation discharge.
- Air quality: The plant maintained full compliance with air quality standards.
- An isolated incident relating to a rain event on 21 January 2026 resulted in an overflow of approximately 22 m^3 of screened wastewater at the plant. The overflow entered the site dry pond where it was contained. No wastewater entered the Rautawa Stream.
- There were no complaints reported related to the plant's operation. Routine inspections and maintenance have ensured the continued minimisation of odours and emissions from the site.

TABLE OF CONTENTS

1 Introduction 1
2 Treatment plant 2
2.1 Changes in this reporting year 2
2.2 Future changes 2
3 Methodology 3
3.1 Monitoring 3
3.2 Data handling and analysis 4
3.3 Compliance criteria 4
4 Results 5
4.1 Effluent volumes 5
4.2 Effluent quality 7
4.2.1 Parameters within consent limits 7
4.2.2 Effluent quality: soil implications 7
4.3 Air quality 8
4.4 Stormwater monitoring 8
4.5 Stream and receiving environment monitoring 8
4.6 Complaints and incidents 8
5 Conclusions 10

Appendix A. Effluent quality data
Appendix B. Supplementary reports
Appendix C. Compliance assessment
Appendix D. Data sources

LIST OF FIGURES

Figure 4-1: Kawakawa Bay WWTP effluent discharge volumes and rainfall for the 2025-2026 reporting period. 5
Figure 4-2: Effluent volumes by effluent disposal fields (EDF1-4) for the 2025-2026 reporting period. 7

LIST OF TABLES

Table 1-1: Kawakawa Bay WWTP resource consents 1
Table 3-1: Compliance assessment criteria 4
Table 4-1: Seasonal irrigation rate limits for Glen Forest blocks 5
Table 4-2: Effluent compliance summary 2025-2026 9

ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
$cBOD_5$	5-day carbonaceous biochemical oxygen demand
DO	Dissolved oxygen
E. coli	*Escherichia coli*
EDF	Effluent Disposal Field
ESP	Exchangeable sodium percentage
MBR	Membrane bioreactor
NH_x	Ammonia and ammonium, reported in milligrams nitrogen
NO_3	Nitrate as measured in units of nitrogen
TN	Total nitrogen
DRP	Dissolved reactive or soluble reactive phosphorus (synonyms)
REMP	Receiving Environment Monitoring Plan
TP	Total phosphorus
TSS	Total suspended solids
Watercare	Watercare Services Limited
WAS	Waste activated sludge
WWTP	Wastewater treatment plant

1 INTRODUCTION

This annual report presents the results for the Kawakawa Bay Wastewater Treatment Plant (WWTP) from 1 July 2025 to 30 June 2026. The report includes:

- Description of the WWTP
- Relevant consents and management plans
- Plant performance
- Summary of compliance

Table 1-1 lists the active consents for the Kawakawa Bay WWTP. Watercare made no changes to these consents in 2025-2026.

A separate report covers the annual findings for consent 31272 (discharge in the collection network). This annual report does not include the results for that consent.

A Receiving Environment Monitoring Plan (REMP) was written in 2010 by Earth Consult Limited in accordance with Consent DIS60262735 condition 40. The REMP details the receiving environment monitoring scheme which is used to assess the potential effects on the Rautawa Stream and Kawakawa Bay to which it discharged. The 2025-2026 Impact Assessment Report, which fulfils the conditions of the REMP, can be found in Appendix B.

Table 1-1: Kawakawa Bay WWTP resource consents

Consent type	Consent number	Council Number	Expiration date
Discharge to Air	30829	DIS60265275	31/12/2042
Discharge to Stormwater	30830	DIS60262712	31/12/2042
Discharge to Land	30833	DIS60262735	31/12/2042
Discharge to Stream	33143	DIS60266313	31/12/2027
Discharge to Land or Water from Collection Network	31272	DIS60264767	31/12/2042

2 TREATMENT PLANT

The Kawakawa Bay WWTP is a membrane bioreactor (MBR) based wastewater treatment plant that consists of the following major treatment devices and processes:

- Inlet screen and grit removal
- Two balancing tanks
- Two-anoxic and one-aerobic tanks
- One membrane bioreactor
- Effluent storage lagoons (one operational, one seasonal)
- Irrigation fields
- Waste activated sludge (WAS) storage tanks.

The treated effluent discharges to the effluent irrigation field at Glen Forest. Should discharging to the irrigation field not be possible, the WWTP can discharge to the Rautawa Stream between May and October (inclusive) subject to meeting specific consent conditions. To date, Watercare has never directly discharged treated effluent to the Rautawa Stream.

Waste activated sludge from the bioreactors is temporarily stored in WAS tanks on-site before the sludge goes to the Māngere WWTP.

2.1 Changes in this reporting year

There have been no upgrades to the WWTP during the reporting period.

2.2 Future changes

Forestry harvesting, including earthworks, is planned to commence at Kawakawa Bay in October 2026. To support these works, Watercare will isolate affected irrigation block sections and manage effluent storage within the seasonal lagoon to maintain compliance with the site's maximum daily field discharge limits. A new access road will be constructed to enable harvesting activities while avoiding impacts to ongoing wastewater operations. Tree removal will be staged to minimise any disruption to effluent disposal, and any redundant or impacted pipework will be replaced once the harvesting and earthworks programme is complete.

Future upgrade needs have been identified for the Kawakawa Bay WWTP. Funding for these has not yet been confirmed, and as a result, their delivery timeframes remain to be determined. The currently identified future upgrade needs include:

1. Buffer Storage Expansion
2. Radio Link Upgrades
3. Irrigation Pumpstation Upgrade

3 METHODOLOGY

3.1 Monitoring

Monitoring included treated effluent quality and discharge volumes, irrigation performance, treatment-process performance, soil conditions, stormwater management, air quality and receiving-environment monitoring.

- Treated wastewater quality was monitored at the permeate tank in accordance with Conditions 24 and 25 of Consent 30833. Samples were collected fortnightly and analysed by the Watercare laboratory for the parameters specified by the consent. Although pH and ammoniacal nitrogen monitoring is only required during May to October, these parameters were monitored throughout the year. Results were assessed against the applicable consent performance criteria, including statistical requirements where specified, rather than solely against individual sample results. Raw monitoring results are provided in Appendix A.
- Discharge volumes and irrigation performance were assessed using operational data recorded through SCADA and PI. Daily treated wastewater volumes discharged to the Glen Forest irrigation area were compared with the maximum consented discharge volume of 800 m^3/day. Irrigation records were also reviewed against the seasonal and slope-dependent application rates specified by Condition 16 of Consent 30833. Relevant PI tags used for reporting are identified in Appendix D.
- Effluent quality parameters including dissolved oxygen within the aerobic treatment process, together with routine plant inspections and maintenance records. Dissolved oxygen performance was assessed against the minimum operating requirement of 1 mg O_2/L.
- Odour monitoring included routine site walkovers (twice weekly).
- Receiving environment monitoring of the Rautawa Stream and Kawakawa Bay, as well as soil monitoring within the irrigation blocks, are required 2-yearly in accordance with consent requirements. Both assessments were undertaken in 2026 and are reported separately; reports are included in Appendix B.
- Soil monitoring was undertaken in May 2026 as part of the two-yearly monitoring programme required by Consent 30833. Sampling and interpretation were undertaken by the Bioeconomy Science Institute in accordance with the applicable monitoring requirements. Results were compared between irrigated and reference areas and with previous monitoring to identify changes potentially attributable to wastewater irrigation.
- Receiving-environment monitoring of Rautawa Stream and Kawakawa Bay was undertaken on 25–26 March 2026 in accordance with the REMP.
- Stormwater performance was assessed through the annual site audit required by Consent 30830, including inspection of site activities and stormwater controls against the applicable consent and operational requirements.

Monitoring data were reviewed for completeness and compliance with the applicable consent conditions. Where numerical limits or statistical criteria applied, results were assessed using the calculation period and statistic specified by the relevant condition. Results were also compared with previous reporting periods, where sufficient comparable data were available, to identify material changes or emerging trends.

3.2 Data handling and analysis

Effluent flow, quality, and irrigation block volumes were sourced directly from the site SCADA system (PI tags listed in Appendix D).

3.3 Compliance criteria

Watercare assesses compliance with consent using the same compliance rating system utilised by the Auckland Council (Table 3-1).

The assessment of WWTP performance considers:

- Results of compliance monitoring
- Recorded incidents and complaints
- Receiving environment monitoring results for Kawakawa Bay.

Table 3-1: Compliance assessment criteria

Rating	Detail
Category 1	Watercare has complied with the consent condition. Where a resource consent condition refers to a provision in a Management Plan, then the plan has been referred to in assessing consent compliance.
Category 2	Watercare has not complied with the consent condition. Watercare has assessed the non-compliance as technical or having no more than minor adverse effect.
Category 3	Watercare has not complied with the consent condition. Watercare has assessed the non-compliance having the potential to result in more than minor adverse effects on the environment. Alternatively, since the last audit, there is evidence of repeat Category 2 non-compliance.
Category 4	Watercare has not complied with the consent condition. Watercare has assessed the non-compliance as having the potential to cause significant adverse effects on the environment. Alternatively, since the last audit, there is evidence of repeat Category 3 non-compliance.

4 RESULTS

4.1 Effluent volumes

Consent 30833 Condition 3 limits the maximum daily discharge of treated final effluent to Glen Forest to ≤800 m^3/day. Figure 4-1 shows the total daily discharge volumes for 2025-2026. The daily discharge volumes were below the consent daily maximum limit for 2025-2026. The average discharge volume was 81 m^3/day, and the total for the reporting period was 29,543 m^3. Production for this reporting period increased from the 2024-2025 period, when the average volume was 69 m^3/day (total 25,265 m^3). This is a result of increased annual rainfall (1,777 mm for 2025-2026, compared to 1,269 mm for 2024-2025).

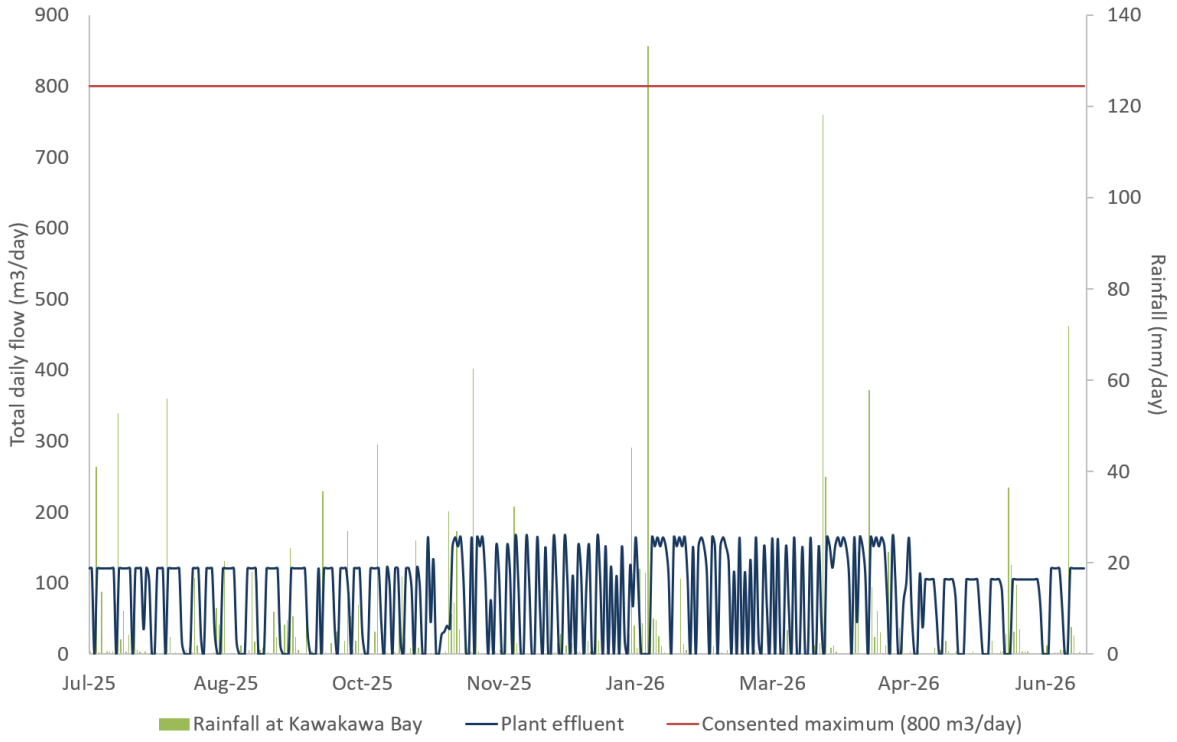


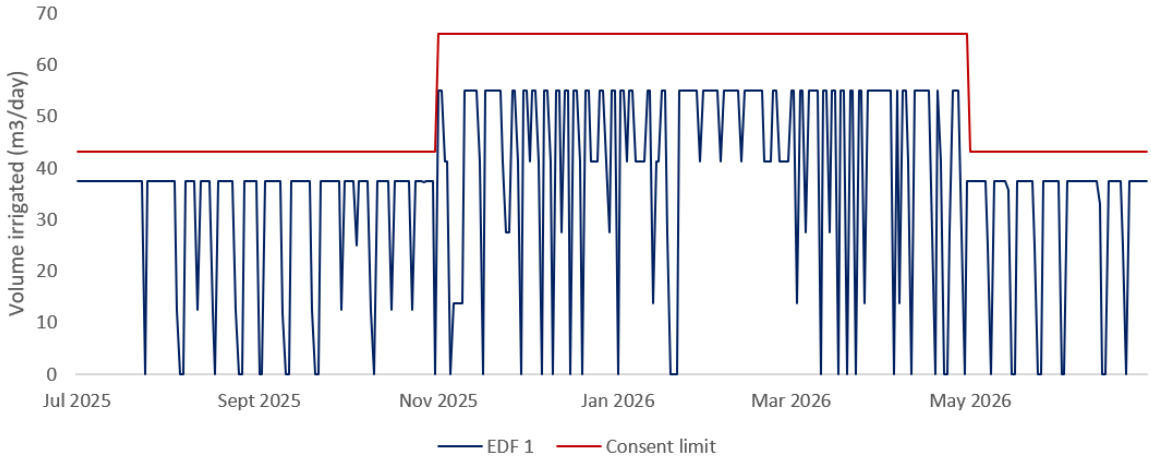
Figure 4-1: Kawakawa Bay WWTP effluent discharge volumes and rainfall for the 2025-2026 reporting period.

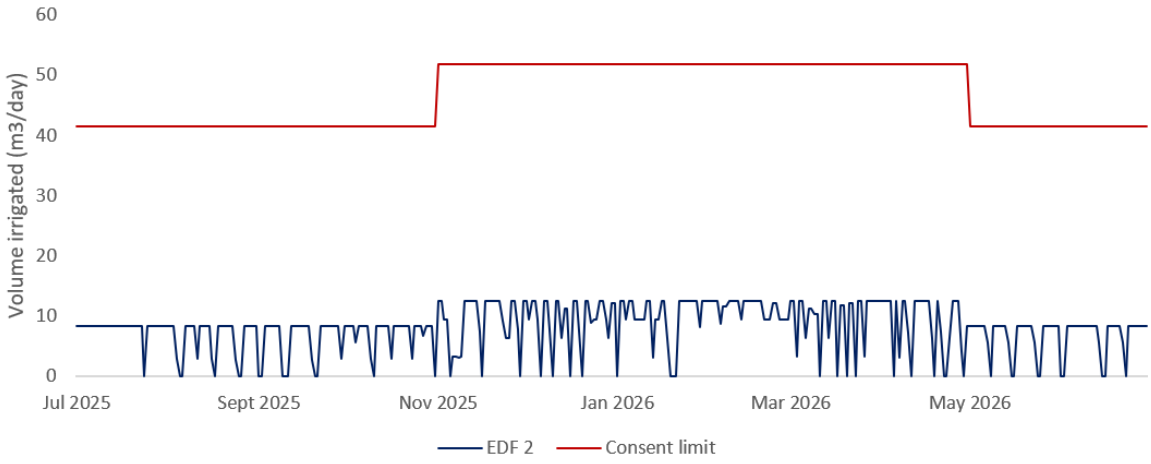
The Glen Forest comprises four effluent disposal fields (EDF). Condition 16, as summarised in Table 4-1, prescribes the daily maximum block irrigation rates (mm/day) and irrigation volumes to the EDFs respectively for the summer (November – April) and winter (May – October) periods.

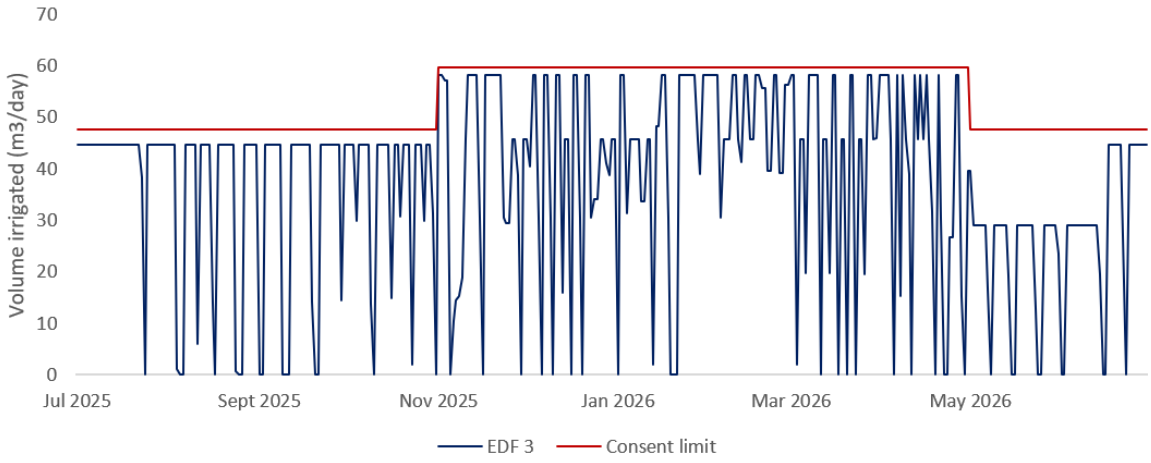
Table 4-1: Seasonal irrigation rate limits for Glen Forest blocks

Effluent disposal field	Net irrigation area (m^2)	Slope	Irrigation rate (mm/day)		Maximum daily irrigation volume limit (m^3/day)	
			Summer	Winter	Summer	Winter
EDF1	25,389	0-20°	2.6	1.7	66.0	43.2
EDF2	34,564	20-30°	1.5	1.2	51.8	41.5
EDF3	39,722	20-30°	1.5	1.2	59.6	47.7
EDF4	26,500	20-30°	1.5	1.2	39.8	31.8

The daily irrigation cycles and durations to Glen Forest are automated. The effluent volume depends on the irrigation volume set points for the respective blocks. Figure 4-2 shows the irrigated volumes to the irrigation blocks. There were no discharges above consent limits during the monitoring period. Irrigation rates for block 3 and 4 for winter and summer were close to their calculated maximum rate, Block 2 had more capacity for irrigation throughout the monitoring period. Where there are periods of no irrigation to Glen Forest, the final effluent remains in the lagoon and irrigation resumed as required.







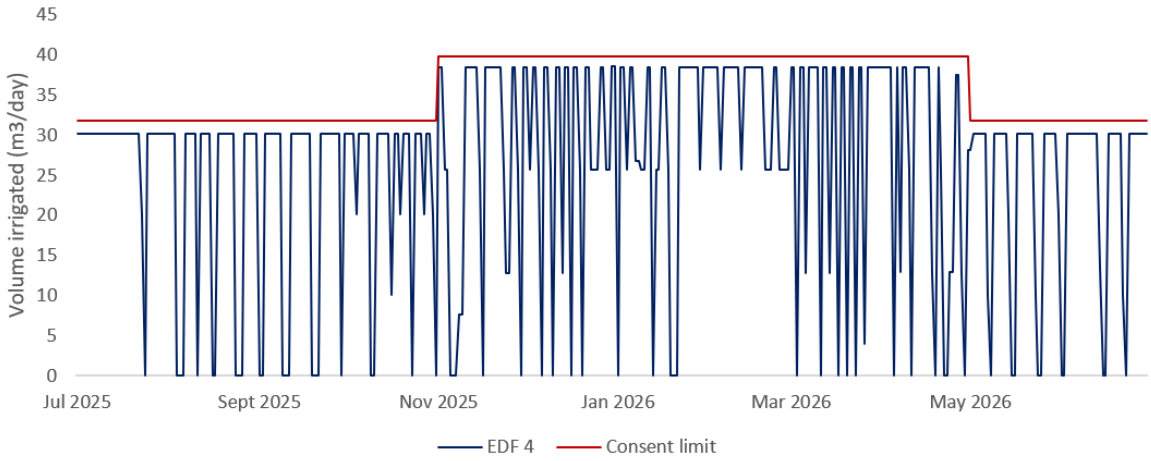


Figure 4-2: Effluent volumes by effluent disposal fields (EDF1-4) for the 2025-2026 reporting period.

4.2 Effluent quality

4.2.1 Parameters within consent limits

Condition 24 requires fortnightly monitoring of the treated effluent from the permeate tank, and Condition 25 lists the test parameters. Table 4-2 shows a summary of effluent monitoring for 2025-2026, with the raw data listed in Appendix A. Since Watercare has not used the stream discharge to the Rautawa Stream, consent 33143 effluent monitoring and performance requirements do not apply.

Effluent was within the consented medians for *E. coli* and faecal coliforms throughout the monitoring period, and many individual results were below the detection limit. Ammoniacal nitrogen was also typically low throughout the period. All the parameters were within similar ranges to the previous monitoring period.

4.2.2 Effluent quality: soil implications

Main cation parameters (magnesium, sodium and calcium) included in the effluent quality results show consistently moderate concentrations. These cations are important for soil chemistry, as they influence the cation exchange capacity (CEC) and the relative balance between exchangeable sodium, calcium, and magnesium.

Conditions 28 – 31 require monitoring of soil in the irrigated and non-irrigated fields in two-yearly intervals. Condition 41 prescribes the monitoring procedures. Bioeconomy Science Institute (formerly Manaaki Whenua) carried out the Kawakawa Bay soil sampling and testing in May 2026, with the report included in Appendix B.

The 2026 assessment determined there are currently no soil chemical properties that are of immediate concern for ongoing wastewater application. However, it was noted that soils within the irrigation fields are considered sodic. Whilst soil exchangeable sodium percentage (ESP) values showed a decline in 2026 compared to 2024 monitoring, the elevated ESP values still indicate a higher proportion of sodium relative to other exchangeable cations. This may increase the risk of soil dispersion and structural decline over time. The assessment recommended consideration of applying a calcium source, such as gypsum, to the irrigation blocks to help improve soil structure and reduce sodicity. Watercare will investigate this further.

The 2026 assessment further recommended measuring near-saturated hydraulic conductivity at the next sampling round to inform ongoing irrigation management. This will be implemented during the next assessment in 2028.

4.3 Air quality

The WWTP was fully compliant with its air discharge consent requirements.

A controlled set point at 2 mg O_2/L maintains the dissolved oxygen levels within the aerobic treatment tank above the minimum limit of 1 mg O_2/L. Average daily aerobic tank dissolved oxygen data is provided in Appendix A. All emissions control equipment, fans and ducting were maintained in good condition, and activities onsite were carried out in a manner that minimised odour.

Walkover inspections were completed a minimum of twice weekly across the reporting period and did not identify any significant odours at the site boundary; walkover inspections are recorded on weekly log sheets and stored electronically in the plant drive. No odour complaints were received by the plant during the reporting period.

4.4 Stormwater monitoring

Consent 30830 Condition 16 requires an annual audit of the WWTP. Watercare carried out an audit of the stormwater and industrial/trade processes on 13 July 2026. The audit found the site fully compliant with consent requirements, and there were no issues to address. Appendix B includes a copy of this report.

4.5 Stream and receiving environment monitoring

Watercare has never used the stream discharge to the Rautawa Stream since commissioning of the WWTP. As a result, the conditions in Consent 33143 were not applicable during the reporting year.

An ecological assessment of the Rautawa Stream is required every two years together with an assessment of part of the coastal marine area of Kawakawa Bay. The 2026 assessment occurred on 25 and 26 March and found no clear adverse effects from irrigation discharges on the Rautawa Stream. The full report is included in Appendix B, the next assessment is due in 2028.

4.6 Complaints and incidents

During a rain event on 21 January 2026 an error with the SCADA system for the wastewater network to the plant resulted in a fault with the network vacuum pump station to the plant. The fault caused wastewater to continue pumping to the plant despite the balancing tanks at the plant reaching capacity and subsequently overflowing with screened wastewater. The fault could not be resolved remotely and had to be stopped manually at the plant.

The overflow drained to the dry pond to the east of the plant where it was contained. An estimated volume of 22 m^3 entered the dry pond and soaked to ground. There was no discharge from the dry pond, and no wastewater entered the Rautawa Stream. The SCADA fault was resolved and no further incidents occurred. Further details on this incident are provided in the 2026 stormwater audit report.

There were no other incidents at the WWTP over the 2025-2026 reporting period.

The WWTP did not receive any complaints related to its operation or maintenance over the reporting period.

Table 4-2: Effluent compliance summary 2025-2026

Parameter	Units	n	Minimum	Average	Maximum	Consented Maximum	Median	Consented Median	Compliant
Discharge Volume	m^3/day	365	0.00	80.94	164.39	800	105.08	-	Yes
pH	-	26	7.00	7.35	7.60	-	7.40	-	-
Sodium	mg/L	52	46.0	69.1	93.0	-	68.0	-	-
Magnesium	mg/L	52	3.80	4.76	7.40	-	4.55	-	-
Calcium	mg/L	52	13.0	17.3	22.0	-	17.5	-	-
NH_x-N	mg/L	26	0.02	0.38	5.40	-	0.04	-	-
Nitrate Nitrogen	mg/L	52	0.04	5.20	14.00	-	5.30	-	-
DRP	mg/L	52	0.05	4.67	13.50	-	4.61	-	-
Faecal Coliforms	cfu/100mL	52	< 1.6	65.2	1200.0	-	4.9	≤1,000	Yes
Escherichia coli	cfu/100mL	52	<1.6	45.6	690.0	-	3.3	≤1,000	Yes

Note: Although weekly effluent testing of pH and Ammonia was completed, Condition 25 only requires testing for May to October inclusive. Full weekly results are presented in Appendix A.

5 CONCLUSIONS

Across all consents, the WWTP was **Category 1** in 2025-2026 (fully compliant). Appendix C lists a condition-by-condition assessment of compliance for the Kawakawa Bay WWTP.

Discharge volumes and quality were within the consented limits throughout the reporting period. Receiving environment monitoring of the irrigation block soil and the Rautawa Stream and coastal marine area did not determine any significant adverse effects as a result of the operation of the Kawakawa Bay WWTP.

An isolated incident relating to a rain event on 21 January 2026 resulted in an overflow of approximately 22 m^3 of screened wastewater at the plant. The overflow entered the site dry pond where it was contained. No wastewater entered the Rautawa stream.

The WWTP did not receive any complaints related to its operation or maintenance over the reporting period.

Appendix A. Effluent quality data

Table A-1: Kawakawa Bay effluent quality

Date	E. coli	F. coliforms	NO_3-N	Ca (Total)	DRP	Mg (total)	Na (total)	pH	NH_x-N
	cfu/100 mL	cfu/100 mL	mg/L	mg/L	mg/L P	mg/L	mg/L	pH unit	mg/L
2-Jul-25	1.60	1.60	6.05	18.00	2.32	4.10	57.00	7.10	0.04
9-Jul-25	3.30	8.20	6.16	19.00	5.17	4.50	57.00	7.10	0.04
16-Jul-25	690.00	1200.00	4.94	22.00	3.42	4.20	51.00	7.10	0.03
23-Jul-25	440.00	450.00	0.68	18.00	7.94	4.90	64.00	7.00	0.60
30-Jul-25	290.00	310.00	0.22	14.00	4.42	4.00	62.00	7.20	5.40
6-Aug-25	98.00	130.00	10.80	16.00	7.95	4.70	63.00	7.10	0.04
13-Aug-25	54.00	80.00	3.80	13.00	4.93	4.10	67.00	7.20	0.30
20-Aug-25	25.00	23.00	6.30	14.00	3.99	3.80	61.00	7.30	0.04
27-Aug-25	1.60	1.60	5.89	17.00	4.85	4.30	66.00	7.40	0.04
3-Sept-25	6.60	62.00	4.90	15.00	5.57	4.20	66.00	7.40	0.02
10-Sept-25	18.00	23.00	6.35	15.00	6.06	4.40	65.00	7.40	0.03
17-Sept-25	16.00	16.00	4.00	17.00	2.87	4.20	59.00	7.50	0.04
24-Sept-25	1.60	1.60	5.50	17.00	4.84	4.60	68.00	7.10	0.04
1-Oct-25	18.00	25.00	3.36	17.00	2.21	4.30	62.00	7.20	0.15
8-Oct-25	1.70	1.70	3.12	18.00	4.36	4.70	63.00	7.50	0.03
15-Oct-25	11.00	9.80	0.79	14.00	4.40	3.80	60.00	7.40	2.30
22-Oct-25	1.60	1.60	0.25	17.00	2.02	4.20	70.00	7.60	0.04
29-Oct-25	1.60	1.60	1.33	16.00	2.13	4.20	65.00	7.50	0.16
5-Nov-25	8.20	9.80	3.99	16.00	3.75	4.40	69.00	7.60	0.04
12-Nov-25	1.60	8.20	2.28	16.00	1.35	4.00	60.00	7.20	0.04
19-Nov-25	1.60	1.60	4.93	18.00	8.87	5.20	66.00	7.40	0.03
26-Nov-25	1.60	1.60	6.70	19.00	6.89	5.20	75.00	7.60	0.04
3-Dec-25	1.60	1.60	7.10	17.00	8.82	5.00	68.00	7.50	0.04
10-Dec-25	1.60	1.60	9.20	18.00	10.40	5.50	68.00	7.60	0.04
17-Dec-25	1.70	1.70	12.00	18.00	9.99	6.10	79.00	7.50	0.05
24-Dec-25	1.70	1.70	8.40	16.00	5.81	4.80	73.00	7.40	0.04
31-Dec-25	3.30	1.70	6.50	18.00	13.50	6.40	88.00	7.40	0.33
7-Jan-26	3.30	3.30	14.00	18.00	10.20	7.00	91.00	7.10	0.07
14-Jan-26	1.60	1.60	11.00	20.00	9.27	7.40	93.00	7.10	0.05

Date	E. coli	F. coliforms	NO_3-N	Ca (Total)	DRP	Mg (total)	Na (total)	pH	NH_x-N
	cfu/100 mL	cfu/100 mL	mg/L	mg/L	mg/L P	mg/L	mg/L	pH unit	mg/L
21-Jan-26	1.60	1.60	8.10	18.00	7.84	6.70	89.00	7.40	0.05
28-Jan-26	1.70	1.60	8.10	21.00	0.83	4.60	60.00	7.70	0.05
4-Feb-26	1.60	1.60	0.33	19.00	0.94	4.40	76.00	7.80	0.09
11-Feb-26	110.00	120.00	5.10	18.00	0.05	5.40	80.00	7.70	0.05
18-Feb-26	26.00	52.00	6.30	16.00	0.41	4.00	70.00	7.70	0.04
25-Feb-26	1.60	4.90	3.10	18.00	9.09	5.10	74.00	7.40	0.89
4-Mar-26	1.60	3.30	6.50	17.00	4.93	4.60	75.00	7.60	0.04
11-Mar-26	1.60	1.60	0.04	18.00	6.60	5.50	79.00	7.60	0.04
18-Mar-26	1.60	4.90	6.40	16.00	7.50	5.20	76.00	7.70	0.04
25-Mar-26	1.60	1.60	4.60	21.00	0.12	5.50	77.00	7.70	0.03
1-Apr-26	1.60	1.60	4.90	19.00	0.83	4.50	60.00	7.60	0.03
8-Apr-26	1.60	1.60	4.20	18.00	1.50	4.60	82.00	7.50	0.03
15-Apr-26	58.00	52.00	1.50	20.00	0.44	4.50	46.00	7.50	0.02
22-Apr-26	15.00	23.00	4.40	18.00	0.69	4.10	56.00	7.60	0.03
29-Apr-26	48.00	62.00	5.70	19.00	1.30	4.40	77.00	7.60	0.03
6-May-26	40.00	50.00	5.60	16.00	5.90	4.60	71.00	7.50	0.03
13-May-26	4.90	9.80	5.50	18.00	3.70	5.00	72.00	7.60	0.04
20-May-26	18.00	33.00	5.00	16.00	4.80	4.90	74.00	7.20	0.03
27-May-26	1.60	4.90	5.90	15.00	5.70	4.70	69.00	7.50	0.05
3-Jun-26	8.20	3.30	2.80	16.00	5.40	4.50	73.00	7.60	0.17
10-Jun-26	230.00	430.00	5.50	19.00	1.20	4.50	63.00	7.60	0.03
17-Jun-26	80.00	120.00	5.50	16.00	2.60	4.20	67.00	7.40	0.04
24-Jun-26	9.80	25.00	4.80	16.00	2.30	3.80	72.00	7.60	0.04

Table A-2: Average daily aerobic tank dissolved oxygen

Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)
1/07/2025	1.99	12/09/2025	1.88	24/11/2025	1.91	5/02/2026	2.14	19/04/2026	1.88
2/07/2025	1.99	13/09/2025	1.93	25/11/2025	1.95	6/02/2026	2.24	20/04/2026	1.88
3/07/2025	1.99	14/09/2025	1.91	26/11/2025	1.97	7/02/2026	2.22	21/04/2026	1.96
4/07/2025	1.95	15/09/2025	1.93	27/11/2025	1.95	8/02/2026	2.25	22/04/2026	1.98
5/07/2025	1.89	16/09/2025	1.93	28/11/2025	1.95	9/02/2026	1.84	23/04/2026	2.03
6/07/2025	1.88	17/09/2025	1.90	29/11/2025	1.95	10/02/2026	1.93	24/04/2026	1.99
7/07/2025	1.94	18/09/2025	1.92	30/11/2025	1.95	11/02/2026	1.98	25/04/2026	2.01
8/07/2025	1.94	19/09/2025	1.91	1/12/2025	1.96	12/02/2026	1.99	26/04/2026	1.99
9/07/2025	1.95	20/09/2025	1.93	2/12/2025	1.98	13/02/2026	1.76	27/04/2026	1.99
10/07/2025	1.92	21/09/2025	1.94	3/12/2025	1.98	14/02/2026	1.93	28/04/2026	2.01
11/07/2025	1.92	22/09/2025	1.91	4/12/2025	2.00	15/02/2026	1.91	29/04/2026	1.99
12/07/2025	1.95	23/09/2025	1.89	5/12/2025	2.05	16/02/2026	1.95	30/04/2026	2.04
13/07/2025	1.95	24/09/2025	1.86	6/12/2025	2.02	17/02/2026	1.99	1/05/2026	2.03
14/07/2025	1.93	25/09/2025	1.88	7/12/2025	1.99	18/02/2026	1.98	2/05/2026	2.00
15/07/2025	1.96	26/09/2025	1.85	8/12/2025	1.95	19/02/2026	2.01	3/05/2026	1.99
16/07/2025	1.95	27/09/2025	1.88	9/12/2025	1.99	20/02/2026	1.98	4/05/2026	2.00
17/07/2025	1.96	28/09/2025	1.85	10/12/2025	2.00	21/02/2026	1.93	5/05/2026	2.03
18/07/2025	1.95	29/09/2025	1.85	11/12/2025	2.01	22/02/2026	1.92	6/05/2026	1.97
19/07/2025	1.98	30/09/2025	1.84	12/12/2025	2.03	23/02/2026	1.96	7/05/2026	2.01
20/07/2025	1.95	1/10/2025	1.91	13/12/2025	2.02	24/02/2026	1.96	8/05/2026	1.99
21/07/2025	2.02	2/10/2025	1.87	14/12/2025	1.98	25/02/2026	1.99	9/05/2026	1.96
22/07/2025	1.99	3/10/2025	1.86	15/12/2025	1.99	26/02/2026	1.99	10/05/2026	1.96
23/07/2025	2.02	4/10/2025	1.86	16/12/2025	2.02	27/02/2026	1.95	11/05/2026	1.98
24/07/2025	2.01	5/10/2025	1.88	17/12/2025	2.05	28/02/2026	1.95	12/05/2026	2.00
25/07/2025	2.03	6/10/2025	1.83	18/12/2025	2.06	1/03/2026	1.91	13/05/2026	2.00
26/07/2025	1.98	7/10/2025	1.84	19/12/2025	2.05	2/03/2026	1.92	14/05/2026	2.01
27/07/2025	1.96	8/10/2025	1.88	20/12/2025	2.02	3/03/2026	2.00	15/05/2026	2.05
28/07/2025	1.98	9/10/2025	1.89	21/12/2025	1.97	4/03/2026	1.99	16/05/2026	1.99
29/07/2025	1.98	10/10/2025	1.87	22/12/2025	1.97	5/03/2026	2.02	17/05/2026	2.00
30/07/2025	1.90	11/10/2025	1.87	23/12/2025	1.95	6/03/2026	2.00	18/05/2026	2.02
31/07/2025	1.94	12/10/2025	1.86	24/12/2025	1.90	7/03/2026	1.98	19/05/2026	2.01
1/08/2025	1.93	13/10/2025	1.87	25/12/2025	1.85	8/03/2026	1.94	20/05/2026	2.00
2/08/2025	1.98	14/10/2025	1.93	26/12/2025	1.82	9/03/2026	1.92	21/05/2026	1.99

Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)
3/08/2025	2.00	15/10/2025	1.89	27/12/2025	1.81	10/03/2026	1.95	22/05/2026	2.01
4/08/2025	2.01	16/10/2025	1.91	28/12/2025	1.83	11/03/2026	2.00	23/05/2026	1.99
5/08/2025	2.05	17/10/2025	1.90	29/12/2025	1.84	12/03/2026	1.99	24/05/2026	1.99
6/08/2025	2.02	18/10/2025	1.87	30/12/2025	1.83	13/03/2026	1.95	25/05/2026	2.00
7/08/2025	2.03	19/10/2025	1.83	31/12/2025	1.83	14/03/2026	1.92	26/05/2026	2.02
8/08/2025	2.02	20/10/2025	1.72	1/01/2026	1.78	15/03/2026	1.92	27/05/2026	2.01
9/08/2025	2.00	21/10/2025	1.90	2/01/2026	1.84	16/03/2026	1.97	28/05/2026	2.00
10/08/2025	2.02	22/10/2025	1.89	3/01/2026	1.80	17/03/2026	1.99	29/05/2026	2.00
11/08/2025	2.01	23/10/2025	1.88	4/01/2026	1.84	18/03/2026	2.00	30/05/2026	1.99
12/08/2025	2.05	24/10/2025	1.91	5/01/2026	1.83	19/03/2026	2.00	31/05/2026	2.00
13/08/2025	2.06	25/10/2025	1.86	6/01/2026	1.83	20/03/2026	2.00	1/06/2026	1.95
14/08/2025	2.11	26/10/2025	1.86	7/01/2026	1.83	21/03/2026	1.97	2/06/2026	1.87
15/08/2025	2.07	27/10/2025	1.79	8/01/2026	1.91	22/03/2026	2.14	3/06/2026	1.88
16/08/2025	2.03	28/10/2025	1.75	9/01/2026	1.91	23/03/2026	1.92	4/06/2026	1.88
17/08/2025	1.98	29/10/2025	1.83	10/01/2026	1.86	24/03/2026	1.89	5/06/2026	1.96
18/08/2025	1.98	30/10/2025	1.86	11/01/2026	1.87	25/03/2026	1.99	6/06/2026	1.94
19/08/2025	1.97	31/10/2025	1.86	12/01/2026	1.87	26/03/2026	1.96	7/06/2026	1.95
20/08/2025	2.01	1/11/2025	1.87	13/01/2026	1.92	27/03/2026	1.99	8/06/2026	1.96
21/08/2025	2.05	2/11/2025	1.88	14/01/2026	1.94	28/03/2026	1.96	9/06/2026	1.99
22/08/2025	2.03	3/11/2025	1.88	15/01/2026	2.00	29/03/2026	1.90	10/06/2026	2.01
23/08/2025	2.00	4/11/2025	1.89	16/01/2026	1.93	30/03/2026	1.97	11/06/2026	2.06
24/08/2025	2.01	5/11/2025	1.86	17/01/2026	1.95	31/03/2026	1.98	12/06/2026	2.05
25/08/2025	2.00	6/11/2025	1.85	18/01/2026	1.95	1/04/2026	1.99	13/06/2026	2.03
26/08/2025	1.98	7/11/2025	1.88	19/01/2026	2.01	2/04/2026	2.00	14/06/2026	2.01
27/08/2025	1.98	8/11/2025	1.86	20/01/2026	2.02	3/04/2026	1.92	15/06/2026	2.06
28/08/2025	1.99	9/11/2025	1.74	21/01/2026	1.96	4/04/2026	1.94	16/06/2026	1.98
29/08/2025	1.99	10/11/2025	1.87	22/01/2026	2.04	5/04/2026	1.92	17/06/2026	2.03
30/08/2025	2.01	11/11/2025	1.86	23/01/2026	2.06	6/04/2026	1.91	18/06/2026	2.03
31/08/2025	1.98	12/11/2025	1.89	24/01/2026	2.01	7/04/2026	2.01	19/06/2026	2.02
1/09/2025	2.00	13/11/2025	1.89	25/01/2026	2.01	8/04/2026	1.98	20/06/2026	1.98
2/09/2025	2.00	14/11/2025	1.95	26/01/2026	1.96	9/04/2026	1.92	21/06/2026	1.98
3/09/2025	2.10	15/11/2025	1.94	27/01/2026	2.00	10/04/2026	1.96	22/06/2026	1.97
4/09/2025	1.95	16/11/2025	1.94	28/01/2026	2.00	11/04/2026	1.92	23/06/2026	1.99
5/09/2025	1.92	17/11/2025	1.93	29/01/2026	1.99	12/04/2026	1.89	24/06/2026	1.92

Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)	Date	DO (mg/L)
6/09/2025	1.88	18/11/2025	1.93	30/01/2026	1.99	13/04/2026	1.92	25/06/2026	1.90
7/09/2025	1.92	19/11/2025	1.96	31/01/2026	1.96	14/04/2026	1.87	26/06/2026	1.95
8/09/2025	1.94	20/11/2025	2.00	1/02/2026	1.96	15/04/2026	1.92	27/06/2026	1.96
9/09/2025	1.95	21/11/2025	1.97	2/02/2026	1.96	16/04/2026	1.98	28/06/2026	1.97
10/09/2025	1.93	22/11/2025	1.91	3/02/2026	2.03	17/04/2026	1.98	29/06/2026	1.98
11/09/2025	1.92	23/11/2025	1.91	4/02/2026	2.08	18/04/2026	1.96	30/06/2026	2.04

Appendix B. Supplementary reports



Kawakawa Bay Wastewater Treatment Plant
Impact Assessment Report

Final - September 2026

Watercare

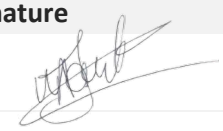
QUALITY INFORMATION

Document	Impact Assessment Report
Date	29 September 2026
Name and position of originator	Matt Conley, Senior Environmental Scientist
Report directory	Watercare Services Limited\Te Taiao - Documents\CMS\Compliance\Drafts\Annual Reports\2025-26\Southeast\DTKAW

REVISION HISTORY

Rev	Revision Date	Name	Position	Signature
1	21/09/2026	Ash Kumar	Operations Controller	
1	21/09/2026	Rohan Bhatia	Wastewater Production Manager South	
2	29/09/2026	Michiel Jonker	Environmental Care Manager	

APPROVED

Date	Name	Position	Signature
29/09/2026	Michiel Jonker	Environmental Care Manager	

CONSENT CHANGE AND MONITORING HISTORY

Change type	Description	Effective date	Reference / condition	Reporting / monitoring implications
REMP update	Rautawa Stream site 7 removed from water quality monitoring programme	Oct 2017	DIS60262735 c.40	Sampling ceased, removed reference from reporting.
REMP update	Ecological monitoring for the Rautawa Stream and coastal marine area frequency reduced to 2 yearly intervals	Oct 2017	DIS60262735 c.40	Surveys conducted biennially instead of biannually.

EXECUTIVE SUMMARY

This report provides the annual review of environmental impacts from the Kawakawa Bay Wastewater Treatment Plant (WWTP). Watercare holds four discharge consents related to the treatment plant:

- DIS60262735, which permits irrigation of fully treated effluent to forestry blocks
- DIS60265275 for air emissions
- DIS6026712 for stormwater
- DIS60266313 for discharges direct to water (currently not in use).

Condition 40 of consent DIS60262735 specifies that the holder develop and implement an approved Receiving Environment Monitoring Plan (REMP) to assess the effects of the WWTP operations on the Rautawa Stream and the Coastal Marine Environment. This impact assessment report (IAR) is written to satisfy the conditions of the REMP by summarising and analysing the results from the period of 1 July 2025 to 30 June 2026.

Key points identified are:

- Total annual rainfall (1,777 mm) increased considerably from the 2024-2025 reporting period (1,269 mm), with seven days exceeding 50 mm/day.
- Irrigation to the forestry block has remained below the consented limit and within effluent quality requirements.
- Effluent quality was generally similar to the previous reporting period. Mann-Kendall analysis for the last 10 years data (July 2016 – June 2026) identified significant decreasing trends for effluent nitrate and ammoniacal-nitrogen.
- No direct discharge has occurred to the Rautawa Stream for the duration of the resource consent.
- Physiochemical parameters in the Rautawa Stream were within the range of natural variation.
- Mean and 95th percentile ammoniacal nitrogen and nitrate-nitrogen levels in the Rautawa Stream were consistent with the previous year and all within attribute band A as set by the National Policy Statement for Freshwater Management (2020) (NPS-FM), with the exception of 95th percentile ammonia-N, which was within band B.
- Median dissolved reactive phosphorus concentration (0.014 mg/L) fell within the range of attribute band C of the NPS-FM, whilst the 95th percentile (0.020 mg/L) was within attribute band A. The 95th percentile further indicates gradual water quality improvements, as first stated in the 2024-2025 IAR. However, concentrations remain slightly elevated compared to baseline data.
- *Escherichia coli* and faecal coliforms were consistently higher than baseline data, likely caused by farmland runoff at both Site 3 and Site 6. Bacterial levels in the effluent remain much lower than the receiving environment monitoring.
- Bacteria levels at Site 6 in the Rautawa Stream were much higher than Site 3, attributed to the additional farmland catchment and tidal influences.
- Mann-Kendall analysis of 10-year stream data identified significant decreasing trends for phosphorus (both total and dissolved) and increasing nitrate and total nitrogen at Site 3. The increasing nitrate trend is in contrast to the observed effluent trend.
- The 2026 assessment of the Rautawa Stream and coastal marine environment indicates the ecological condition of both the freshwater and marine receiving environments has remained broadly consistent with previous surveys, and that there are no clear adverse effects associated with WWTP irrigation discharges.

TABLE OF CONTENTS

List of Figures iv

1 Introduction 7

1.1 Background 7

1.2 Scope 7

2 Monitoring 8

2.1 Rainfall 8

2.2 Influent flow 9

2.3 Effluent flow to effluent disposal field 9

2.4 Effluent quality 12

2.4.1 Effluent trends over time 14

2.5 Rautawa Stream flow and water quality 15

2.5.1 Flow rates 15

2.5.2 Water quality 16

2.5.3 Site 3 16

2.5.4 Comparison to baseline water quality data 20

2.5.5 Site 6 21

2.5.6 Stream quality long-term trends 22

2.5.7 Ecological assessment of the Rautawa Stream and coastal marine environment 23

3 Conclusions 24

Appendix A. Daily rainfall, influent, effluent, EDF flow and environmental data

Appendix B. Effluent disposal field maps

Appendix C. Data Sources

Appendix D. Rautawa Stream and Coastal Marine Environment Ecological Assessment

LIST OF FIGURES

Figure 2-1: Daily rainfall recorded at the Kawakawa Bay WWTP rain gauge for the reporting period 2025-2026. 8

Figure 2-2: Daily influent flow to the Kawakawa Bay WWTP for the reporting period 2025-2026. 9

Figure 2-3: Total daily final effluent discharge to the irrigation system for the reporting period 2025-2026. 9

Figure 2-4: Total daily final effluent discharge by EDF (1-4) for the monitoring period 2025-2026. 11

Figure 2-5: Results for E. coli and faecal coliforms in the final effluent for the monitoring period. 13

Figure 2-6: Results for ammoniacal nitrogen in the final effluent for the monitoring period. 13

Figure 2-7: Results for nitrate-nitrogen in the final effluent for the monitoring period. 13

Figure 2-8: Results for dissolved reactive phosphorus in the final effluent for the monitoring period. 14
Figure 2-9: Results for total calcium, sodium, and magnesium in the final effluent for the monitoring period. 14
Figure 2-10: Location of Site 3 on the Rautawa Stream inside the WWTP boundary, Site 6 in Kawakawa Bay town. 15
Figure 2-11: Rautawa Stream mean daily flow rate for the 2025-2026 monitoring period. 16
Figure 2-12: Rautawa Stream Site 3 results for temperature and dissolved oxygen for the monitoring period. 18
Figure 2-13: Rautawa Stream Site 3 results for total suspended solids for the monitoring period. 18
Figure 2-14: Rautawa Stream Site 3 results for ammoniacal nitrogen for the monitoring period. 18
Figure 2-15: Rautawa Stream Site 3 results for nitrate (as nitrogen) and total nitrogen for the monitoring period. 19
Figure 2-16: Rautawa Stream Site 3 results for total phosphorus and dissolved reactive phosphorus for the monitoring period. 19
Figure 2-17: Rautawa Stream Site 3 results for E. coli and faecal coliforms for the monitoring period. 19
Figure 2-18: Rautawa Stream Site 3 results for biochemical oxygen demand for the monitoring period. 20
Figure 2-19: Rautawa Stream site 6 results of bacterial parameters for the monitoring period. 22

LIST OF TABLES

Table 2-1: Seasonal irrigation rate limits for Glen Forest blocks 10
Table 2-2: Median and maximum bacteria results for the monitoring period 2025-2026. 12
Table 2-3: Seasonal Mann-Kendall effluent trend results for 2016-2026 data. 15
Table 2-4: REMP water quality monitoring schedule 16
Table 2-5: Rautawa Stream water quality (Site 3) comparison between 2004-05 (baseline), 2024-25 and 2025-26. 21
Table 2-6: Seasonal Mann-Kendall Rautawa Stream trend results for 2016-2026 data. 22
Table 3-1: Download location of environmental monitoring data used in this report. 59

ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Full Form
BOD	Biochemical oxygen demand
cBOD5	Carbonaceous biochemical oxygen demand
cfu	Colony forming units
DO	Dissolved oxygen
DRP	Dissolved reactive phosphorus
E. coli	Escherichia coli
EDF	Effluent disposal field
F. coliforms	Faecal coliforms
IAR	Impact Assessment Report
TN	Total Nitrogen
NH3-N	Ammoniacal nitrogen
NO3-N	Nitrate
NTU	Nephelometric turbidity units
REMP	Receiving Environment Monitoring Programme
TSS	Total suspended solids
TP	Total phosphorus
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 Background

The Kawakawa Bay Wastewater Treatment Plant (WWTP) treats wastewater from the Kawakawa Bay township. Raw wastewater is conveyed via a vacuum wastewater collection network. A single pump station in Kawakawa Bay regulates the flow of influent to the plant. This report provides the annual review of environmental impacts from the WWTP. Watercare holds four discharge consents related to the WWTP:

- DIS60262735, which permits Watercare to irrigate fully treated effluent to forestry blocks.
- DIS60265275 for air emissions
- DIS6026712 for stormwater
- DIS60266313 for discharges direct to water

Condition 40 of consent DIS60262735 specifies that the holder develop and implement an approved Receiving Environment Monitoring Plan (REMP) to assess the effects on the Rautawa Stream and the Coastal Marine Environment. The REMP does not cover the effects on air quality associated with the use of DIS60265275 or stormwater (DIS6026712). Such effects are assessed in separate annual reports.

The WWTP provides treatment via a membrane bioreactor process. The WWTP also has two storage lagoons as a buffer capacity for treated effluent and two disposal systems: the land-based effluent disposal field (EDF) via a spray irrigation system to a mature pine forest to the south of the plant and discharge directly to the Rautawa Stream via an overland flow path. There are four effluent disposal fields currently in use within a larger block of forest that acts as the upper catchment for the Rautawa Stream.

Discharges to the stream (DIS60266313; originally 33143) may only occur under the following conditions:

- during winter
- storage capacity is full
- discharge to land is not possible due to saturated soils.

This option has not been used to date.

1.2 Scope

In accordance with condition 40 of resource consent DIS60262735, a REMP was written by Earth Consult Limited in 2010. The REMP details the monitoring requirements to assess the potential effects of the effluent discharges of the receiving environment ecosystems of the Rautawa Stream and Kawakawa Bay Coastal Marine Environment.

Section 4.1 of the REMP states that: *"an annual Impact Assessment Report detailing the methodologies used, the results obtained and an interpretation of the results including trends shall be prepared."*

This report satisfies Condition 40 for the reporting period of 1 July 2025 to 30 June 2026. All data sources for this report are detailed in Appendix C.

2 MONITORING

2.1 Rainfall

Rainfall data is collected in accordance with condition 29 of consent DIS60262735 using a Hydro Services TB3 0.5 mm tipping bucket and recorded every 10 minutes. Figure 2-1 shows daily totals for the reporting period from midnight to midnight.

The total rainfall for the 2025-2026 reporting period was 1,777 mm, an increase on the 2024-2025 period (1,269 mm). The maximum 24-hour rainfall was 133 mm on 21 January 2026. Seven days exceeded 50 mm total rainfall, and the maximum 7-day rainfall was 230 mm between 15 and 22 January 2026.

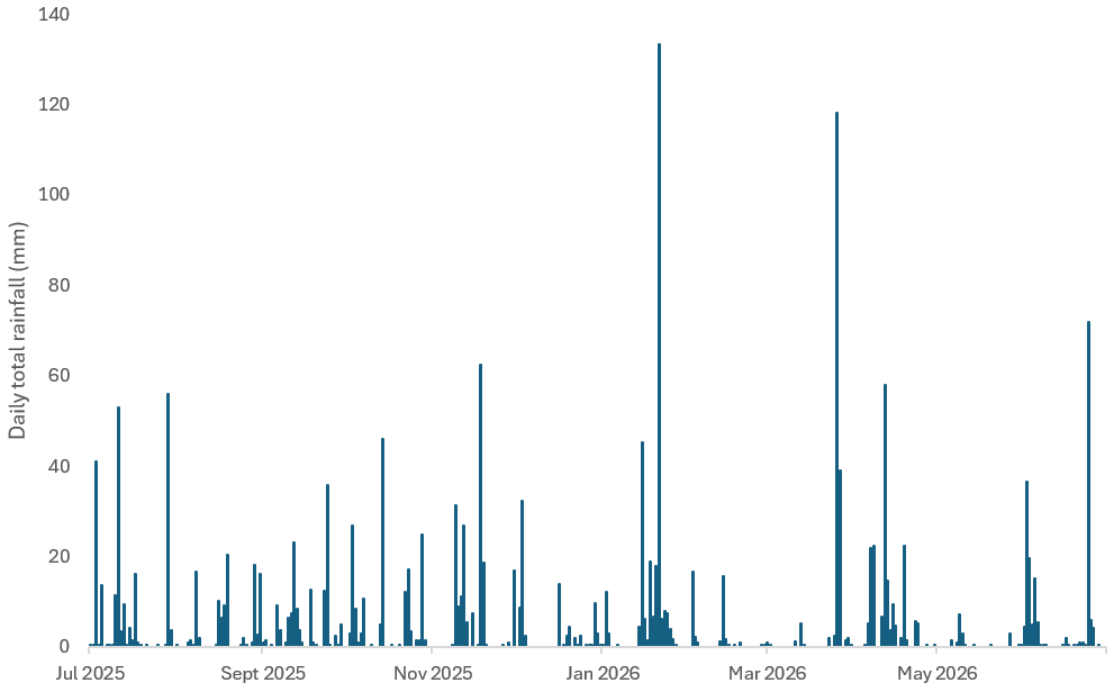


Figure 2-1: Daily rainfall recorded at the Kawakawa Bay WWTP rain gauge for the reporting period 2025-2026.

2.2 Influent flow

Total daily flows of wastewater entering the plant, treated effluent to the effluent disposal field (EDF) and flows to each irrigation field are recorded per condition 22 of consent DIS60262735. The Kawakawa Bay wastewater network is under vacuum, which has the benefit of reducing stormwater infiltration, however increased flows still occur during wet weather. Figure 2-2 shows the total influent flows to the plant. The full dataset is in Appendix A. Average inflows were 85.7 m^3/day, with peak inflows of 251.8 m^3 on 21 January 2026; coinciding with the highest daily rainfall for the year.

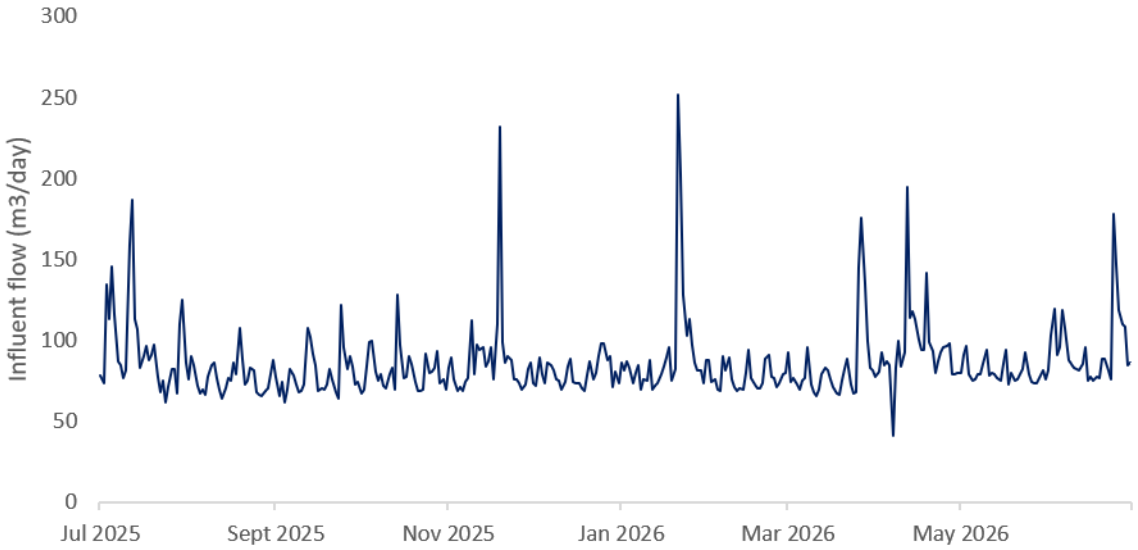


Figure 2-2: Daily influent flow to the Kawakawa Bay WWTP for the reporting period 2025-2026.

2.3 Effluent flow to effluent disposal field

Condition 3 of consent DIS60262735 states that the WWTP is to discharge no more than 800 m^3 treated effluent to land per day. The WWTP was compliant with this condition for 2025-2026, with the maximum discharge being 164.39 m^3 on 22 November 2025. Figure 2-3 shows the daily final effluent discharge to the EDFs, and the full dataset is attached in Appendix A.

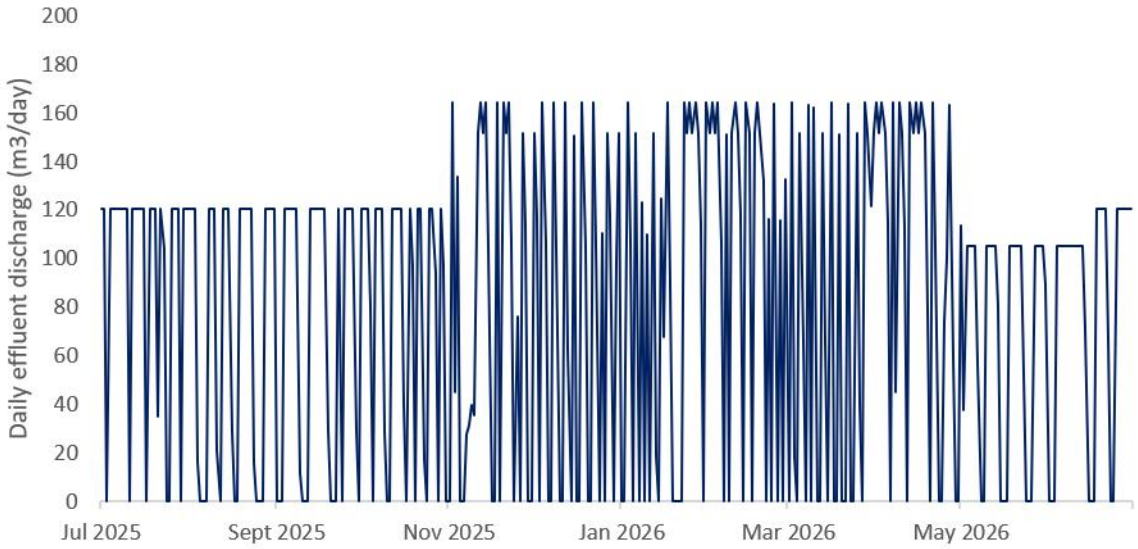


Figure 2-3: Total daily final effluent discharge to the irrigation system for the reporting period 2025-2026.

Condition 16 of consent DIS60262735 sets the maximum irrigation loading rates to land. These rates vary depending on the slope of the land and the season and are detailed in Table 2-1.

At present, the effluent disposal field has four irrigation blocks. Maps of the irrigation blocks and the calculated rates of application are included in Appendix B. For the purposes of the consent, "Winter" is May to October inclusive, and "Summer" is November to April inclusive.

Total daily irrigation volumes to irrigation blocks 1-4 are shown in Figure 2-4. There were no discharges above consent limits during the monitoring period.

Table 2-1: Seasonal irrigation rate limits for Glen Forest blocks

Block	Net irrigation area (m^2)	Slope	Irrigation rate (mm/day)		Maximum daily irrigation volume limit (m^3/day)	
			Summer	Winter	Summer	Winter
Block 1	25,389	0-20°	2.6	1.7	66.0	43.2
Block 2	34,564	20-30°	1.5	1.2	51.8	41.5
Block 3	39,722	20-30°	1.5	1.2	59.6	47.7
Block 4	26,500	20-30°	1.5	1.2	39.8	31.8

Note: Nominal application rate: 0.3 mm/hour across the entire site

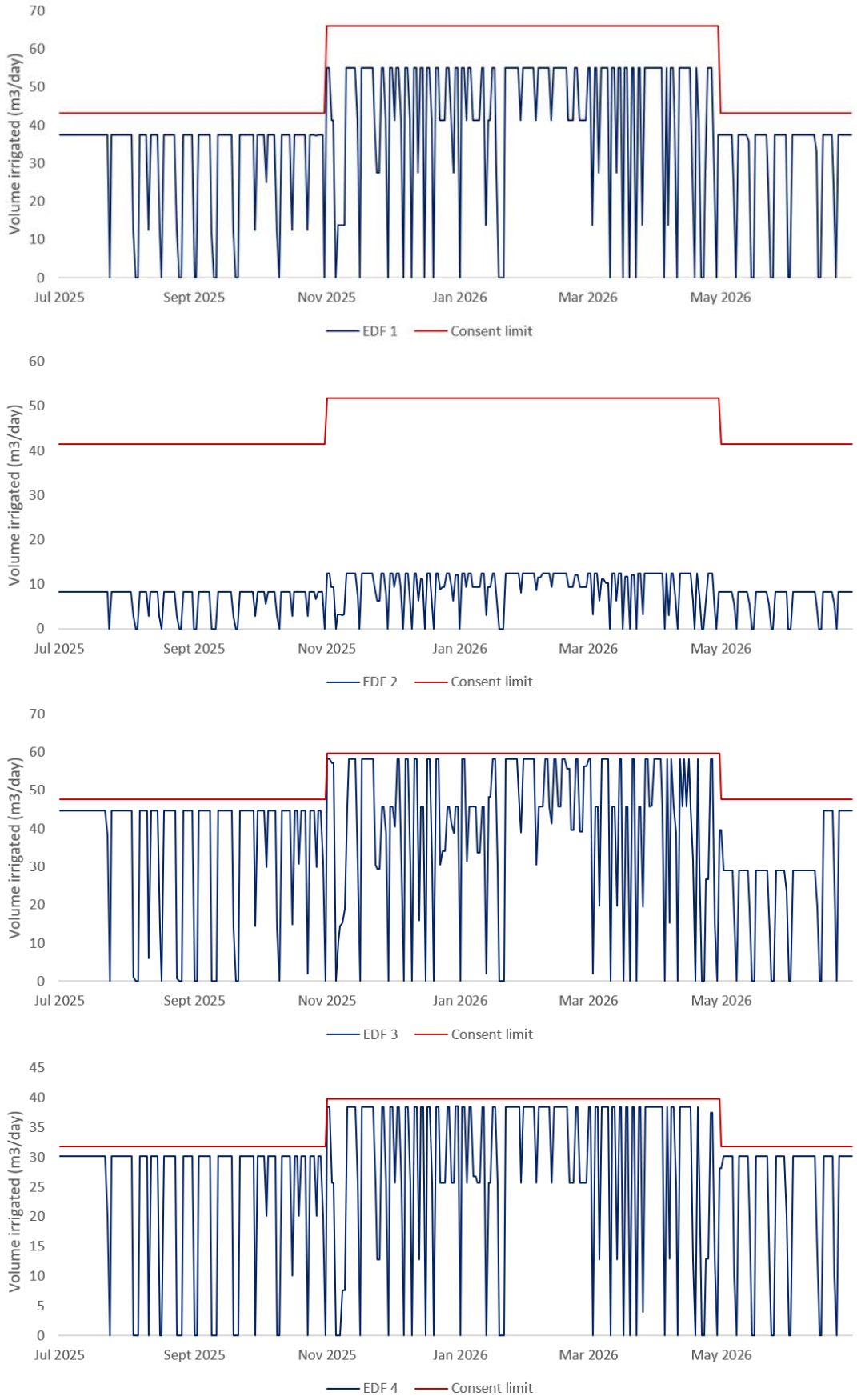


Figure 2-4: Total daily final effluent discharge by EDF (1-4) for the monitoring period 2025-2026.

2.4 Effluent quality

24-hour composite samples of final effluent were obtained weekly and tested by Watercare Laboratory Services for the following parameters per consent DIS60262735 conditions 24-27:

- Nitrate
- Ammoniacal nitrogen
- Dissolved reactive phosphorus
- Sodium
- Calcium
- Magnesium
- pH

Weekly grab samples were tested for the following:

- *Escherichia coli*
- Faecal coliforms.

In addition to the parameters required by the consent, Watercare tests for the following parameters as a 24-hour composite sample:

- $cBOD_5$ (as O_2)
- Total suspended solids
- Total nitrogen.

The median and maximum results for the bacterial sampling in the reporting period are shown in Table 2-2. The maximum results for both parameters were higher than in previous periods but did not result in any exceedance of the consented median as results were typically below the detection level. The elevated results were considered to be due to a build-up of biofilm in the pipes, resulting in an increase in bacterial level, and as such, are not reflective of the effluent quality. The pipes were flushed several times with sodium hypochlorite to resolve this. Figure 2-5 to Figure 2-9 display the results of the bacterial, nutrient and mineral testing in the effluent. The data for the sampling is in Appendix A.

Table 2-2: Median and maximum bacteria results for the monitoring period 2025-2026.

Parameter	Units	Median	Maximum	Consent median limit
Escherichia coli	Cfu/100ml	3.30	690.00	1,000
Faecal coliforms	Cfu/100ml	4.90	1,200.00	1,000

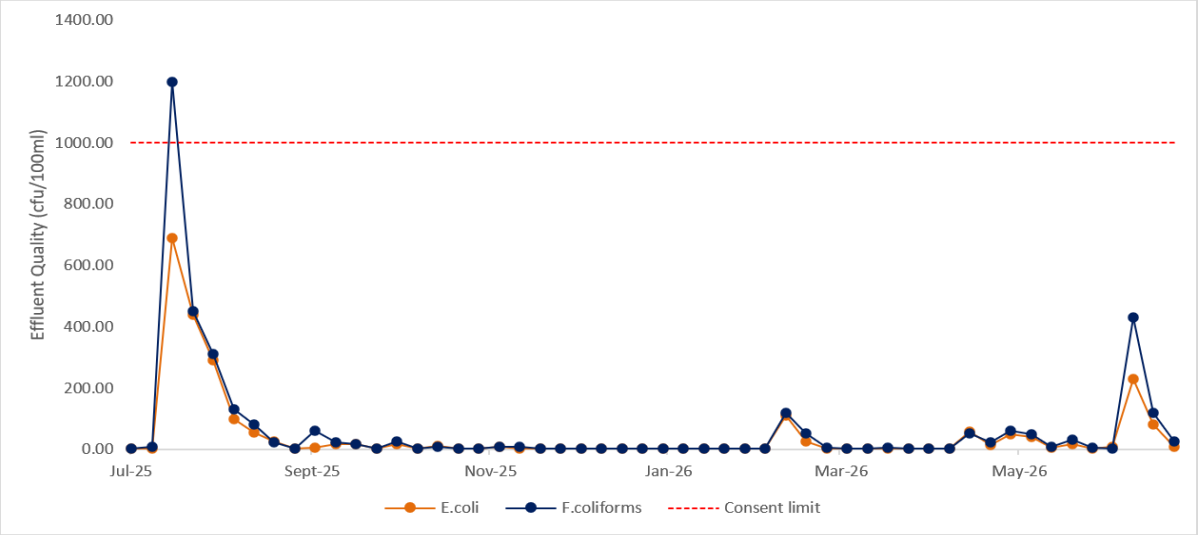


Figure 2-5: Results for E. coli and faecal coliforms in the final effluent for the monitoring period.

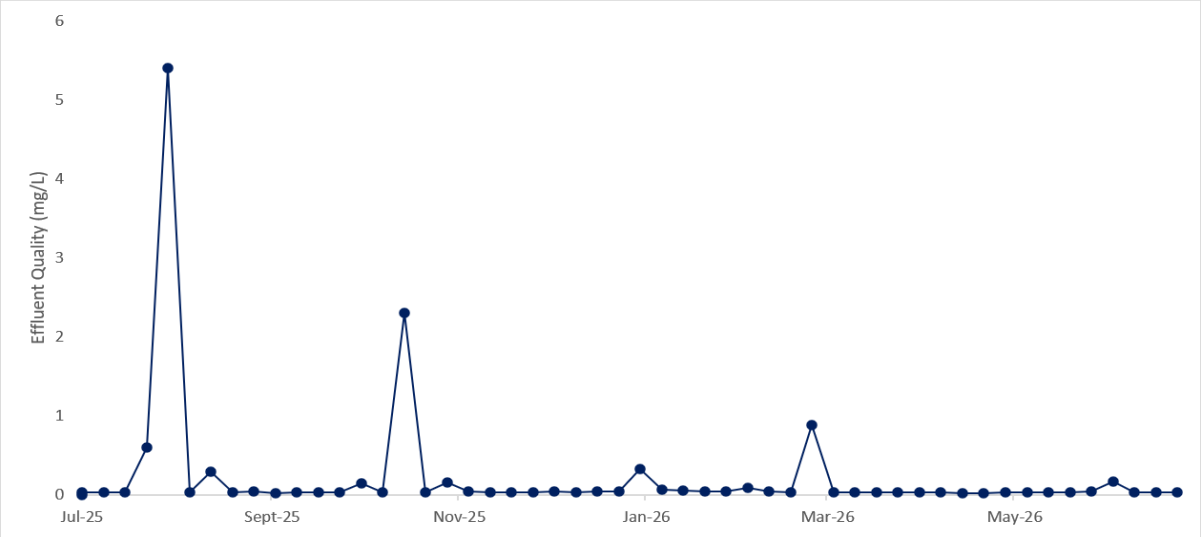


Figure 2-6: Results for ammoniacal nitrogen in the final effluent for the monitoring period.

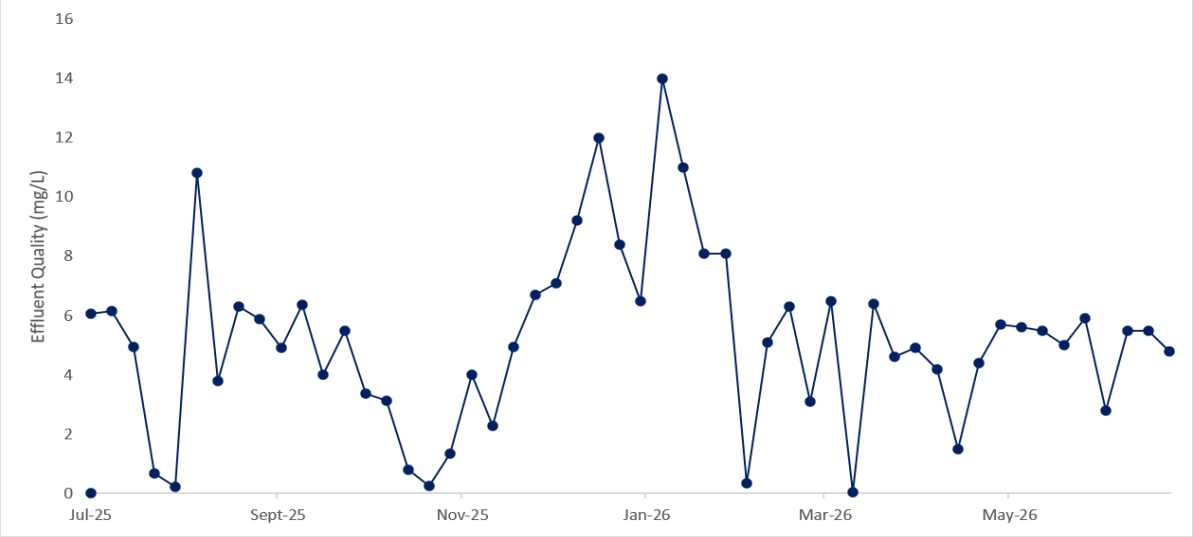


Figure 2-7: Results for nitrate-nitrogen in the final effluent for the monitoring period.

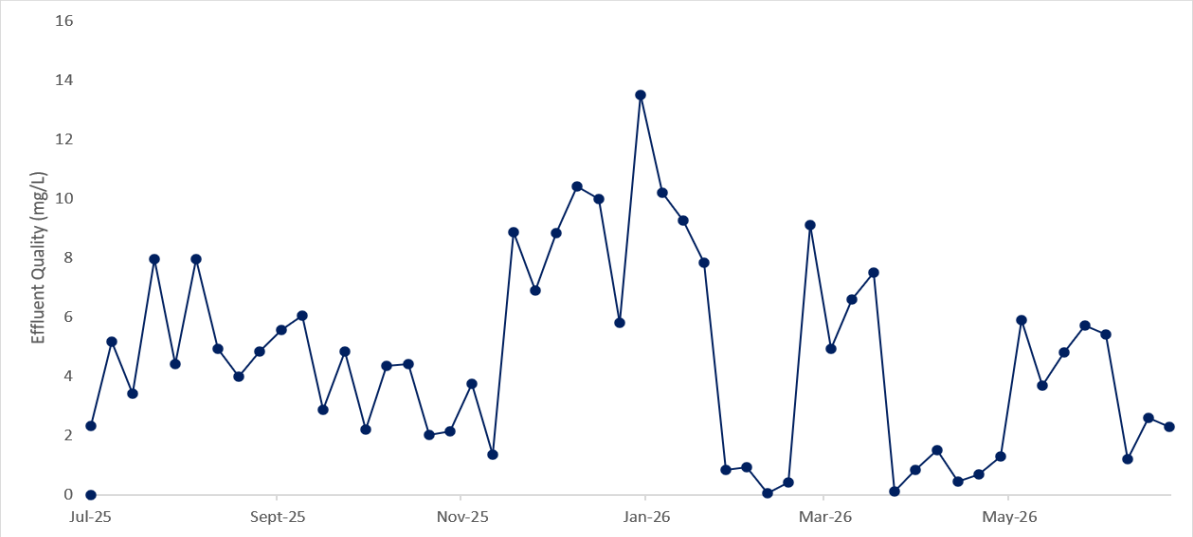


Figure 2-8: Results for dissolved reactive phosphorus in the final effluent for the monitoring period.

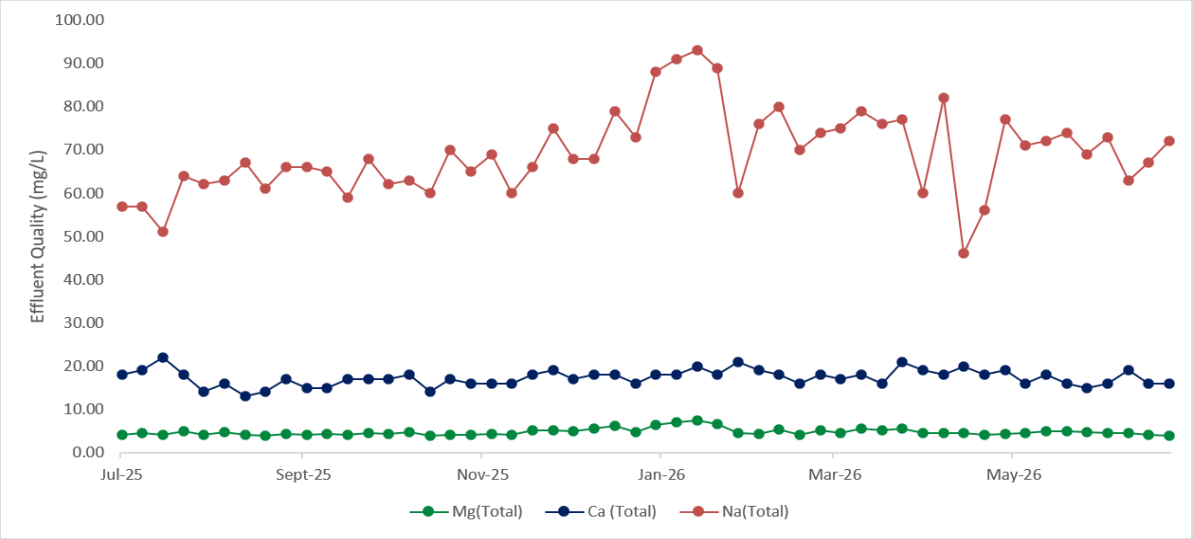


Figure 2-9: Results for total calcium, sodium, and magnesium in the final effluent for the monitoring period.

2.4.1 Effluent trends over time

Seasonal Mann-Kendall analysis was used to assess monotonic trends in nutrient and bacterial concentrations in treated effluent over the 10-year period from July 2016 to June 2026, while accounting for seasonal variation in the data. Kendall's tau (τ) indicates the direction and relative strength of the trend, with positive values indicating an increasing trend and negative values indicating a decreasing trend. Statistical significance was assessed at $p < 0.05$. The analysis identifies the presence and direction of a trend but does not determine its cause. Results are presented in Table 2-3 and show statistically significant declining trends for ammoniacal nitrogen and nitrate, while dissolved reactive phosphorus, E. coli and faecal coliforms showed no statistically significant trend.

Table 2-3: Seasonal Mann-Kendall effluent trend results for 2016-2026 data.

Parameter	n	Tau value (τ)	p-value	Trend Direction	Significant
Nitrate	522	-0.141	<0.001	Declining	Yes
NH3-N	523	-0.332	<0.001	Declining	Yes
DRP	522	-0.012	0.695	-	No
E. coli	544	0.015	0.668	-	No
F. coliforms	544	-0.018	0.578	-	No

2.5 Rautawa Stream flow and water quality

As discussed in Section 1, consent DIS60266313 permits discharges directly to the Rautawa Stream under certain conditions. This option has not been utilised yet as all effluent has been discharged to the EDF irrigation system. The REMP requires monitoring of the stream in two downstream locations from the potential discharge point, shown in Figure 2-10, Site 3 and Site 6 are both located on the Rautawa Stream, downstream of the WWTP. Site 3 is near the boundary of the WWTP property, just upstream of the bridge over Forestry Road and near the weir. Site 6 is downstream of Site 3, located by the footbridge near Rautawa Place, and is not far from the foreshore. Site 6 is tidally influenced and was selected as a monitoring site to determine the impact of transition from failing septic tanks within Kawakawa Bay to the reticulated wastewater network and treatment plant.



Figure 2-10: Location of Site 3 on the Rautawa Stream inside the WWTP boundary, Site 6 in Kawakawa Bay town.

2.5.1 Flow rates

The flow rate of the Rautawa Stream is measured at Site 3 from the REMP and the mean daily flow rate is displayed in Figure 2-11. The weir is maintained by Watercare staff and excess sediment is removed when necessary. The mean daily flow rate closely mirrors the rainfall data. As no discharge has occurred into the stream this monitoring period, there are no direct impacts of the plant's operation on the flow rate.

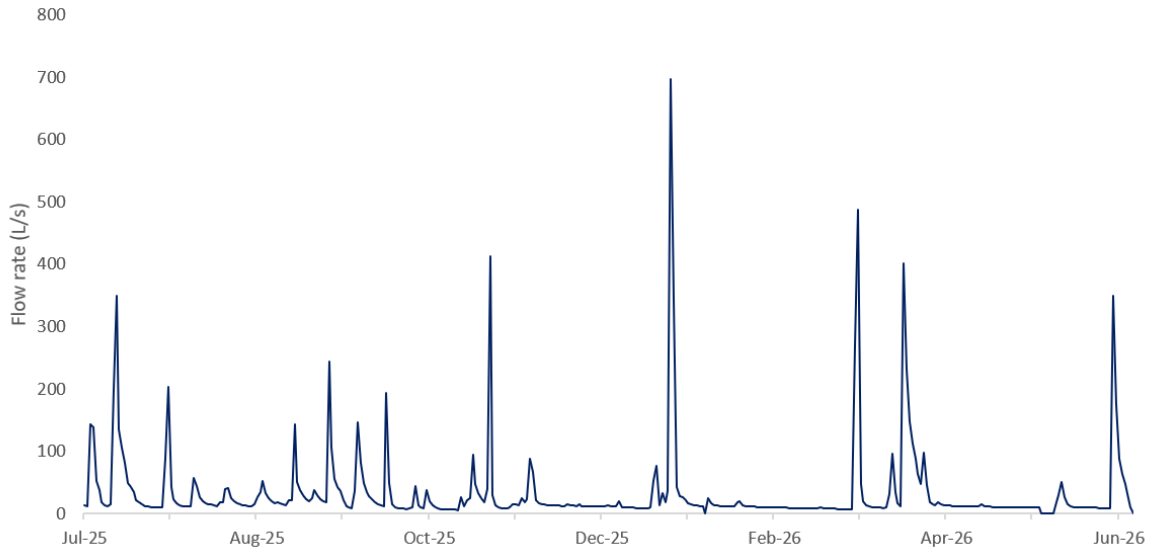


Figure 2-11: Rautawa Stream mean daily flow rate for the 2025-2026 monitoring period.

2.5.2 Water quality

The REMP details the monitoring plan for water quality. A summary of this is provided in Table 2-4. All sampling was completed for this reporting period.

Table 2-4: REMP water quality monitoring schedule

Parameter	Site(s)	Frequency
Biological oxygen demand ($cBOD_5$)	3	Fortnightly
Total suspended solids	3	Fortnightly
Total oxidised nitrogen (NO_3 and NO_2)	3	Fortnightly
Nitrate (NO_3)	3	Fortnightly
Nitrite (NO_2)	3	Fortnightly
Ammoniacal nitrogen (NH_3 and NH_4)	3	Fortnightly
Un-ionised ammonia nitrogen	3	Fortnightly
Total nitrogen	3	Fortnightly
Dissolved reactive phosphorus	3	Fortnightly
Total phosphorus	3	Fortnightly
Faecal coliforms	3, 6	Fortnightly
E. coli	3, 6	Fortnightly
Enterococci	6	Fortnightly
pH	3	Fortnightly
Dissolved oxygen	3	Fortnightly
Temperature	3	Fortnightly

2.5.3 Site 3

The full results for all the parameters tested at Site 3 are displayed in Figure 2-12 to Figure 2-18 and listed in Appendix A, while Table 2-5 provides a comparison between baseline water quality data.

The temperature and dissolved oxygen levels ranged from 9.9 – 17.6 °C and 9.2 – 11.1 mg/L respectively. Total suspended solids measured a maximum of 129.0 mg/L on 11 October 2025 and an average of 14.2 mg/L. These results are consistent with previous monitoring periods.

The annual median ammoniacal nitrogen concentration at Site 3 was 0.026 mg/L, placing it in the National Policy Statement for Freshwater Management 2020 (NPS-FM)[1] attribute band A (≤0.03 mg/L), which indicates a 99% species protection level. The annual 95th percentile was 0.06 mg/L and fell within attribute band B (>0.05 and ≤0.40 mg/L, offering 95% species protection). These levels were similar to the 2024–2025 results (Table 2-5), where the median was 0.014 mg/L, and the 95th percentile was 0.04 mg/L.

Nitrate-nitrogen had an annual median of 0.12 mg/L and an annual 95th percentile of 0.24 mg/L. These values are within the NPS-FM guidelines for attribute band A for a high conservation value system, with effects unlikely on sensitive species. Total nitrogen ranged between 0.12 mg/L and 0.83 mg/L, with a median of 0.23 mg/L and a 95th percentile of 0.73 mg/L for the reporting period. This is consistent with previous periods, however there is no NPS-FM attribute bands for this parameter in river systems.

The median dissolved reactive phosphorus concentration (0.014 mg/L) is within attribute band C of the NPS-FM, whilst the 95th percentile (0.020 mg/L) is within attribute band A. This further indicates gradual water quality improvements, as first stated in the 2024-2025 report. Comparatively, the median and 95th percentile in 2024-2025 were both within band C (0.015 mg/L and 0.042 mg/L, respectively); in 2023-2024 concentrations were within bands C (median, 0.014 mg/L) and D (95th percentile, 0.109 mg/L), and in 2022-2023 concentrations were both within attribute band D (0.044 mg/L and 0.131 mg/L, respectively).

Total phosphorus is also elevated. However, attribute bands are not determined for riverine systems in the NPS-FM (2020). Total phosphorus ranged from 0.018 - 0.076 mg/L, with an average of 0.031 mg/L and a median of 0.026 mg/L. These results are consistent with previous monitoring periods.

The values for *E. coli* and faecal coliforms were generally consistent with previous monitoring periods, ranging between 23 – 5,800 cfu/100mL and 28 – 6,300 cfu/100 mL respectively. *E. coli* was elevated above 1,000 cfu/100mL on one occasion: 9 November 2025 (5,800 cfu/100mL). Faecal coliforms were elevated above 1,000 cfu/100mL on two occasions: 3 July 2025 (1,300 cfu/100mL), and 9 November 2025 (6,300 cfu/100mL). The results at Site 3 are considerably higher than the levels recorded in the final effluent discharge, indicating that the source is primarily from the surrounding catchment runoff, which includes stormwater runoff from the EDF and other forestry areas.

Biochemical oxygen demand ranged between 0.50 – 2.00 mg/L, with an average of 0.70 mg/L and a median of 0.53 mg/L, consistent with baseline data.

[1] https://environment.govt.nz/assets/publications/npsfm-2020-amended-december-2025.pdf?v=02a04bb9053b02aadf1c2f2035a658b4d02bd24c

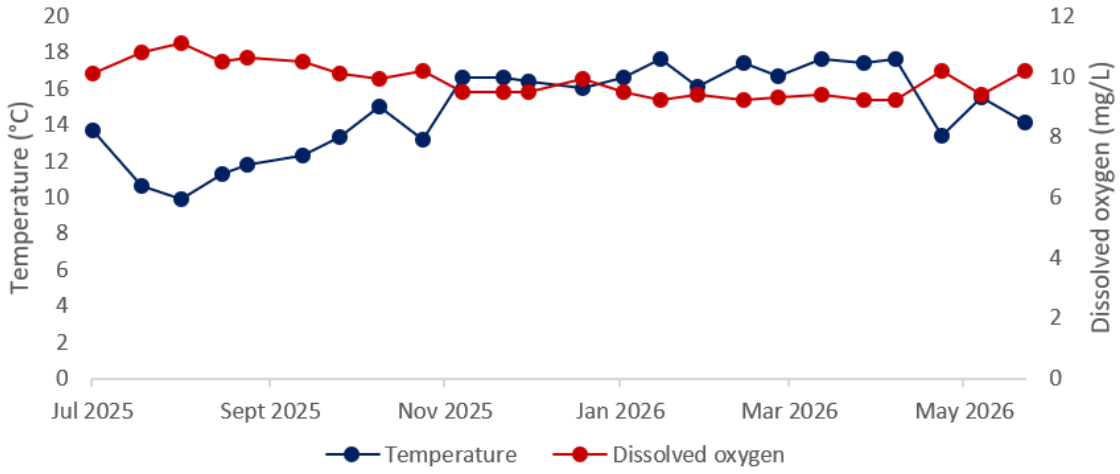


Figure 2-12: Rautawa Stream Site 3 results for temperature and dissolved oxygen for the monitoring period.

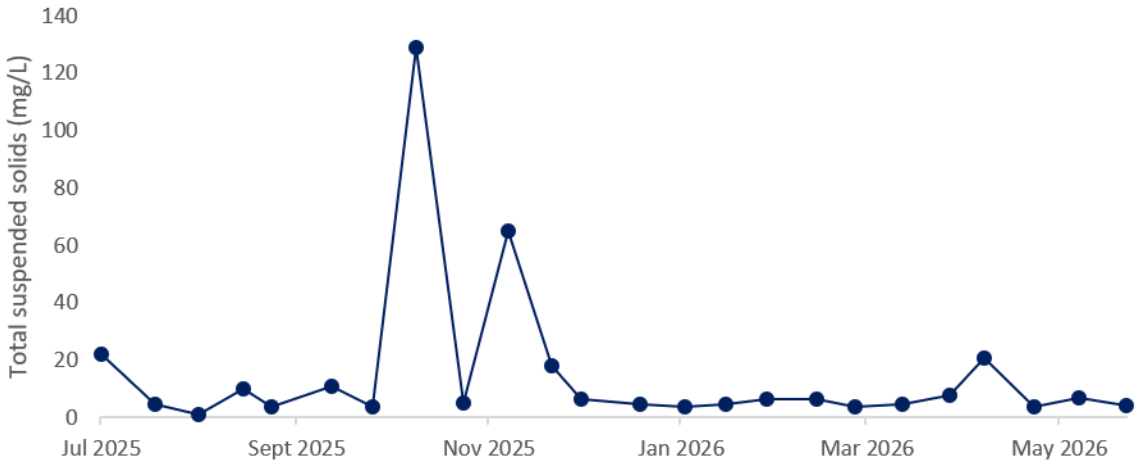


Figure 2-13: Rautawa Stream Site 3 results for total suspended solids for the monitoring period.

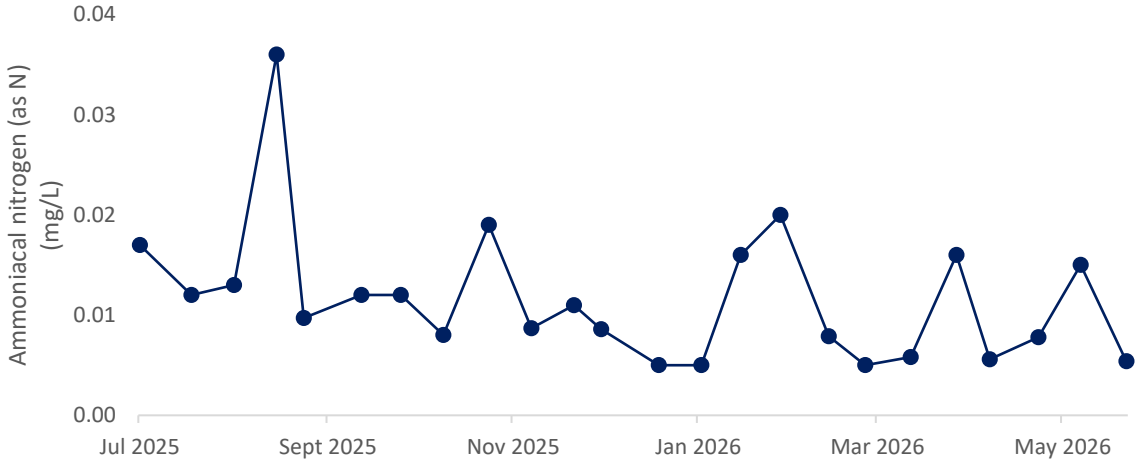


Figure 2-14: Rautawa Stream Site 3 results for ammoniacal nitrogen for the monitoring period.

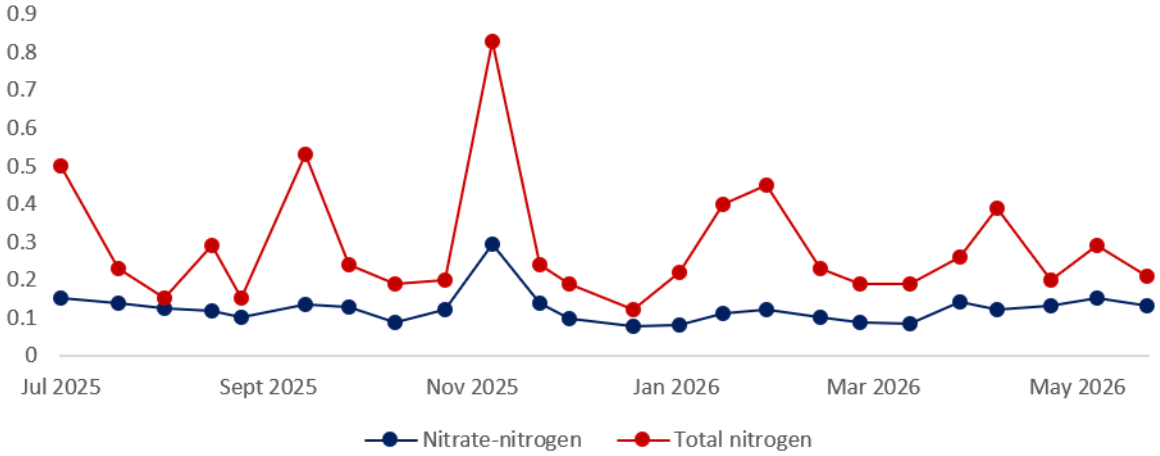


Figure 2-15: Rautawa Stream Site 3 results for nitrate (as nitrogen) and total nitrogen for the monitoring period.

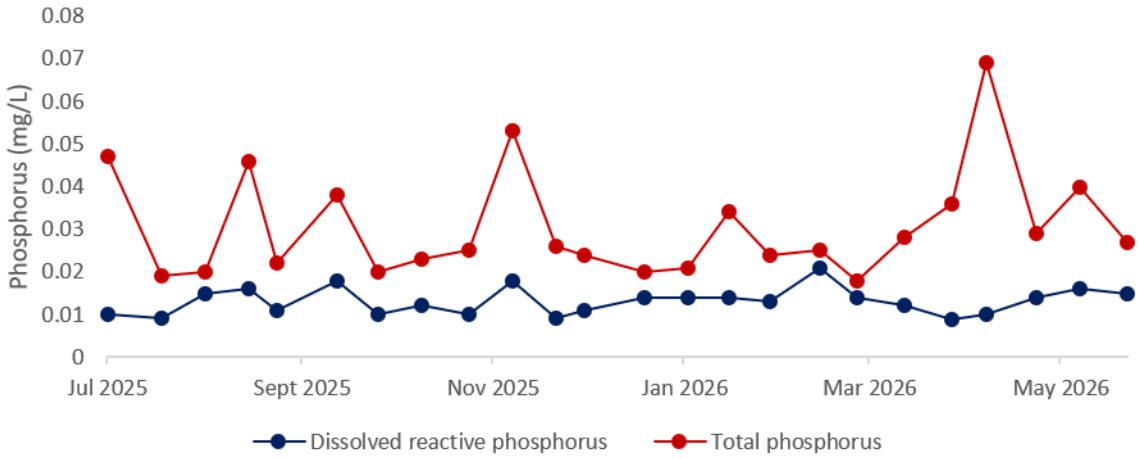


Figure 2-16: Rautawa Stream Site 3 results for total phosphorus and dissolved reactive phosphorus for the monitoring period.

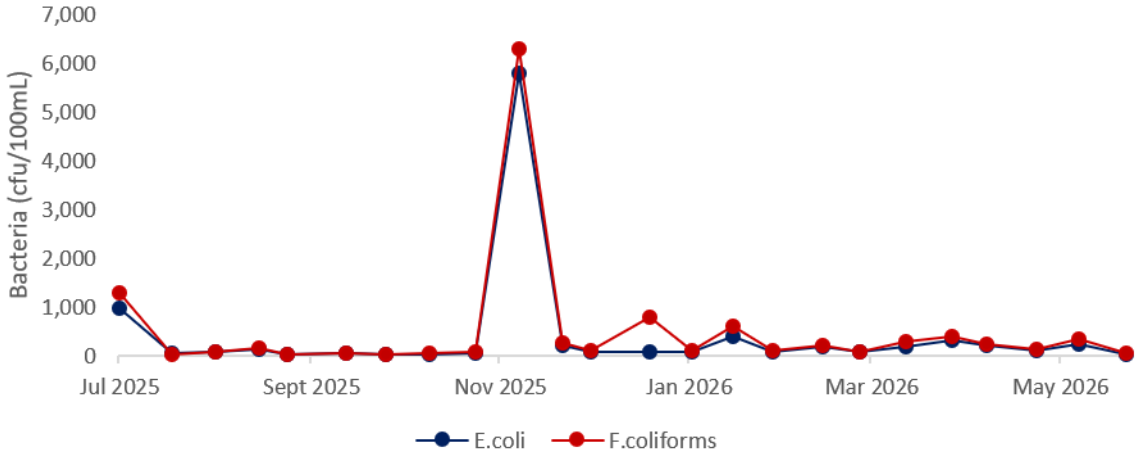


Figure 2-17: Rautawa Stream Site 3 results for E. coli and faecal coliforms for the monitoring period.

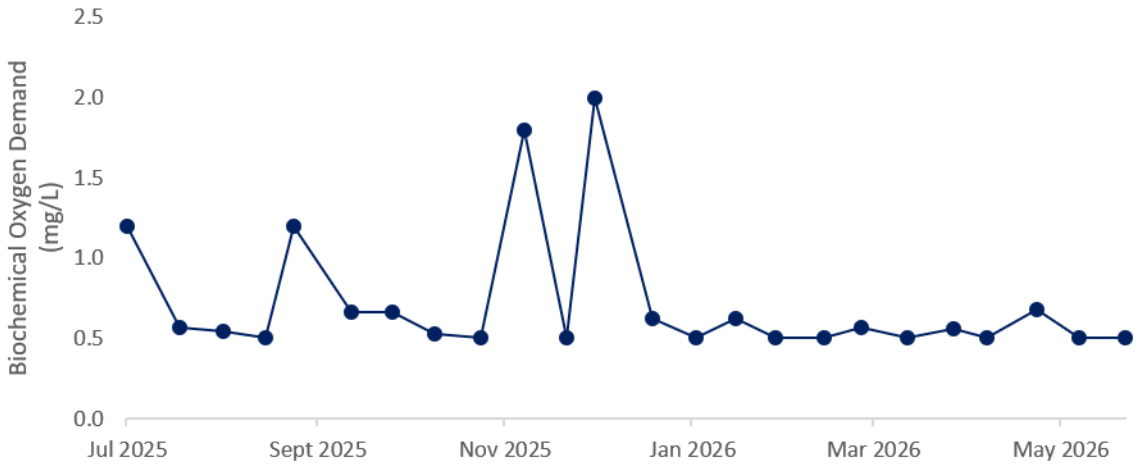


Figure 2-18: Rautawa Stream Site 3 results for biochemical oxygen demand for the monitoring period.

2.5.4 Comparison to baseline water quality data

Bioresearches were commissioned by Manukau Water to undertake an assessment of the aquatic biology and water quality condition of the main stem of the Rautawa Stream to assess the baseline conditions prior to construction of the WWTP[2]. The monitoring was conducted once monthly from May 2004 to January 2005. In the conclusions of that report, the Rautawa Stream was characterised as typical of streams within the Auckland region that flow from agricultural catchments. Table 2-5 presents a summary of the water quality results from that study compared to water quality results from the most recent two monitoring periods (July 2024 – June 2025, and July 2025 – June 2026). Due to the limited number of results for the baseline survey, the results are indicative of the baseline natural environment but may not include the full range of natural variation within the Rautawa Stream.

As shown in Table 2-5, the general physiochemical parameters have remained largely consistent with the baseline survey results on average. Total suspended solids showed some elevated levels in 2025–2026, leading to a wider range and greater mean compared to the baseline, however the results are consistent with the 2024-2025 monitoring period. The forms of nitrogen in the most recent monitoring periods are similar to the baseline water quality results, as were results for total and dissolved reactive phosphorus.

E. coli and faecal coliform results in 2025-2026 monitoring period were much higher than results from the baseline monitoring period. As Table 2-2 showed, the *E. coli* and faecal coliforms in the effluent are low, therefore the increased levels in the stream may be due to the wider farmland catchment, and a smaller number of baseline results compared to current monitoring results.

[2] Bioresearches 2005, Stream baseline survey May 2004- January 2005: proposed sewage plant Kawakawa Bay

Table 2-5: Rautawa Stream water quality (Site 3) comparison between 2004-05 (baseline), 2024-25 and 2025-26.

Parameter	2004-05 (baseline)		2024-25		2025-26	
	Range	Mean	Range	Mean	Range	Mean
Temperature (^{0}C)	8.8 – 16.3	12.5	9.8 – 18.4	14.4	9.9 – 17.6	14.7
DO (mg/L)	7.69 – 11.04	9.52	9.0 – 11.0	9.9	9.2 – 11.1	9.9
pH (field) (pH units)	5.7 – 7.4	7.0	6.4 – 7.7	7.0	6.0 – 7.4	6.8
pH (laboratory) (pH units)	6.8 – 7.6	7.3	6.9 – 7.6	7.3	6.9 – 7.5	7.2
TSS (mg/L)	3 – 10	5.2	1.0 – 100.0	16.4	1.0 – 129.0	14.2
Total ammoniacal-N (mg/L)	<0.01 – 0.06	0.02*	0.005 – 0.037	0.015	<0.005 – 0.036	0.012*
Total oxidised nitrogen (mg/L)	0.052 – 0.227	0.131	0.04 – 0.43	0.12	0.08 – 0.35	0.14
Total nitrogen (mg/L)	0.141 – 0.622	0.375	0.09 – 0.68	0.28	0.12 – 0.83	0.29
Nitrate-N (mg/L)	0.051 – 0.225	0.129	<0.04 – 0.43	0.12*	0.08 – 0.29	0.012
Nitrite-N (mg/L)	<0.002 – 0.003	0.002*	<0.002 –0.003	0.002*	<0.002 – 0.003	0.002*
DRP (mg/L)	0.007 – 0.016	0.011	0.010 – 0.054	0.017	0.009 – 0.021	0.013
Total phosphorus (mg/L)	0.021 – 0.212	0.053	0.016 – 0.079	0.041	0.018 – 0.069	0.031
$cBOD_5$ (mgO_2/L)	<1 – 2	0.67*	<0.5 – 2.0	0.8*	<0.5 – 2.0	0.7*
Escherichia coli (cfu/100mL)	20 – 470	141	<1.60 – 4,800	399*	23.0 – 5,800	368
Faecal Coliforms (cfu/100mLl)	22 – 560	158	28 – 23,000	1,669	28.0 – 6,300	465

*Includes value(s) below detection limit

2.5.5 Site 6

The *E. coli* and faecal coliforms results at Site 6 were much higher than those at Site 3, consistent with previous monitoring periods. *Enterococci*, faecal coliforms and *E. coli* ranged between 36 – 31,000, 400 – 92,000 and 340 – 54,000 cfu/100mL respectively.

The Rautawa Stream passes through farmland without riparian vegetation or fenced separation from stock before it enters the Kawakawa Bay town. In comparison to Site 3's approximate catchment of 1.68 km^2, Site 6 has an estimated catchment of 6.92 km^2 with a higher proportion of this catchment being farmland. Site 6 is also influenced by the high tide, with mangroves forming a large proportion of the vegetation of this site. As such, these results more closely reflect the agricultural land use of the catchment downstream in addition to tidal influences from the bay.

The results for all the parameters tested at Site 6 are displayed in Figure 2-19 and listed in Appendix A.

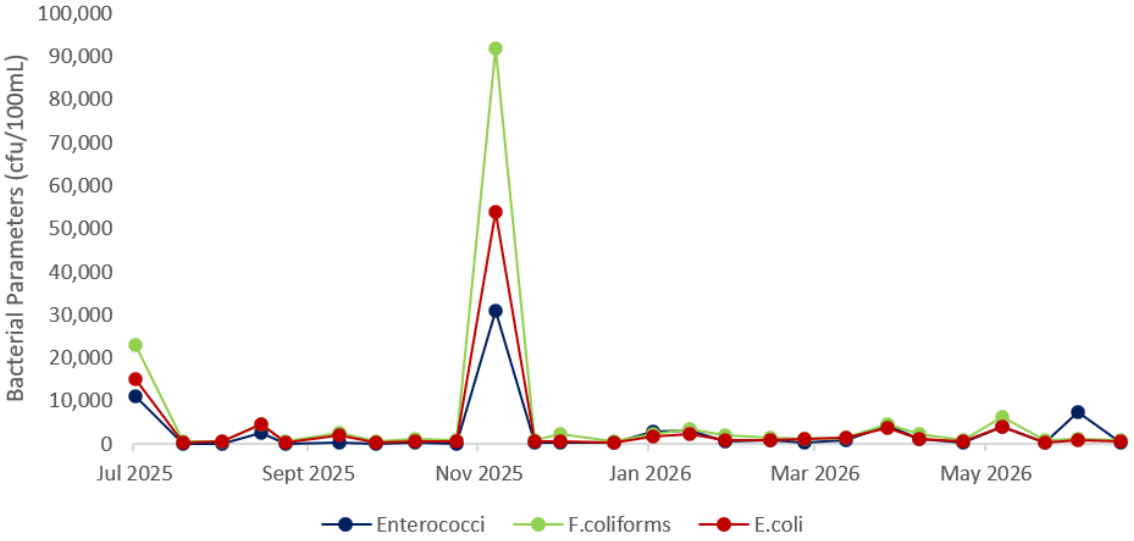


Figure 2-19: Rautawa Stream site 6 results of bacterial parameters for the monitoring period.

2.5.6 Stream quality long-term trends

Seasonal Mann-Kendall analysis, as described in Section 2.4.1, was undertaken on nutrient data from Site 3 and bacterial data from Sites 3 and 6 to assess long-term trends in receiving-environment water quality from July 2016 to June 2026.

Mann-Kendall analysis was undertaken on the nutrient data from Site 3 and bacterial data from both sites to investigate statistically significant long-term trends in water quality (July 2016 – June 2026). Results are presented in Table 2-6 below. At Site 3, phosphorus (both DRP and TP) displays a significant declining trend between 2016 and 2026; whereas total nitrogen and nitrate display significant increasing trends. The significant trends remained evident after accounting for seasonal variation through the Seasonal Mann-Kendall analysis. The increasing stream nitrate trend contrasts with the decreasing effluent trend discussed in Section 2.4.1

E. coli and faecal coliforms showed no long-term trend at Site 3 and were strongly seasonal at both sites; running roughly twice as high in summer months compared to winter. Faecal coliforms did, however, decline significantly at Site 6 over the 10-year period.

Table 2-6: Seasonal Mann-Kendall Rautawa Stream trend results for 2016-2026 data.

Site	Parameter	n	Tau value (τ)	p-value	Trend Direction	Significant
Site 3	DRP	236	-0.192	<0.001	Declining	Yes
	TP	236	-0.111	0.019	Declining	Yes
	TN	236	0.105	0.028	Increasing	Yes
	NO3-N	236	0.107	0.024	Increasing	Yes
	NH3-N	235	-0.056	0.244	—	No
	E. coli	236	-0.076	0.109	—	No
	F. coliforms	236	-0.075	0.113	—	No
Site 6	*E. coli*	236	-0.092	0.054	—	No
	F. coliforms	236	-0.107	0.024	Declining	Yes

2.5.7 Ecological assessment of the Rautawa Stream and coastal marine environment

An ecological assessment of the Rautawa Stream is required every two years together with an assessment of part of the coastal marine environment of Kawakawa Bay. The latest assessment was undertaken by Viridis Limited in March 2026[3] and is included in Appendix D. Site 3 within the Viridis assessment is the same site as the Site 3 monitored in routine operations, displayed in Figure 10. Sites 1, 2 and 5 are exclusively monitored in the ecological assessments and are not monitored in routine operations.

The main conclusions from the 2026 report were:

- Physical habitat characteristics were broadly consistent with previous surveys and reflected natural differences between sites. Increased erosion and fine sediment deposition were observed at Site 5, likely associated with nearby forestry activities. Spot water quality measurements were comparable with historical conditions and within ranges expected to support healthy aquatic communities.
- Macrophyte communities remained broadly consistent with previous surveys, with differences between sites reflecting riparian shading and substrate conditions. No significant changes were observed that would suggest an ecological response to WWTP irrigation discharges.
- Macroinvertebrate community composition and biotic indices were broadly consistent with previous surveys. While some interannual variability was evident, there was no indication of a sustained decline in macroinvertebrate community condition or adverse effects attributable to WWTP irrigation.
- Fish communities continued to support high-integrity fish communities. Although Fish IBI scores varied between surveys, there was no evidence of a sustained decline in community composition or abundance.
- Macroalgal cover remained absent or very low across the intertidal monitoring area despite the availability of suitable shell substrate. Shell cover was generally within historical ranges, and there was no evidence of nutrient-induced macroalgal proliferation associated with WWTP irrigation discharges.
- Overall, the 2026 monitoring results indicate that the ecological condition of both the freshwater and marine receiving environments has remained broadly consistent with previous surveys. Results at sites potentially influenced by land irrigation were generally comparable to, or within the range of, those recorded at the control site on the Glen Forest tributary, indicating no clear adverse effect associated with WWTP irrigation discharges.

[3] Viridis 2026, Kawakawa Bay Wastewater Treatment Plant Stream and Coastal Marine Monitoring 2026

3 CONCLUSIONS

For the monitoring period 1 July 2025 to 30 June 2026, the operation of the Kawakawa Bay Wastewater Treatment Plant is within the specifications of consent DIS60262735 and the REMP with all the appropriate monitoring being undertaken at or exceeding the frequency required by the schedule of the consent.

Irrigation volumes and effluent quality were within the consented limits and similar to previous monitoring periods. No direct discharge occurred to the Rautawa Stream in this period. Two-yearly monitoring of the Rautawa Stream and coastal marine environment of Kawakawa Bay was undertaken in March 2026 and continues to indicate the ecological condition of both the freshwater and marine receiving environments has remained broadly consistent with previous surveys. Results at sites potentially influenced by land irrigation were generally comparable to, or within the range of, those recorded at the control site on the Glen Forest tributary, indicating no clear adverse effect associated with WWTP irrigation discharges.

Appendix A. Daily rainfall, influent, effluent, EDF flow and environmental data

Rainfall data for 2025-2026

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
1/07/2025	0.5	12/09/2025	23.2	24/11/2025	0.0	5/02/2026	0.0	19/04/2026	22.3
2/07/2025	0.5	13/09/2025	8.3	25/11/2025	0.0	6/02/2026	0.0	20/04/2026	1.4
3/07/2025	41.0	14/09/2025	3.7	26/11/2025	0.5	7/02/2026	0.0	21/04/2026	0.0
4/07/2025	0.5	15/09/2025	0.9	27/11/2025	0.0	8/02/2026	0.0	22/04/2026	0.0
5/07/2025	13.7	16/09/2025	0.0	28/11/2025	1.0	9/02/2026	0.0	23/04/2026	5.7
6/07/2025	0.0	17/09/2025	0.0	29/11/2025	0.0	10/02/2026	0.0	24/04/2026	5.2
7/07/2025	0.5	18/09/2025	12.5	30/11/2025	16.8	11/02/2026	0.0	25/04/2026	0.0
8/07/2025	0.5	19/09/2025	0.9	1/12/2025	0.0	12/02/2026	1.3	26/04/2026	0.0
9/07/2025	0.5	20/09/2025	0.5	2/12/2025	8.7	13/02/2026	15.7	27/04/2026	0.5
10/07/2025	11.3	21/09/2025	0.0	3/12/2025	32.2	14/02/2026	1.7	28/04/2026	0.0
11/07/2025	52.8	22/09/2025	0.0	4/12/2025	2.4	15/02/2026	0.4	29/04/2026	0.0
12/07/2025	3.3	23/09/2025	12.5	5/12/2025	0.0	16/02/2026	0.0	30/04/2026	0.5
13/07/2025	9.4	24/09/2025	35.7	6/12/2025	0.0	17/02/2026	0.4	1/05/2026	0.0
14/07/2025	0.5	25/09/2025	0.5	7/12/2025	0.0	18/02/2026	0.0	2/05/2026	0.0
15/07/2025	4.3	26/09/2025	0.0	8/12/2025	0.0	19/02/2026	0.9	3/05/2026	0.0
16/07/2025	1.4	27/09/2025	2.3	9/12/2025	0.0	20/02/2026	0.0	4/05/2026	0.0
17/07/2025	16.0	28/09/2025	0.5	10/12/2025	0.0	21/02/2026	0.0	5/05/2026	0.0
18/07/2025	1.0	29/09/2025	4.9	11/12/2025	0.0	22/02/2026	0.0	6/05/2026	1.4
19/07/2025	0.5	30/09/2025	0.0	12/12/2025	0.0	23/02/2026	0.0	7/05/2026	0.0
20/07/2025	0.0	1/10/2025	0.0	13/12/2025	0.0	24/02/2026	0.0	8/05/2026	1.0
21/07/2025	0.5	2/10/2025	2.9	14/12/2025	0.0	25/02/2026	0.0	9/05/2026	7.1
22/07/2025	0.0	3/10/2025	26.8	15/12/2025	0.0	26/02/2026	0.0	10/05/2026	2.9
23/07/2025	0.0	4/10/2025	8.3	16/12/2025	14.0	27/02/2026	0.4	11/05/2026	0.5
24/07/2025	0.0	5/10/2025	1.0	17/12/2025	0.0	28/02/2026	0.4	12/05/2026	0.0
25/07/2025	0.5	6/10/2025	2.9	18/12/2025	0.5	1/03/2026	0.9	13/05/2026	0.0
26/07/2025	0.0	7/10/2025	10.7	19/12/2025	2.4	2/03/2026	0.4	14/05/2026	0.5
27/07/2025	0.0	8/10/2025	0.0	20/12/2025	4.3	3/03/2026	0.0	15/05/2026	0.0

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
28/07/2025	0.5	9/10/2025	0.0	21/12/2025	0.0	4/03/2026	0.0	16/05/2026	0.0
29/07/2025	56.0	10/10/2025	0.5	22/12/2025	1.9	5/03/2026	0.0	17/05/2026	0.0
30/07/2025	3.7	11/10/2025	0.0	23/12/2025	0.5	6/03/2026	0.0	18/05/2026	0.0
31/07/2025	0.0	12/10/2025	0.0	24/12/2025	2.4	7/03/2026	0.0	19/05/2026	0.0
1/08/2025	0.5	13/10/2025	4.9	25/12/2025	0.0	8/03/2026	0.0	20/05/2026	0.5
2/08/2025	0.0	14/10/2025	45.9	26/12/2025	0.5	9/03/2026	0.0	21/05/2026	0.0
3/08/2025	0.0	15/10/2025	0.0	27/12/2025	0.5	10/03/2026	0.0	22/05/2026	0.0
4/08/2025	0.0	16/10/2025	0.0	28/12/2025	0.5	11/03/2026	1.3	23/05/2026	0.0
5/08/2025	0.9	17/10/2025	0.5	29/12/2025	9.6	12/03/2026	0.0	24/05/2026	0.0
6/08/2025	1.4	18/10/2025	0.0	30/12/2025	2.9	13/03/2026	5.2	25/05/2026	0.0
7/08/2025	0.5	19/10/2025	0.0	31/12/2025	0.5	14/03/2026	0.4	26/05/2026	0.0
8/08/2025	16.7	20/10/2025	0.5	1/01/2026	0.5	15/03/2026	0.0	27/05/2026	2.9
9/08/2025	1.9	21/10/2025	0.0	2/01/2026	12.0	16/03/2026	0.0	28/05/2026	0.0
10/08/2025	0.0	22/10/2025	12.2	3/01/2026	2.9	17/03/2026	0.0	29/05/2026	0.0
11/08/2025	0.0	23/10/2025	17.1	4/01/2026	0.0	18/03/2026	0.0	30/05/2026	0.5
12/08/2025	0.0	24/10/2025	3.4	5/01/2026	0.0	19/03/2026	0.0	31/05/2026	0.5
13/08/2025	0.0	25/10/2025	0.0	6/01/2026	0.5	20/03/2026	0.0	1/06/2026	4.4
14/08/2025	0.0	26/10/2025	1.5	7/01/2026	0.0	21/03/2026	0.0	2/06/2026	36.5
15/08/2025	0.5	27/10/2025	1.5	8/01/2026	0.0	22/03/2026	0.0	3/06/2026	19.5
16/08/2025	10.2	28/10/2025	24.9	9/01/2026	0.0	23/03/2026	1.9	4/06/2026	4.9
17/08/2025	6.5	29/10/2025	1.5	10/01/2026	0.0	24/03/2026	0.0	5/06/2026	15.1
18/08/2025	9.3	30/10/2025	0.0	11/01/2026	0.0	25/03/2026	2.4	6/06/2026	5.4
19/08/2025	20.4	31/10/2025	0.0	12/01/2026	0.0	26/03/2026	118.2	7/06/2026	0.5
20/08/2025	0.0	1/11/2025	0.0	13/01/2026	0.0	27/03/2026	38.9	8/06/2026	0.5
21/08/2025	0.0	2/11/2025	0.0	14/01/2026	4.3	28/03/2026	0.0	9/06/2026	0.5
22/08/2025	0.0	3/11/2025	0.0	15/01/2026	45.2	29/03/2026	1.4	10/06/2026	0.0
23/08/2025	0.0	4/11/2025	0.0	16/01/2026	6.3	30/03/2026	1.9	11/06/2026	0.0
24/08/2025	0.5	5/11/2025	0.0	17/01/2026	1.4	31/03/2026	0.5	12/06/2026	0.0
25/08/2025	1.9	6/11/2025	0.0	18/01/2026	18.8	1/04/2026	0.0	13/06/2026	0.0

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
26/08/2025	0.5	7/11/2025	0.0	19/01/2026	6.7	2/04/2026	0.0	14/06/2026	0.0
27/08/2025	0.0	8/11/2025	0.5	20/01/2026	17.8	3/04/2026	0.0	15/06/2026	0.5
28/08/2025	0.9	9/11/2025	31.2	21/01/2026	133.3	4/04/2026	0.0	16/06/2026	2.0
29/08/2025	18.1	10/11/2025	8.8	22/01/2026	6.3	5/04/2026	0.5	17/06/2026	0.5
30/08/2025	2.8	11/11/2025	11.2	23/01/2026	7.8	6/04/2026	5.2	18/06/2026	0.0
31/08/2025	16.2	12/11/2025	26.8	24/01/2026	7.4	7/04/2026	21.8	19/06/2026	0.5
1/09/2025	0.9	13/11/2025	5.4	25/01/2026	3.9	8/04/2026	22.3	20/06/2026	0.5
2/09/2025	1.4	14/11/2025	0.0	26/01/2026	1.7	9/04/2026	0.0	21/06/2026	0.9
3/09/2025	0.0	15/11/2025	7.3	27/01/2026	0.4	10/04/2026	0.0	22/06/2026	0.9
4/09/2025	0.5	16/11/2025	0.0	28/01/2026	0.0	11/04/2026	6.6	23/06/2026	0.5
5/09/2025	0.0	17/11/2025	0.5	29/01/2026	0.0	12/04/2026	57.9	24/06/2026	71.9
6/09/2025	9.3	18/11/2025	62.5	30/01/2026	0.0	13/04/2026	14.7	25/06/2026	6.0
7/09/2025	3.7	19/11/2025	18.5	31/01/2026	0.0	14/04/2026	3.8	26/06/2026	4.1
8/09/2025	0.0	20/11/2025	0.5	1/02/2026	0.0	15/04/2026	9.5	27/06/2026	0.0
9/09/2025	0.9	21/11/2025	0.0	2/02/2026	16.5	16/04/2026	4.8	28/06/2026	0.5
10/09/2025	6.5	22/11/2025	0.0	3/02/2026	2.2	17/04/2026	0.0	29/06/2026	0.0
11/09/2025	7.4	23/11/2025	0.0	4/02/2026	0.9	18/04/2026	1.9	30/06/2026	0.0

Influent flow data for 2025-2026

Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)
1/07/2025	78.2	12/09/2025	107.1	24/11/2025	75.9	5/02/2026	68.5	19/04/2026	141.5
2/07/2025	73.2	13/09/2025	102.1	25/11/2025	75.9	6/02/2026	89.7	20/04/2026	99.0
3/07/2025	134.6	14/09/2025	91.6	26/11/2025	73.5	7/02/2026	81.7	21/04/2026	93.2
4/07/2025	112.9	15/09/2025	84.4	27/11/2025	69.3	8/02/2026	89.6	22/04/2026	79.6
5/07/2025	145.7	16/09/2025	68.7	28/11/2025	72.5	9/02/2026	75.4	23/04/2026	86.5
6/07/2025	115.8	17/09/2025	70.4	29/11/2025	82.2	10/02/2026	70.8	24/04/2026	92.6
7/07/2025	86.5	18/09/2025	69.8	30/11/2025	86.4	11/02/2026	68.5	25/04/2026	95.5
8/07/2025	84.3	19/09/2025	72.8	1/12/2025	73.5	12/02/2026	70.1	26/04/2026	96.4
9/07/2025	76.8	20/09/2025	81.7	2/12/2025	71.7	13/02/2026	69.7	27/04/2026	98.2
10/07/2025	81.3	21/09/2025	75.9	3/12/2025	88.9	14/02/2026	79.6	28/04/2026	78.9
11/07/2025	158.8	22/09/2025	67.4	4/12/2025	79.3	15/02/2026	94.1	29/04/2026	79.0
12/07/2025	186.8	23/09/2025	64.2	5/12/2025	73.2	16/02/2026	76.8	30/04/2026	80.0
13/07/2025	113.0	24/09/2025	121.9	6/12/2025	86.2	17/02/2026	72.5	1/05/2026	80.0
14/07/2025	106.6	25/09/2025	95.3	7/12/2025	84.1	18/02/2026	70.2	2/05/2026	90.5
15/07/2025	82.8	26/09/2025	81.7	8/12/2025	81.4	19/02/2026	70.2	3/05/2026	96.4
16/07/2025	90.3	27/09/2025	90.4	9/12/2025	75.5	20/02/2026	73.6	4/05/2026	79.0
17/07/2025	96.5	28/09/2025	83.9	10/12/2025	74.7	21/02/2026	88.2	5/05/2026	75.2
18/07/2025	87.8	29/09/2025	72.2	11/12/2025	69.2	22/02/2026	90.8	6/05/2026	75.8
19/07/2025	90.4	30/09/2025	74.5	12/12/2025	74.1	23/02/2026	77.2	7/05/2026	78.6
20/07/2025	97.2	1/10/2025	66.9	13/12/2025	83.3	24/02/2026	76.3	8/05/2026	78.5
21/07/2025	77.1	2/10/2025	69.2	14/12/2025	88.8	25/02/2026	70.6	9/05/2026	85.5
22/07/2025	67.6	3/10/2025	83.7	15/12/2025	74.2	26/02/2026	73.1	10/05/2026	93.6
23/07/2025	75.3	4/10/2025	98.8	16/12/2025	73.1	27/02/2026	78.9	11/05/2026	77.8
24/07/2025	61.6	5/10/2025	99.4	17/12/2025	73.2	28/02/2026	79.4	12/05/2026	79.6
25/07/2025	70.7	6/10/2025	80.3	18/12/2025	70.3	1/03/2026	92.0	13/05/2026	79.1
26/07/2025	82.2	7/10/2025	75.0	19/12/2025	69.0	2/03/2026	73.8	14/05/2026	76.7
27/07/2025	81.9	8/10/2025	79.0	20/12/2025	78.3	3/03/2026	76.7	15/05/2026	75.3
28/07/2025	67.2	9/10/2025	71.6	21/12/2025	86.8	4/03/2026	72.5	16/05/2026	85.6
29/07/2025	109.8	10/10/2025	70.2	22/12/2025	75.9	5/03/2026	69.2	17/05/2026	93.8
30/07/2025	124.6	11/10/2025	78.9	23/12/2025	79.9	6/03/2026	74.7	18/05/2026	72.6

Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)
31/07/2025	85.7	12/10/2025	82.8	24/12/2025	89.8	7/03/2026	76.8	19/05/2026	79.7
1/08/2025	75.8	13/10/2025	69.6	25/12/2025	98.1	8/03/2026	95.5	20/05/2026	74.7
2/08/2025	90.3	14/10/2025	128.1	26/12/2025	98.2	9/03/2026	72.3	21/05/2026	75.4
3/08/2025	84.8	15/10/2025	96.8	27/12/2025	87.5	10/03/2026	67.6	22/05/2026	78.9
4/08/2025	71.5	16/10/2025	76.6	28/12/2025	90.2	11/03/2026	65.7	23/05/2026	81.9
5/08/2025	66.9	17/10/2025	77.3	29/12/2025	70.6	12/03/2026	69.1	24/05/2026	92.2
6/08/2025	69.7	18/10/2025	90.0	30/12/2025	80.2	13/03/2026	79.3	25/05/2026	79.3
7/08/2025	66.1	19/10/2025	85.1	31/12/2025	73.0	14/03/2026	82.9	26/05/2026	73.8
8/08/2025	77.5	20/10/2025	74.0	1/01/2026	86.0	15/03/2026	81.4	27/05/2026	73.6
9/08/2025	84.7	21/10/2025	68.7	2/01/2026	81.4	16/03/2026	75.8	28/05/2026	73.0
10/08/2025	86.1	22/10/2025	68.7	3/01/2026	86.6	17/03/2026	71.2	29/05/2026	78.4
11/08/2025	76.4	23/10/2025	69.5	4/01/2026	82.7	18/03/2026	67.4	30/05/2026	81.6
12/08/2025	69.3	24/10/2025	91.6	5/01/2026	73.1	19/03/2026	66.6	31/05/2026	75.7
13/08/2025	64.2	25/10/2025	79.7	6/01/2026	79.4	20/03/2026	75.0	1/06/2026	81.0
14/08/2025	69.9	26/10/2025	80.6	7/01/2026	84.2	21/03/2026	82.2	2/06/2026	102.5
15/08/2025	76.4	27/10/2025	82.5	8/01/2026	69.6	22/03/2026	88.2	3/06/2026	119.1
16/08/2025	75.0	28/10/2025	93.1	9/01/2026	75.7	23/03/2026	72.8	4/06/2026	90.8
17/08/2025	85.9	29/10/2025	73.5	10/01/2026	75.2	24/03/2026	66.6	5/06/2026	95.3
18/08/2025	78.9	30/10/2025	75.5	11/01/2026	87.5	25/03/2026	68.1	6/06/2026	118.9
19/08/2025	107.7	31/10/2025	69.1	12/01/2026	69.4	26/03/2026	144.3	7/06/2026	107.4
20/08/2025	88.2	1/11/2025	82.6	13/01/2026	71.7	27/03/2026	175.4	8/06/2026	87.4
21/08/2025	72.6	2/11/2025	89.3	14/01/2026	73.7	28/03/2026	134.9	9/06/2026	85.0
22/08/2025	74.6	3/11/2025	75.6	15/01/2026	78.7	29/03/2026	99.5	10/06/2026	83.2
23/08/2025	82.8	4/11/2025	68.8	16/01/2026	83.9	30/03/2026	82.7	11/06/2026	81.8
24/08/2025	81.4	5/11/2025	71.1	17/01/2026	89.0	31/03/2026	81.2	12/06/2026	81.3
25/08/2025	67.5	6/11/2025	68.3	18/01/2026	95.2	1/04/2026	77.3	13/06/2026	85.6
26/08/2025	66.3	7/11/2025	74.4	19/01/2026	74.7	2/04/2026	80.8	14/06/2026	95.4
27/08/2025	65.3	8/11/2025	76.3	20/01/2026	81.9	3/04/2026	92.3	15/06/2026	75.1
28/08/2025	68.5	9/11/2025	112.2	21/01/2026	251.8	4/04/2026	84.4	16/06/2026	77.6
29/08/2025	69.9	10/11/2025	78.6	22/01/2026	202.8	5/04/2026	87.1	17/06/2026	74.9
30/08/2025	79.1	11/11/2025	97.0	23/01/2026	128.1	6/04/2026	84.8	18/06/2026	77.7
31/08/2025	87.5	12/11/2025	94.2	24/01/2026	103.0	7/04/2026	41.0	19/06/2026	76.9

Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)	Date	Influent Vol (m^3/day)
1/09/2025	77.1	13/11/2025	95.9	25/01/2026	112.7	8/04/2026	82.7	20/06/2026	88.8
2/09/2025	65.2	14/11/2025	83.6	26/01/2026	97.2	9/04/2026	99.7	21/06/2026	88.1
3/09/2025	74.1	15/11/2025	87.1	27/01/2026	86.4	10/04/2026	83.8	22/06/2026	81.6
4/09/2025	61.5	16/11/2025	95.9	28/01/2026	81.2	11/04/2026	92.1	23/06/2026	75.9
5/09/2025	69.0	17/11/2025	75.5	29/01/2026	81.5	12/04/2026	194.7	24/06/2026	178.2
6/09/2025	81.8	18/11/2025	109.9	30/01/2026	73.5	13/04/2026	113.7	25/06/2026	147.4
7/09/2025	77.8	19/11/2025	232.0	31/01/2026	87.7	14/04/2026	117.3	26/06/2026	118.9
8/09/2025	72.6	20/11/2025	99.0	1/02/2026	87.9	15/04/2026	113.2	27/06/2026	109.9
9/09/2025	67.7	21/11/2025	86.0	2/02/2026	74.4	16/04/2026	100.1	28/06/2026	108.4
10/09/2025	68.8	22/11/2025	90.2	3/02/2026	76.0	17/04/2026	94.3	29/06/2026	84.6
11/09/2025	72.6	23/11/2025	87.4	4/02/2026	69.7	18/04/2026	93.9	30/06/2026	86.4

Effluent disposal field 1-4 daily volumes

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
1/07/2025	37.43	8.33	44.74	30.19
2/07/2025	37.43	8.33	44.74	30.19
3/07/2025	37.42	8.33	44.73	30.18
4/07/2025	37.43	8.33	44.73	30.19
5/07/2025	37.43	8.32	44.75	30.19
6/07/2025	37.43	8.33	44.75	30.18
7/07/2025	37.43	8.33	44.75	30.17
8/07/2025	37.43	8.33	44.74	30.19
9/07/2025	37.44	8.33	44.73	30.19
10/07/2025	37.44	8.32	44.73	30.17
11/07/2025	37.43	8.33	44.73	30.18
12/07/2025	37.43	8.35	44.73	30.18
13/07/2025	37.42	8.35	44.72	30.19
14/07/2025	37.43	8.33	44.73	30.19
15/07/2025	37.43	8.32	44.73	30.18
16/07/2025	37.43	8.32	44.73	30.17
17/07/2025	37.42	8.34	44.73	30.17
18/07/2025	37.43	8.34	44.73	30.18
19/07/2025	37.43	8.33	44.75	30.18
20/07/2025	37.43	8.33	44.75	30.17

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
21/07/2025	37.43	8.33	44.73	30.19
22/07/2025	37.43	8.35	44.73	30.19
23/07/2025	37.41	8.35	38.25	20.11
24/07/2025	0.00	0.00	0.00	0.00
25/07/2025	37.41	8.33	44.71	30.18
26/07/2025	37.41	8.35	44.73	30.19
27/07/2025	37.43	8.35	44.75	30.19
28/07/2025	37.43	8.32	44.75	30.18
29/07/2025	37.44	8.32	44.74	30.17
30/07/2025	37.44	8.33	44.74	30.17
31/07/2025	37.43	8.33	44.74	30.18
1/08/2025	37.43	8.33	44.74	30.18
2/08/2025	37.43	8.33	44.74	30.19
3/08/2025	37.43	8.33	44.74	30.19
4/08/2025	12.46	2.80	1.18	0.00
5/08/2025	0.00	0.00	0.00	0.00
6/08/2025	0.00	0.00	0.00	0.00
7/08/2025	37.43	8.33	44.77	30.16
8/08/2025	37.44	8.34	44.77	30.19
9/08/2025	37.44	8.34	44.73	30.19
10/08/2025	37.43	8.33	44.73	30.18

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
11/08/2025	12.48	2.78	6.10	0.00
12/08/2025	37.43	8.31	44.75	30.17
13/08/2025	37.43	8.33	44.75	30.18
14/08/2025	37.43	8.33	44.73	30.18
15/08/2025	37.43	8.32	44.73	30.18
16/08/2025	12.47	2.81	13.95	0.00
17/08/2025	0.00	0.00	0.00	0.00
18/08/2025	37.43	8.32	44.74	30.17
19/08/2025	37.43	8.33	44.74	30.17
20/08/2025	37.44	8.33	44.73	30.17
21/08/2025	37.45	8.33	44.73	30.17
22/08/2025	37.45	8.34	44.75	30.17
23/08/2025	37.42	8.34	44.75	30.17
24/08/2025	12.49	2.77	0.67	0.00
25/08/2025	0.00	0.00	0.00	0.00
26/08/2025	0.00	0.00	0.00	0.00
27/08/2025	37.42	8.34	44.74	30.16
28/08/2025	37.42	8.34	44.74	30.18
29/08/2025	37.47	8.33	44.74	30.19
30/08/2025	37.47	8.33	44.74	30.19
31/08/2025	37.42	8.32	44.73	30.16

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
1/09/2025	0.00	0.00	0.00	0.00
2/09/2025	0.00	0.00	0.00	0.00
3/09/2025	37.43	8.33	44.74	30.16
4/09/2025	37.43	8.34	44.74	30.17
5/09/2025	37.43	8.34	44.74	30.17
6/09/2025	37.43	8.34	44.74	30.18
7/09/2025	37.43	8.34	44.73	30.18
8/09/2025	37.40	8.33	44.73	30.17
9/09/2025	11.90	0.00	0.00	0.00
10/09/2025	0.00	0.00	0.00	0.00
11/09/2025	0.00	0.00	0.00	0.00
12/09/2025	37.42	8.35	44.74	30.19
13/09/2025	37.42	8.35	44.74	30.19
14/09/2025	37.43	8.37	44.79	30.17
15/09/2025	37.43	8.37	44.79	30.18
16/09/2025	37.46	8.33	44.74	30.18
17/09/2025	37.46	8.36	44.74	30.18
18/09/2025	37.42	8.36	44.73	30.18
19/09/2025	12.48	2.77	14.21	0.00
20/09/2025	0.00	0.00	0.00	0.00
21/09/2025	0.00	0.00	0.00	0.00

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
22/09/2025	37.43	8.31	44.74	30.17
23/09/2025	37.43	8.31	44.74	30.17
24/09/2025	37.43	8.32	44.72	30.19
25/09/2025	37.44	8.32	44.76	30.19
26/09/2025	37.44	8.33	44.76	30.18
27/09/2025	37.43	8.33	44.73	30.18
28/09/2025	37.42	8.33	44.73	30.18
29/09/2025	12.48	2.78	14.47	0.00
30/09/2025	37.44	8.31	44.74	30.18
1/10/2025	37.44	8.33	44.74	30.18
2/10/2025	37.43	8.33	44.76	30.18
3/10/2025	37.42	8.33	44.76	30.18
4/10/2025	24.96	5.56	29.81	20.12
5/10/2025	37.42	8.33	44.73	30.18
6/10/2025	37.44	8.33	44.75	30.18
7/10/2025	37.46	8.31	44.75	30.18
8/10/2025	37.46	8.31	44.75	30.18
9/10/2025	12.44	2.78	13.81	0.00
10/10/2025	0.00	0.00	0.00	0.00
11/10/2025	37.43	8.34	44.71	30.19
12/10/2025	37.43	8.34	44.74	30.19

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
13/10/2025	37.44	8.33	44.74	30.18
14/10/2025	37.44	8.35	44.74	30.20
15/10/2025	37.44	8.35	44.71	30.20
16/10/2025	12.47	2.79	14.92	10.06
17/10/2025	37.43	8.32	44.76	30.18
18/10/2025	37.43	8.34	44.76	30.18
19/10/2025	37.41	8.34	30.63	20.12
20/10/2025	37.41	8.35	44.74	30.18
21/10/2025	37.43	8.35	44.75	30.19
22/10/2025	37.43	8.33	44.75	30.19
23/10/2025	12.47	2.78	2.07	0.00
24/10/2025	37.43	8.34	44.76	30.16
25/10/2025	37.43	8.36	44.76	30.16
26/10/2025	37.42	8.36	44.76	30.16
27/10/2025	37.35	6.63	29.83	20.13
28/10/2025	37.41	8.34	44.74	30.17
29/10/2025	37.43	8.34	44.74	30.17
30/10/2025	37.43	8.33	31.28	20.13
31/10/2025	0.00	0.00	0.00	0.00
1/11/2025	55.09	12.47	58.29	38.48
2/11/2025	55.09	12.47	58.29	38.48

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
3/11/2025	41.30	9.37	57.13	25.69
4/11/2025	41.30	9.37	57.13	25.69
5/11/2025	0.00	0.00	0.00	0.00
6/11/2025	13.78	3.14	10.45	0.00
7/11/2025	13.78	3.14	14.43	0.00
8/11/2025	13.80	3.13	15.28	7.59
9/11/2025	13.80	3.14	18.82	7.59
10/11/2025	55.09	12.48	45.78	38.51
11/11/2025	55.10	12.49	58.26	38.52
12/11/2025	55.10	12.49	58.26	38.52
13/11/2025	55.09	12.52	58.25	38.50
14/11/2025	55.08	12.52	58.25	38.50
15/11/2025	41.34	7.48	30.54	25.66
16/11/2025	0.00	0.00	0.00	0.00
17/11/2025	55.10	12.49	58.25	38.47
18/11/2025	55.10	12.49	58.25	38.47
19/11/2025	55.08	12.49	58.27	38.51
20/11/2025	55.11	12.49	58.27	38.51
21/11/2025	55.12	12.49	58.29	38.51
22/11/2025	55.12	12.49	58.29	38.49
23/11/2025	41.35	9.21	30.52	25.69

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
24/11/2025	27.56	6.25	29.41	12.84
25/11/2025	27.56	6.25	29.41	12.84
26/11/2025	55.08	12.50	45.78	38.51
27/11/2025	55.08	12.50	45.78	38.51
28/11/2025	41.30	7.71	38.87	25.68
29/11/2025	0.00	0.00	0.00	0.00
30/11/2025	55.10	12.47	45.77	38.52
1/12/2025	55.10	12.47	45.77	38.52
2/12/2025	41.34	9.37	40.42	25.69
3/12/2025	55.10	12.47	58.27	38.50
4/12/2025	55.10	12.47	58.27	38.50
5/12/2025	41.33	9.34	30.51	25.70
6/12/2025	0.00	0.00	0.00	0.00
7/12/2025	55.06	12.52	58.26	38.51
8/12/2025	55.06	12.52	58.26	38.51
9/12/2025	41.32	7.74	30.53	25.68
10/12/2025	0.00	0.00	0.00	0.00
11/12/2025	55.11	12.50	58.28	38.48
12/12/2025	55.11	12.50	58.28	38.48
13/12/2025	27.58	6.25	15.90	12.84
14/12/2025	55.10	11.13	45.76	38.48

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
15/12/2025	55.10	11.13	45.76	38.48
16/12/2025	0.00	0.00	0.00	0.00
17/12/2025	55.09	12.48	58.27	38.46
18/12/2025	55.09	12.48	58.27	38.46
19/12/2025	41.33	7.63	30.51	25.69
20/12/2025	0.00	0.00	0.00	0.00
21/12/2025	55.07	12.51	58.25	38.51
22/12/2025	55.07	12.51	58.25	38.51
23/12/2025	41.33	8.88	30.51	25.68
24/12/2025	41.31	9.38	34.10	25.68
25/12/2025	41.31	9.38	34.10	25.68
26/12/2025	55.11	12.48	45.78	38.51
27/12/2025	55.11	12.48	45.78	38.51
28/12/2025	41.34	9.37	41.14	25.67
29/12/2025	27.56	6.26	38.86	25.68
30/12/2025	55.10	12.17	45.78	38.53
31/12/2025	55.10	12.17	45.78	38.53
1/01/2026	0.00	0.00	0.00	0.00
2/01/2026	55.07	12.49	58.28	38.50
3/01/2026	55.07	12.49	58.28	38.50
4/01/2026	41.33	9.38	31.40	25.67

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
5/01/2026	55.06	12.52	45.79	38.50
6/01/2026	55.06	12.52	45.79	38.50
7/01/2026	41.33	9.36	45.76	26.78
8/01/2026	41.33	9.36	45.76	26.78
9/01/2026	41.35	9.38	33.60	25.69
10/01/2026	41.35	9.38	33.60	25.69
11/01/2026	55.11	12.49	45.80	38.47
12/01/2026	55.11	12.49	45.80	38.47
13/01/2026	13.78	3.13	2.07	0.00
14/01/2026	41.34	9.40	48.30	25.68
15/01/2026	41.34	9.40	48.30	25.68
16/01/2026	55.07	12.49	58.24	38.51
17/01/2026	55.07	12.49	58.24	38.51
18/01/2026	27.56	6.26	30.53	25.68
19/01/2026	0.00	0.00	0.00	0.00
20/01/2026	0.00	0.00	0.00	0.00
21/01/2026	0.00	0.00	0.00	0.00
22/01/2026	55.10	12.47	58.25	38.49
23/01/2026	55.10	12.49	58.25	38.50
24/01/2026	55.10	12.49	58.25	38.51
25/01/2026	55.09	12.49	58.25	38.51

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
26/01/2026	55.08	12.49	58.27	38.49
27/01/2026	55.07	12.53	58.27	38.51
28/01/2026	55.07	12.53	45.78	38.51
29/01/2026	41.34	8.13	38.89	25.67
30/01/2026	55.09	12.49	58.27	38.50
31/01/2026	55.09	12.50	58.27	38.50
1/02/2026	55.11	12.50	58.26	38.51
2/02/2026	55.11	12.49	58.26	38.51
3/02/2026	55.12	12.49	58.27	38.51
4/02/2026	55.12	12.46	58.27	38.49
5/02/2026	41.34	8.59	30.51	25.69
6/02/2026	55.10	11.61	45.75	38.52
7/02/2026	55.10	11.61	45.75	38.52
8/02/2026	55.10	12.48	45.77	38.51
9/02/2026	55.10	12.48	58.29	38.51
10/02/2026	55.09	12.48	58.29	38.51
11/02/2026	55.09	12.48	45.75	38.50
12/02/2026	41.31	9.37	41.25	25.67
13/02/2026	55.10	12.50	58.26	38.50
14/02/2026	55.10	12.50	58.26	38.50
15/02/2026	55.09	12.48	45.79	38.50

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
16/02/2026	55.10	12.47	45.79	38.48
17/02/2026	55.11	12.47	58.27	38.50
18/02/2026	55.11	12.49	58.27	38.50
19/02/2026	55.10	12.49	55.68	38.50
20/02/2026	41.32	9.41	55.68	25.64
21/02/2026	41.33	9.41	39.72	25.68
22/02/2026	41.33	9.41	39.72	25.68
23/02/2026	55.08	12.03	58.28	38.50
24/02/2026	55.08	12.03	58.28	38.50
25/02/2026	41.32	9.38	39.13	25.68
26/02/2026	41.32	9.38	39.13	25.68
27/02/2026	41.35	9.38	56.42	25.66
28/02/2026	41.35	9.38	56.42	25.66
1/03/2026	55.11	12.49	58.30	38.49
2/03/2026	55.11	12.49	58.30	38.49
3/03/2026	13.78	3.15	1.89	0.00
4/03/2026	55.08	12.52	45.78	38.49
5/03/2026	55.08	12.52	45.78	38.49
6/03/2026	27.57	6.25	19.70	12.83
7/03/2026	55.08	11.19	58.29	38.48
8/03/2026	55.08	11.19	58.29	38.48

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
9/03/2026	55.11	10.35	58.26	38.50
10/03/2026	55.11	10.35	58.26	38.50
11/03/2026	0.00	0.00	0.00	0.00
12/03/2026	55.10	12.48	45.76	38.51
13/03/2026	55.10	12.48	45.76	38.51
14/03/2026	27.56	6.27	19.77	12.84
15/03/2026	55.10	12.49	58.27	38.49
16/03/2026	55.10	12.49	58.27	38.49
17/03/2026	0.00	0.00	0.00	0.00
18/03/2026	55.09	11.72	45.74	38.52
19/03/2026	55.09	11.72	45.74	38.52
20/03/2026	0.00	0.00	0.00	0.00
21/03/2026	55.05	12.08	58.28	38.51
22/03/2026	55.05	12.08	58.28	38.51
23/03/2026	0.00	0.00	0.00	0.00
24/03/2026	55.10	12.47	45.78	38.50
25/03/2026	55.10	12.47	45.78	38.50
26/03/2026	13.77	3.14	19.43	3.98
27/03/2026	55.12	12.49	58.28	38.48
28/03/2026	55.12	12.51	58.28	38.51
29/03/2026	55.08	12.51	45.75	38.51

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
30/03/2026	55.06	12.51	45.95	38.48
31/03/2026	55.06	12.51	58.27	38.50
1/04/2026	55.09	12.50	58.27	38.50
2/04/2026	55.09	12.49	58.28	38.49
3/04/2026	55.09	12.51	58.28	38.49
4/04/2026	55.08	12.51	45.76	38.49
5/04/2026	0.00	0.00	0.00	0.00
6/04/2026	55.11	12.49	58.26	38.50
7/04/2026	13.77	3.14	15.26	12.84
8/04/2026	55.09	12.48	58.31	38.49
9/04/2026	55.08	12.50	45.75	38.50
10/04/2026	41.33	7.20	38.89	25.67
11/04/2026	0.00	0.00	0.00	0.00
12/04/2026	55.07	12.46	58.26	38.49
13/04/2026	55.09	12.48	45.78	38.50
14/04/2026	55.09	12.48	58.29	38.49
15/04/2026	55.06	12.51	45.78	38.50
16/04/2026	55.07	12.51	58.29	38.50
17/04/2026	55.05	12.51	45.80	38.49
18/04/2026	27.55	6.25	31.88	12.84
19/04/2026	0.00	0.00	0.00	0.00

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
20/04/2026	55.08	12.51	58.25	38.50
21/04/2026	41.32	7.42	30.51	25.67
22/04/2026	0.00	0.00	0.00	0.00
23/04/2026	0.00	0.00	0.00	0.00
24/04/2026	27.56	6.29	26.70	12.85
25/04/2026	55.09	12.52	26.70	12.85
26/04/2026	55.09	12.54	58.25	37.46
27/04/2026	55.09	12.54	58.25	37.46
28/04/2026	27.55	4.09	15.26	12.84
29/04/2026	0.00	0.00	0.00	0.00
30/04/2026	37.44	8.33	39.53	28.09
1/05/2026	37.44	8.33	39.53	28.09
2/05/2026	37.44	8.33	29.13	30.16
3/05/2026	37.44	8.34	29.13	30.17
4/05/2026	37.43	8.34	29.14	30.17
5/05/2026	37.43	8.35	29.14	30.16
6/05/2026	37.42	8.35	29.13	30.16
7/05/2026	24.96	5.55	16.79	10.06
8/05/2026	0.00	0.00	0.00	0.00
9/05/2026	37.42	8.33	29.14	30.17
10/05/2026	37.43	8.33	29.14	30.18

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
11/05/2026	37.43	8.34	29.14	30.18
12/05/2026	37.43	8.34	29.14	30.17
13/05/2026	37.43	8.33	29.12	30.17
14/05/2026	35.88	5.57	19.42	20.12
15/05/2026	0.00	0.00	0.00	0.00
16/05/2026	0.00	0.00	0.00	0.00
17/05/2026	37.43	8.34	29.14	30.17
18/05/2026	37.43	8.34	29.14	30.17
19/05/2026	37.43	8.34	29.14	30.17
20/05/2026	37.43	8.34	29.14	30.17
21/05/2026	37.44	8.34	29.15	30.17
22/05/2026	37.44	8.33	29.15	30.17
23/05/2026	24.97	5.55	12.88	10.06
24/05/2026	0.00	0.00	0.00	0.00
25/05/2026	0.00	0.00	0.00	0.00
26/05/2026	37.43	8.33	29.13	30.17
27/05/2026	37.43	8.33	29.13	30.17
28/05/2026	37.43	8.34	29.13	30.17
29/05/2026	37.44	8.34	29.13	30.17
30/05/2026	37.44	8.35	29.13	30.17
31/05/2026	37.42	8.35	23.47	20.12

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
1/06/2026	0.00	0.00	0.00	0.00
2/06/2026	0.00	0.00	0.00	0.00
3/06/2026	37.42	8.35	29.13	30.18
4/06/2026	37.44	8.35	29.14	30.18
5/06/2026	37.44	8.34	29.14	30.17
6/06/2026	37.43	8.35	29.15	30.16
7/06/2026	37.42	8.35	29.15	30.17
8/06/2026	37.42	8.35	29.14	30.17
9/06/2026	37.43	8.35	29.14	30.17
10/06/2026	37.43	8.33	29.13	30.18
11/06/2026	37.43	8.34	29.13	30.18
12/06/2026	37.43	8.34	29.14	30.17
13/06/2026	37.42	8.34	29.14	30.16
14/06/2026	32.94	5.55	19.43	13.64
15/06/2026	0.00	0.00	0.00	0.00
16/06/2026	0.00	0.00	0.00	0.00
17/06/2026	37.44	8.34	44.72	30.17
18/06/2026	37.44	8.34	44.75	30.17
19/06/2026	37.42	8.36	44.75	30.17
20/06/2026	37.41	8.36	44.74	30.17
21/06/2026	37.41	8.36	44.72	30.17

Date	EDF 1 daily volume (m^3/day)	EDF 2 daily volume (m^3/day)	EDF 3 daily volume (m^3/day)	EDF 4 daily volume (m^3/day)
22/06/2026	24.96	5.55	27.12	10.05
23/06/2026	0.00	0.00	0.00	0.00
24/06/2026	37.43	8.34	44.74	30.18
25/06/2026	37.43	8.34	44.74	30.18
26/06/2026	37.43	8.34	44.74	30.18
27/06/2026	37.43	8.34	44.74	30.18
28/06/2026	37.43	8.34	44.76	30.17
29/06/2026	37.43	8.34	44.76	30.18
30/06/2026	37.42	8.34	44.74	30.18

Effluent quality for 2025-2026

Date	$cBOD_5$	Total Calcium	Total Sodium	Total Magnesium	DRP (as P)	E. coli	Faecal coliforms	Nitrate (as N)	Ammoniacal N (as N)	pH	TSS
	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	cfu/100mL	mg/L	mg/L	mg/L	mg/L
2/07/2025	0.53	18.0	57.0	4.1	2.32	1.6	1.6	6.1	0.04	7.1	1.2
9/07/2025	0.58	19.0	57.0	4.5	5.17	3.3	8.2	6.2	0.04	7.1	2.6
16/07/2025	0.77	22.0	51.0	4.2	3.42	690	1200	4.9	0.03	7.1	4.8
23/07/2025	0.84	18.0	64.0	4.9	7.94	440	450	0.7	0.60	7.0	1.0
30/07/2025	0.50	14.0	62.0	4.0	4.42	290	310	0.2	5.40	7.2	1.0
6/08/2025	1.10	16.0	63.0	4.7	7.95	98	130	10.8	0.04	7.1	2.6
13/08/2025	0.96	13.0	67.0	4.1	4.93	54	80	3.8	0.30	7.2	11.0
20/08/2025	3.30	14.0	61.0	3.8	3.99	25	23	6.3	0.04	7.3	1.8
27/08/2025	0.85	17.0	66.0	4.3	4.85	1.6	1.6	5.9	0.04	7.4	2.2
3/09/2025	1.40	15.0	66.0	4.2	5.57	6.6	62	4.9	0.02	7.4	1.8
10/09/2025	1.30	15.0	65.0	4.4	6.06	18	23	6.3	0.03	7.4	1.0
17/09/2025	1.30	17.0	59.0	4.2	2.87	16	16	4.0	0.04	7.5	3.4
24/09/2025	0.90	17.0	68.0	4.6	4.84	1.6	1.6	5.5	0.04	7.1	1.0
1/10/2025	0.52	17.0	62.0	4.3	2.21	18	25	3.4	0.15	7.2	1.0
8/10/2025	3.30	18.0	63.0	4.7	4.36	1.7	1.7	3.1	0.03	7.5	5.8
15/10/2025	2.90	14.0	60.0	3.8	4.40	11	9.8	0.8	2.30	7.4	17.0
22/10/2025	2.90	17.0	70.0	4.2	2.02	1.6	1.6	0.3	0.04	7.6	2.6
29/10/2025	2.00	16.0	65.0	4.2	2.13	1.6	1.6	1.3	0.16	7.5	1.2
5/11/2025	2.00	16.0	69.0	4.4	3.75	8.2	9.8	4.0	0.04	7.6	2.0
12/11/2025	0.51	16.0	60.0	4.0	1.35	1.6	8.2	2.3	0.04	7.2	1.0

Date	$cBOD_5$	Total Calcium	Total Sodium	Total Magnesium	DRP (as P)	E. coli	Faecal coliforms	Nitrate (as N)	Ammoniacal N (as N)	pH	TSS
	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	cfu/100mL	mg/L	mg/L	mg/L	mg/L
19/11/2025	1.70	18.0	66.0	5.2	8.87	1.6	1.6	4.9	0.03	7.4	1.0
26/11/2025	2.10	19.0	75.0	5.2	6.89	1.6	1.6	6.7	0.04	7.6	1.0
3/12/2025	2.00	17.0	68.0	5.0	8.82	1.6	1.6	7.1	0.04	7.5	4.4
10/12/2025	1.90	18.0	68.0	5.5	10.40	1.6	1.6	9.2	0.04	7.6	3.4
17/12/2025	1.00	18.0	79.0	6.1	9.99	1.7	1.7	12.0	0.05	7.5	1.0
24/12/2025	0.52	16.0	73.0	4.8	5.81	1.7	1.7	8.4	0.04	7.4	1.0
31/12/2025	1.10	18.0	88.0	6.4	13.50	3.3	1.7	6.5	0.33	7.4	1.8
7/01/2026	0.62	18.0	91.0	7.0	10.20	3.3	3.3	14.0	0.07	7.1	1.0
14/01/2026	0.88	20.0	93.0	7.4	9.27	1.6	1.6	11.0	0.05	7.1	1.6
21/01/2026	2.80	18.0	89.0	6.7	7.84	1.6	1.6	8.1	0.05	7.4	2.2
28/01/2026	2.40	21.0	60.0	4.6	0.83	1.7	1.6	8.1	0.05	7.7	3.0
4/02/2026	3.00	19.0	76.0	4.4	0.94	1.6	1.6	0.3	0.09	7.8	2.6
11/02/2026	1.90	18.0	80.0	5.4	0.05	110	120	5.1	0.05	7.7	4.0
18/02/2026	2.50	16.0	70.0	4.0	0.41	26	52	6.3	0.04	7.7	2.4
25/02/2026	2.80	18.0	74.0	5.1	9.09	1.6	4.9	3.1	0.89	7.4	2.0
4/03/2026	2.20	17.0	75.0	4.6	4.93	1.6	3.3	6.5	0.04	7.6	3.8
11/03/2026	1.90	18.0	79.0	5.5	6.60	1.6	1.6	0.0	0.04	7.6	3.8
18/03/2026	1.90	16.0	76.0	5.2	7.50	1.6	4.9	6.4	0.04	7.7	3.6
25/03/2026	1.60	21.0	77.0	5.5	0.12	1.6	1.6	4.6	0.03	7.7	4.8
1/04/2026	1.50	19.0	60.0	4.5	0.83	1.6	1.6	4.9	0.03	7.6	1.0
8/04/2026	1.50	18.0	82.0	4.6	1.50	1.6	1.6	4.2	0.03	7.5	1.0

Date	$cBOD_5$	Total Calcium	Total Sodium	Total Magnesium	DRP (as P)	E. coli	Faecal coliforms	Nitrate (as N)	Ammoniacal N (as N)	pH	TSS
	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	cfu/100mL	mg/L	mg/L	mg/L	mg/L
15/04/2026	1.20	20.0	46.0	4.5	0.44	58	52	1.5	0.02	7.5	1.4
22/04/2026	1.30	18.0	56.0	4.1	0.69	15	23	4.4	0.03	7.6	2.4
29/04/2026	1.70	19.0	77.0	4.4	1.30	48	62	5.7	0.03	7.6	2.0
6/05/2026	1.20	16.0	71.0	4.6	5.90	40	50	5.6	0.03	7.5	2.4
13/05/2026	1.50	18.0	72.0	5.0	3.70	4.9	9.8	5.5	0.04	7.6	2.4
20/05/2026	1.30	16.0	74.0	4.9	4.80	18	33	5.0	0.03	7.2	3.6
27/05/2026	1.60	15.0	69.0	4.7	5.70	1.6	4.9	5.9	0.05	7.5	1.6
3/06/2026	1.40	16.0	73.0	4.5	5.40	8.2	3.3	2.8	0.17	7.6	1.0
10/06/2026	1.20	19.0	63.0	4.5	1.20	230	430	5.5	0.03	7.6	5.0
17/06/2026	1.40	16.0	67.0	4.2	2.60	80	120	5.5	0.04	7.4	5.2
24/06/2026	1.40	16.0	72.0	3.8	2.30	9.8	25	4.8	0.04	7.6	1.6

Rautawa Stream site 3 water quality monitoring results for 2025-2026

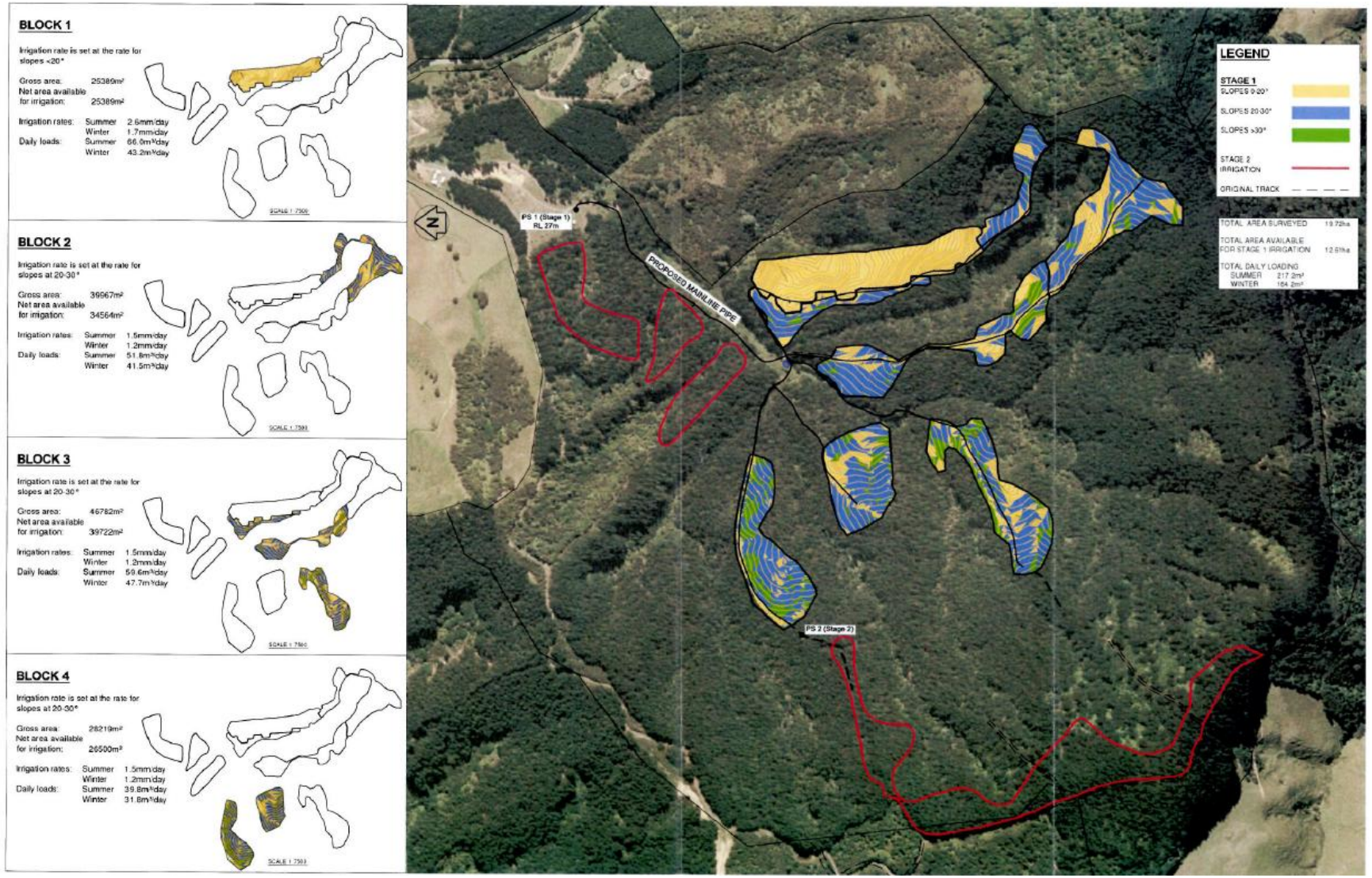
Date	$cBOD_5$	DRP	*E. coli*	Faecal coliforms	NO_2-N	NO_3-N	NO_x-N	TKN	TN	NH_x-N	Total P	TSS	pH (lab)	pH (field)	Dissolved oxygen (field)	Temperature (field)
	mg/L	mg/L	cfu/100mL	cfu/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Unit	Unit	mg/L	°C
03/07/25	1.20	0.010	980	1300	0.002	0.152	0.15	0.35	0.50	0.017	0.047	22.0	6.9	6.5	10.1	13.7
20/07/25	0.57	0.009	52	41	0.002	0.138	0.14	0.09	0.23	0.012	0.019	4.4	7.1	6.3	10.8	10.6
03/08/25	0.54	0.015	68	70	0.002	0.125	0.13	0.02	0.15	0.013	0.020	1.0	7.2	7.3	11.1	9.9
17/08/25	0.50	0.016	140	150	0.002	0.118	0.12	0.17	0.29	0.036	0.046	9.8	7.2	6.4	10.5	11.3
26/08/25	1.20	0.011	30	28	0.002	0.100	0.10	0.05	0.15	0.010	0.022	3.8	7.3	6.9	10.6	11.8
14/09/25	0.66	0.018	50	64	0.002	0.134	0.13	0.39	0.53	0.012	0.038	11.0	7.0	6.6	10.5	12.3
27/09/25	0.66	0.010	28	30	0.002	0.127	0.13	0.11	0.24	0.012	0.020	3.8	7.1	6.7	10.1	13.3
11/10/25	0.53	0.012	33	43	0.002	0.089	0.35	0.10	0.19	0.008	0.023	129.0	7.2	6.5	9.9	15.0
26/10/25	0.50	0.010	62	76	0.002	0.122	0.12	0.08	0.20	0.019	0.025	5.2	7.1	6.0	10.2	13.2
09/11/25	1.80	0.018	5800	6300	0.003	0.293	0.30	0.53	0.83	0.009	0.053	65.0	6.9	6.9	9.5	16.6
23/11/25	0.50	0.009	200	260	0.002	0.139	0.14	0.10	0.24	0.011	0.026	18.0	6.9	6.8	9.5	16.6
02/12/25	2.00	0.011	68	120	0.002	0.098	0.10	0.09	0.19	0.009	0.024	6.6	7.2	6.5	9.5	16.4
21/12/25	0.62	0.014	68	800	0.002	0.077	0.08	0.04	0.12	0.005	0.020	4.8	7.4	7.4	9.9	16.0
04/01/26	0.50	0.014	82	110	0.002	0.079	0.08	0.14	0.22	0.005	0.021	3.8	7.4	7.2	9.5	16.6
17/01/26	0.62	0.014	390	600	0.002	0.110	0.11	0.29	0.40	0.016	0.034	4.8	7.3	6.6	9.2	17.6
30/01/26	0.50	0.013	78	100	0.002	0.120	0.12	0.33	0.45	0.020	0.024	6.2	7.3	6.1	9.4	16.1
15/02/26	0.50	0.021	180	220	0.002	0.100	0.10	0.13	0.23	0.008	0.025	6.6	7.3	6.5	9.2	17.4
27/02/26	0.57	0.014	84	92	0.002	0.086	0.09	0.10	0.19	0.005	0.018	3.8	7.3	6.8	9.3	16.7
14/03/26	0.50	0.012	180	300	0.002	0.084	0.08	0.10	0.19	0.006	0.028	4.6	7.3	6.7	9.4	17.6

Date	$cBOD_5$	DRP	*E. coli*	Faecal coliforms	NO_2-N	NO_3-N	NO_x-N	TKN	TN	NH_x-N	Total P	TSS	pH (lab)	pH (field)	Dissolved oxygen (field)	Temperature (field)
	mg/L	mg/L	cfu/100mL	cfu/100mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Unit	Unit	mg/L	°C
29/03/26	0.56	0.009	310	390	0.002	0.140	0.14	0.12	0.26	0.016	0.036	7.8	7.1	6.8	9.2	17.4
09/04/26	0.50	0.010	210	250	0.002	0.120	0.12	0.27	0.39	0.006	0.069	20.6	7.1	6.9	9.2	17.6
25/04/26	0.68	0.014	100	130	0.002	0.130	0.13	0.07	0.20	0.008	0.029	3.6	7.1	7.3	10.2	13.4
09/05/26	0.50	0.016	240	340	0.002	0.150	0.15	0.14	0.29	0.015	0.040	7.0	7.3	7.1	9.4	15.5
24/05/26	0.50	0.015	25	44	0.002	0.130	0.13	0.08	0.21	0.005	0.027	4.0	7.3	6.8	10.2	14.1
5/06/26	0.50	0.014	92	200	0.002	0.130	0.13	0.24	0.37	0.012	0.046	7.4	7.0	7.0	10.0	14.8
20/06/26	0.50	0.014	23	31	0.002	0.140	0.14	0.05	0.19	0.005	0.026	3.6	7.5	7.1	10.9	10.7

Rautawa Stream site 6 water quality monitoring results for 2025-2026

Date	Enterococci (cfu/100mL)	Faecal coliforms (cfu/100mL)	E. coli (cfu/100mL)
3/07/2025	11,000	23,000	15,000
20/07/2025	120	610	360
3/08/2025	96	670	600
17/08/2025	2,500	4,600	4,600
26/08/2025	36	510	420
14/09/2025	490	2,600	2,000
27/09/2025	66	600	420
11/10/2025	380	1,200	780
26/10/2025	200	1,000	770
9/11/2025	31,000	92,000	54,000
23/11/2025	340	930	720
2/12/2025	440	2,200	590
21/12/2025	370	500	340
4/01/2026	2,800	2,300	1,900
17/01/2026	3,200	3,400	2,400
30/01/2026	760	2,000	1,000
15/02/2026	920	1,500	990
27/02/2026	450	1,300	1,300
14/03/2026	1,000	1,600	1,400
29/03/2026	4,200	4,600	3,800
9/04/2026	1,300	2,300	1,100
25/04/2026	380	990	540
9/05/2026	4,100	6,400	4,000
24/05/2026	430	820	400
5/06/2026	7,400	1,300	1,000
20/06/2026	360	830	500

Appendix B. Effluent disposal field maps


BLOCK 1
Irrigation rate is set at the rate for slopes <20°
Gross area: 25389m²
Net area available for irrigation: 25389m²
Irrigation rates: Summer 2.6mm/day
Winter 1.7mm/day
Daily loads: Summer 66.0m³/day
Winter 43.2m³/day
BLOCK 2
Irrigation rate is set at the rate for slopes at 20-30°
Gross area: 39967m²
Net area available for irrigation: 34564m²
Irrigation rates: Summer 1.5mm/day
Winter 1.2mm/day
Daily loads: Summer 51.8m³/day
Winter 41.5m³/day
BLOCK 3
Irrigation rate is set at the rate for slopes at 20-30°
Gross area: 46782m²
Net area available for irrigation: 39722m²
Irrigation rates: Summer 1.5mm/day
Winter 1.2mm/day
Daily loads: Summer 59.6m³/day
Winter 47.7m³/day
BLOCK 4
Irrigation rate is set at the rate for slopes at 20-30°
Gross area: 28219m²
Net area available for irrigation: 26500m²
Irrigation rates: Summer 1.5mm/day
Winter 1.2mm/day
Daily loads: Summer 39.8m³/day
Winter 31.8m³/day
PS 1 (Stage 1) RL 27m
PROPOSED MAINLINE PIPE
PS 2 (Stage 2)
LEGEND
STAGE 1
SLOPES 0-20°
SLOPES 20-30°
SLOPES >30°
STAGE 2 IRRIGATION
ORIGINAL TRACK
TOTAL AREA SURVEYED 19.72ha
TOTAL AREA AVAILABLE FOR STAGE 1 IRRIGATION 12.51ha
TOTAL DAILY LOADING
SUMMER 217.2m³
WINTER 164.2m³

Appendix C. Data Sources

Table 3-1: Download location of environmental monitoring data used in this report.

Category	Parameter	Source platform	Tag/ID
Rainfall	N/A	Hydrotel	N/A
Influent volume	N/A	Pi	DTKAW_21_FQ_010_VOLUMEDAY
Effluent volume	N/A	Pi	DTKAW_49_FQ_150_VOLUMEDAY
Irrigation volume	EDF 1	Pi	DTKAW_49_FQ_150_B1VOLDAY
Irrigation volume	EDF 2	Pi	DTKAW_49_FQ_150_B2VOLDAY
Irrigation volume	EDF 3	Pi	DTKAW_49_FQ_150_B3VOLDAY
Irrigation volume	EDF 4	Pi	DTKAW_49_FQ_150_B4VOLDAY
Effluent quality	E. Coli	Pi	DTKAW_52_15_FE_ECOLMTEC
Effluent quality	Faecal Coliforms	Pi	DTKAW_52_15_FE_FC
Effluent quality	Nitrate	Pi	DTKAW_52_15_FE_NO3
Effluent quality	Calcium (Total)	Pi	DTKAW_52_15_FE_Ca-tot
Effluent quality	DRP	Pi	DTKAW_52_15_FE_DRP
Effluent quality	Mg(Total)	Pi	DTKAW_52_15_FE_Mg-tot
Effluent quality	Na(Total)	Pi	DTKAW_52_15_FE_Na-tot
Effluent quality	pH	Pi	DTKAW_52_15_FE_pH
Effluent quality	NH3-N	Pi	DTKAW_52_15_FE_TNH3N
Rautawa Stream	Flow	Pi (or Hydrotel)	DTKAW_16_FT_311
Rautawa Stream	Site 3 quality	Pi	DTKAW_55_RAUTAWA_Site3_
Rautawa Stream	Site 6 quality	Pi	DTKAW_55_RAUTAWA_Site6_

Appendix D. Rautawa Stream and Coastal Marine Environment Ecological Assessment

VIRIDIS
Environmental Consultants

Kawakawa Bay Wastewater Treatment Plant

Stream and Coastal Marine Monitoring 2026

Prepared for: Watercare Services Limited

July 2026



DOCUMENT CONTROL AND REVISION HISTORY

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Cover photo: Kawakawa Bay inlet, pictured on 24 March 2026.

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TABLE OF CONTENTS

1 Introduction 1
2 Survey Methods 3
2.1 Monitoring Sites 3
2.2 Monitoring Activities 3
3 Wastewater Discharge 7
4 Freshwater Habitat Characteristics 8
4.1 Site Descriptions 8
4.2 Physical Habitat Comparison 10
4.3 Water Quality 11
5 Macrophytes 13
6 Benthic Invertebrates 1
6.1 Community Composition 1
6.2 Biotic Indices 3
7 Fish Communities 6
8 Marine Macroalgae and Shell Cover 8
9 Summary 10
References 11

List of Tables

Table 1. Freshwater sampling sites. 3
Table 2. Marine sampling sites. 3
Table 3. Estimates of stream health using MCI and QMCI indices. 5
Table 4. Attribute bands defined by the NPS-FM for fish IBI scores. 5
Table 5. Classes of dominance for macroalgae and shell. 6
Table 6. Habitat characteristics at the Rautawa Stream and tributary site during the 2026 survey. 11
Table 7. Water quality measurements obtained during the 2026 survey. 11
Table 8. Macroinvertebrate community indices of samples collected during the 2026 survey. 3
Table 9. Fish (and kōura) abundance and species richness recorded in the 2026 survey. 7
Table 10. Estimated shell and macroalgal cover at the transects surveyed in 2026. 8

List of Figures

Figure 1. Kawakawa Bay WWTP Monitoring sites 2
Figure 2. Quadrat layout. 6
Figure 3. Daily discharge volumes from Kawakawa Bay WWTP from 1 April 2024 to 30 March 2026 7
Figure 4. Site 1 viewed facing a) upstream and b) downstream. 8
Figure 5. Site 2, located within Glen Forest tributary, viewed facing a) upstream and b) downstream. 9
Figure 6. Site 3 viewed facing a) upstream and b) downstream. 9
Figure 7. Site 5 viewed facing a) upstream and b) downstream. 10
Figure 8. Streambed composition (%) across sites for the 2026 survey. 11
Figure 9. Mean macrophyte cover at each site within the Rautawa Stream and Glen Forest tributary, compared to historical data (shaded grey) from 2012 to 2024. 14

Figure 10. Mean relative abundance (%) of macroinvertebrates by key taxonomic groups in samples collected at each site during the last 5 surveys. 2
Figure 11. MCI and QMCI scores of samples collected at each freshwater site during the 2026 survey. ... 4
Figure 12. Long-term MCI and QMCI scores for each freshwater site between 2014 and 2026 5
Figure 13. Fish IBI scores at each site between 2014 and 2026. 7
Figure 14. Estimated shell cover at marine transects between 2014 and 2026. 9

List of Appendices

Appendix A Macrophyte Data
Appendix B Macroinvertebrate Data
Appendix C Fish Data
Appendix D Quadrat Photos
Appendix E Marine Shell and Macroalgal Data

1 INTRODUCTION

Watercare Services Limited (Watercare) operates a wastewater treatment plant (WWTP) in Kawakawa Bay, located off Kawakawa-Orere Road, about 1.5 km south of the main township ('the site', Figure 1). Watercare holds resource consent from Auckland Council to discharge treated effluent from the WWTP to land (Permit No. 30833) and the Rautawa Stream (Permit No. 33143). To date, discharges from the Kawakawa Bay WWTP have only occurred via the land irrigation system and the consented outfall to Rautawa Stream has not been utilised (Conley 2026).

As required by conditions of the permits, environmental monitoring must be undertaken in both the freshwater and marine receiving environments, in accordance with the receiving environment monitoring plan (REMP), which was prepared by Earth Consult (2010). The REMP requires biennial ecological assessments of the Rautawa Stream and the coastal marine area (CMA) of Kawakawa Bay.

Watercare has engaged Viridis Limited (Viridis) to prepare this report, which presents and interprets the results of monitoring undertaken by Viridis in March 2026, the eighth monitoring round undertaken since the permits were granted.

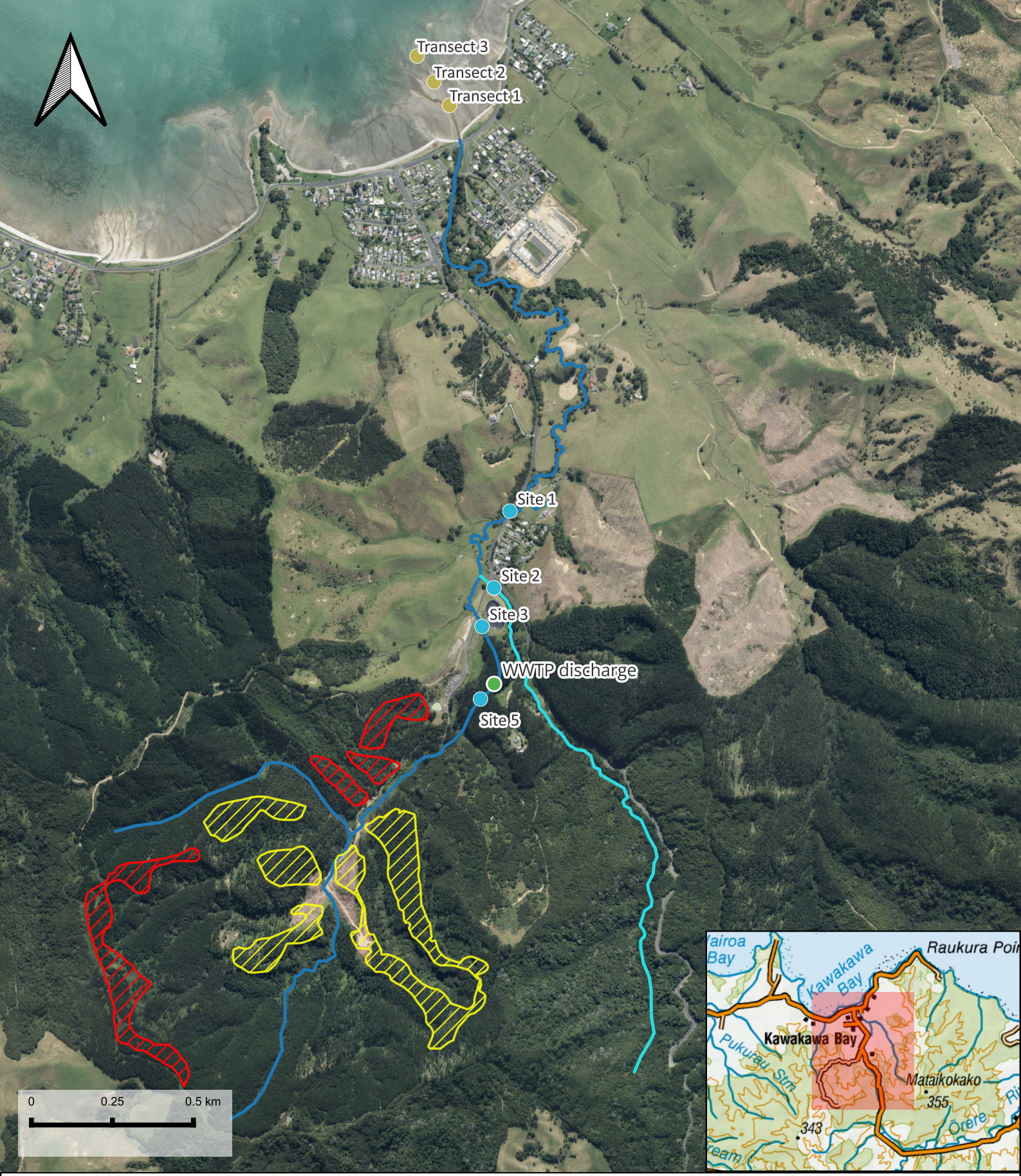

Figure 1. Kawakawa Bay WWTP Monitoring Sites

PROJECT NO.	10214
DRAWN BY:	S.A
DATE:	2 July 2026
SCALE	**1:15,000** @ A4

Legend

- WWTP discharge
- Glen Forest Tributary
- Rautawa Stream

Irrigation areas

- Stage 1
- Stage 2

Monitoring sites

- Freshwater
- CMA

VIRIDIS Environmental Consultants

SOURCES
Google Earth Pro 2024

DISCLAIMER:
This map/plan is not an engineering draft. This map/plan is illustrative only and all information should be independently verified on site before taking any action.

2 SURVEY METHODS

2.1 Monitoring Sites

2.1.1 Freshwater

Assessments were carried out at three sites in the Rautawa Stream (Sites 1, 3 and 5) and one site (Site 2) on a tributary of the Rautawa Stream (referred to as Glen Forest tributary in the REMP) (Table 1, Figure 1). Site 5 is located upstream of the Rautawa Stream outfall and would, if the outfall were utilised, function as a control site for this activity. The Glen Forest tributary lies outside the influence of the land irrigation areas[1] and, accordingly, Site 2 is also considered a control site (Earth Consultants 2010).

Table 1. Freshwater sampling sites.

Site	Waterbody	Location	Location (NZMG)	
			Easting	Northing
1	Rautawa Stream	Kawakawa-Orere Road bridge, downstream of the WWTP discharge point.	2703895	6469252
2	Glen Forest tributary	Upstream of the tributary's confluence with the Rautawa Stream mainstem, and outside land irrigation influences.	2703847	6469015
3	Rautawa Stream	Upstream of Rautawa Stream's confluence with the Glen Forest tributary, adjacent to the WWTP access road.	2703811	6468897
5	Rautawa Stream	Upstream of the WWTP outfall to the Rautawa Stream, but downstream of land irrigation influences.	2703807	6468674

2.1.2 Marine

Monitoring of the CMA was undertaken at three locations, situated at differing shore heights within the intertidal zone of Kawakawa Bay, near the mouth of the Rautawa Stream (Table 2). At each location, a 15-m long transect was established parallel to the low tide line.

Table 2. Marine sampling sites.

Transect	Description	Location (NZMG)	
		Easting	Northing
1	Situated approx. 100 m north-west of the Rautawa Stream inlet	2703728	6470462
2	Situated approx. 200 m north-west of the Rautawa Stream inlet	2703682	6470533
3	Situated approx. 300 m north-west of the Rautawa Stream inlet	2703627	6470611

2.2 Monitoring Activities

2.2.1 Overview

As specified in the REMP, an ecological assessment of the Rautawa Stream and part of the CMA of Kawakawa Bay is required every two years. The 2026 round of monitoring was undertaken on 25 and 26 March 2026. Monitoring involved:

[1] To date, irrigation has been limited to the Stage 1 fields. The Stage 2 fields may be brought into use in the future (Conley, pers. comm., July 2026) - refer Figure 1.

- Measuring in-situ stream water quality.
- Undertaking a visual assessment of in-stream habitat.
- Estimating macrophyte cover and composition within Rautawa Stream.
- Collecting macroinvertebrates from Rautawa Stream for identification and enumeration.
- Identifying the fish communities present in Rautawa Stream.
- Estimating macroalgae and shell cover along three transects within the intertidal zone.

2.2.2 Stream water quality

Spot measurements of water temperature, specific conductance (conductivity at 25°C) and dissolved oxygen (DO) were recorded at each freshwater site using a calibrated hand-held meter. These data were used to aid in the interpretation of the biological data.

2.2.3 Stream habitat

Visual estimates of in-stream habitat characteristics were recorded at each freshwater site. The methods were the same as those used previously to allow comparisons to be made over time.

2.2.4 Macrophytes

The aquatic plant species present and the percentage cover of each species were recorded at ten transects within each of the freshwater sites. A representative 50 m sampling reach was surveyed at each freshwater site, with cross-sectional transects spaced at 5 m intervals.

2.2.5 Benthic invertebrates

A composite sample was collected from each freshwater site using a D-net, following the NEMS (2022) semi-quantitative sampling method for soft-bottomed streams. This method was employed based on the available habitat and the dominance of soft-bottom substrates and/or high sediment loading across all sites. All samples were preserved in 70% isopropyl alcohol for later identification and enumeration.

Benthic macroinvertebrates were identified and counted to a level suitable for calculating taxa richness, abundance, EPT taxa richness and %EPT abundance, macroinvertebrate community index (MCI) and quantitative MCI (QMCI) following protocols outlined in NEMS (2022). EPT refers to taxa that belong to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxonomic groups.

Taxa richness is a measure of the number of invertebrate taxa in a sample. In general, streams that support a high number of invertebrate taxa are more likely to be of a higher environmental quality than streams with few taxa present. However, interpretation of taxa number data as an environmental indicator is dependent on the pollution sensitivity or tolerance of taxa present.

Abundance is a measure of the total number of invertebrates in a sample. Abundance tends to increase in the presence of organic or nutrient enrichment and decreases in the presence of toxic contaminants. Abundance is a useful measure for comparison between sites but can be highly variable.

EPT taxa are generally sensitive to changes in water and habitat quality. %EPT abundance is the proportion of EPT individuals making up the community. EPT and %EPT abundance[2] can provide a good indication of stream health, with high values indicating good water/habitat quality and low values indicating poor water/habitat quality.

[2] The caddisflies Oxyethira and Paroxyethira are not sensitive to nutrient enrichment so are excluded from EPT calculations.

The MCI and QMCI are biological indices that are based on tolerance scores between 1 and 10, which are assigned to each taxon based on their sensitivity to organic enrichment. These indicator scores usually differ for hard-bottom and soft-bottom environments[3]. Although developed to assess nutrient enrichment, these scores are now used to assess the general health of New Zealand streams. MCI scores are based on presence/absence data, while the QMCI incorporates abundance data. Higher MCI and QMCI indicate better habitat quality (and, as such, better water quality) with scores compared to the attribute bands and national bottom line (NBL) defined in the National Policy Statement for Freshwater Management 2020 (NPS-FM) (MfE 2025).

Table 3. Estimates of stream health using MCI and QMCI indices.

NPS-FM (MfE 2024)			
Attribute band	**Description**	**Numeric attribute states**	
		MCI	**QMCI**
A	Pristine conditions	>130	≥6.5
B	Mild pollution	≥110 and <130	≥5.5 and <6.5
C	Moderate pollution	≥90 and <110	≥4.5 and <5.5
National bottom line		90	4.5
D	Severe pollution	<90	<4.5

2.2.6 Freshwater fish

To provide an indication of the fish communities present in Rautawa Stream, three fyke nets and six gee minnow traps were baited, set and left overnight at each site. Only fine meshed fykes with a separator grill were used and all nets and traps were set with an airspace to provide trapped fish access to atmospheric oxygen. All traps were checked the following morning.

Following the overnight trapping, electric fishing was carried out using an EFM300 electric fishing machine. The electric fishing machine temporarily stuns the fish, allowing them to be captured. All fish captured were identified, enumerated, and their size estimated before being returned to their habitats.

An index of biotic integrity (IBI) was calculated using the Ministry for the Environment (MfE) Fish IBI Calculator (MfE 2023), which implements the methodology of Joy and Death (2004) using updated species classifications and regionally derived maximum species richness lines. Fish IBI is a multi-metric indicator of fish community integrity that considers species richness and the representation of ecological guilds relative to expected reference conditions. The NPS-FM specifies Attribute Bands (A-D) for fish IBI scores, which aid in the interpretation of these data (Table 4).

Table 4. Attribute bands defined by the NPS-FM for fish IBI scores.

NPS-FM Attribute band	Description	Numeric attribute state
A	High integrity	≥34
B	Moderate integrity	<34 and ≥28
C	Low integrity	<28 and ≥18
D	Severe loss of integrity	<18

[3] Not all taxon have tolerance scores. These are specified in NEMS (2022).

2.2.7 Macroalgae and shell cover

A tape measure was used to define each 15 m long transect, which ran parallel to the low tide line. A 500 mm x 500 mm quadrat was used along six fixed distances along the inshore side of the tape (as presented in Figure 2). Quadrats were photographed from directly above.

The cover of macroalgae species and shell for each of the four quarters of the quadrat was recorded using the classes of dominance presented in Table 5. The 24 class records for each location were converted to the midpoint percentages and the mean station percentage cover plus 95% confidence interval was calculated. Cover was defined as the fraction of the seabed obscured by the macroalgae species or shell when viewed from directly above.

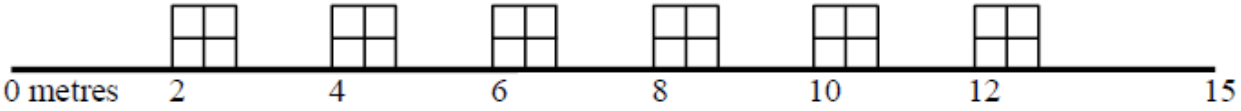

Figure 2. Quadrat layout.

Table 5. Classes of dominance for macroalgae and shell.

Class	Range of cover (%)	Midpoint (%)
0	0	0
1	0.1-5	2.5
2	5.1-10	7.5
3	10.1-25	17.5
4	25.1-50	37.5
5	50.1-75	62.5
6	75.1-100	87.5

Notes: Modified from the survey manual for tropical marine resources (English *et al.* 1997).

3 WASTEWATER DISCHARGE

To date, all discharges from the Kawakawa Bay WWTP have been to land, via an irrigation system located upstream of Site 5 (refer Figure 1). Daily irrigation volumes from the WWTP between 1 April 2024 and 1 April 2026 are presented in Figure 3, with the 2026 survey date denoted by a blue dot. During the monitoring period, daily discharge volumes ranged from 0 m^3 to 164 m^3, with an overall mean daily flow of 45 m^3 (denoted using a dotted line on Figure 3). On the date of the survey, discharges from the Kawakawa Bay WWTP were just below the mean daily volume.

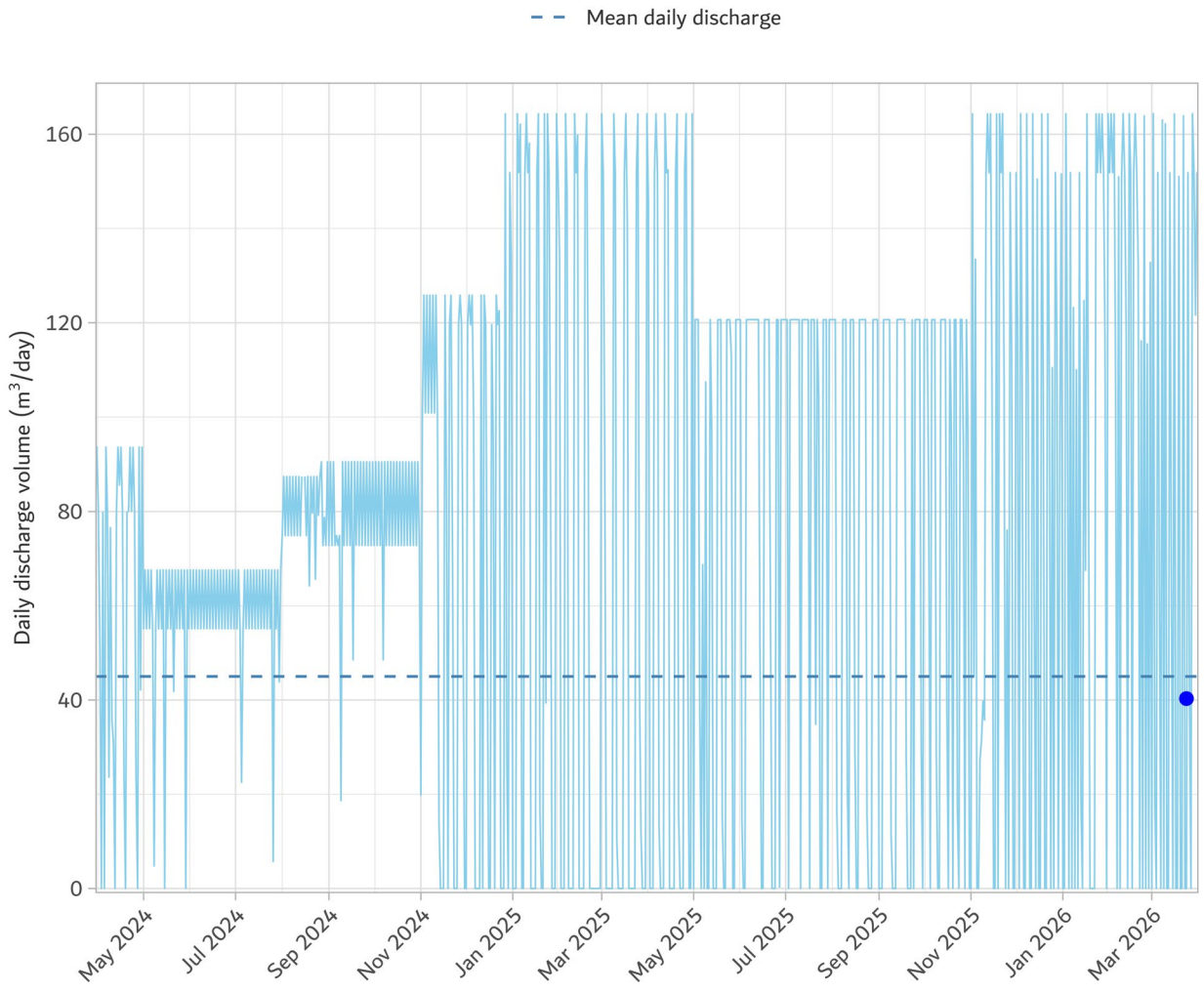

Figure 3. Daily discharge volumes from Kawakawa Bay WWTP from 1 April 2024 to 30 March 2026 [4].

[4] Data provided by Watercare (Conley 2026).

4 FRESHWATER HABITAT CHARACTERISTICS

4.1 Site Descriptions

4.1.1 Site 1

Site 1, located approximately 700 m downstream of the WWTP, included a section of Rautawa Stream that was relatively wide and deep. The survey reach comprised an open channel of predominantly run habitat, with some pools present in the meanders. Consistent with previous surveys, the streambed substrate was dominated by silt/sand (i.e., mud) with occasional small to large gravels also present. Riparian vegetation consisted of mostly kikuyu grass (*Cenchrus clandestinus*) and a few isolated mānuka (*Leptospermum scoparium*) trees, offering limited shade. Some hydrophyte species were also observed along the banks, including buttercup (*Ranunculus* sp.) and water pepper (*Persicaria* sp.) (Figure 4). Fish cover was offered by some instream macrophyte growth, as well as undercut banks and pools within the meanders.

a) **b)**



Figure 4. Site 1 viewed facing a) upstream and b) downstream.

4.1.2 Site 2

The Glen Forest tributary (Site 2) consisted of a very shallow and narrow channel, with deeply incised banks. Site 2 was partially shaded by kikuyu grass, mānuka, flax (*Phormium tenax*), kiokio (*Parablechnum novae-zelandiae*), and black mamaku (*Sphaeropteris medullaris*) (Figure 5). The channel substrate composition was predominantly gravel, but significant fine sediment deposition was evident when disturbed underfoot. The site comprised mainly run habitat, with a small proportion of riffles and pools present. Fish cover was offered by some undercut banks and overhanging bank vegetation, although the water depth was notably shallow at the time of the survey.

a) b)



Figure 5. Site 2, located within Glen Forest tributary, viewed facing a) upstream and b) downstream.

4.1.3 Site 3

Site 3 is situated upstream of Rautawa Stream's confluence with the Glen Forest tributary. It comprised a straight, partially shaded reach with *Carex* sp., flax, kiokio, black mamaku, and kikuyu grass along its banks (Figure 6). The substate composition at Site 3 was dominated by silt/sand, with some small to large gravels and cobbles also present. The habitat type was mostly run, with a small proportion of pools and riffles. Site 3 offered limited fish habitat, restricted to macrophytes, and some pools situated further upstream. A weir, present downstream of the reach, is considered likely to act as a barrier for non-climbing fish to move upstream.

a) b)



Figure 6. Site 3 viewed facing a) upstream and b) downstream.

4.1.4 Site 5

Site 5 is located upstream of the WWTP discharge point in Rautawa Stream[5] and adjacent to a pine (*Pinus* sp.) plantation. The stream reach was well shaded by mature pine trees and understorey vegetation such as silver fern (*Cyathea dealbata*), whekī (*Dicksonia squarrosa*), and māhoe (*Melicytus ramiflorus*) (Figure 7). The channel was relatively narrow and shallow, bordered by steep and unstable banks. The pine plantation located uphill of the stream was subject to active forestry works during the survey, likely contributing to the high erosion and large sediment deposits observed in the stream.

[5] To date, this discharge point has not been utilised.

As such, the streambed substrate had a high proportion of mud, which reduced clarity significantly when disturbed. However, hard substrates such as gravels, cobbles and bedrock were also present. The site was mostly comprised of run habitat, with some pools and small riffles present, and fish cover was provided by some undercut banks and woody debris.

a) **b)**



Figure 7. Site 5 viewed facing a) upstream and b) downstream.

4.2 Physical Habitat Comparison

Physical in-stream and riparian habitat characteristics recorded at each site during the 2026 survey are summarised in Table 6. Figure 8 presents the streambed substrate composition recorded at each site during the 2026 monitoring survey.

The key findings from the in-stream and riparian habitat data collected were:

- Site 1 and Site 3 were slightly wider and deeper compared to Sites 2 and 5, consistent with previous years.
- All sites were dominated by run habitat, with the upstream site (Site 5) exhibiting the greatest variability in habitat types.
- Shading varied between sites, with Site 1 classified as open, reflecting its grassed riparian margins (refer Section 4.1.1), and Site 5 was classified as shaded due to its location within a forested area. Both Sites 2 and 3 had partial shading offered by its shrub-tier riparian vegetation.
- Soft substrates (i.e. mud or silt/sand) were dominant at Sites 1 and 3, while hard substrates (namely gravels) were more prevalent at Sites 2 and 5. Despite this, significant fine sediment deposition was observed across all sites[6] (refer Section 4.1).

[6] Soft-bottom macroinvertebrate sampling methods were employed at each site, based on the available habitat and the dominance of soft-bottom substrates or high sediment loading across all sites. As such, each site was treated as soft-bottom for purpose of calculating MCI/QMCI scores (refer Section 6).

Table 6. Habitat characteristics at the Rautawa Stream and tributary site during the 2026 survey.

Site	Average wetted width (m)*	Average depth (m)*	Habitat type (%)**			Shading^
			Run	Riffle	Pool	
1	1.4	0.22	95	0	5	Open
2	1.1	0.09	96	2	2	Partial
3	1.7	0.18	90	2	8	Partial
5	1.1	0.12	80	5	15	Shaded

Notes: *Average of five measurements; **chutes were absent at all sites; ^shading is considered 'open' when <20% shade is provided by riparian vegetation, 'partial' when 21-79% shade is provided, and 'shaded' when >80% shade is provided.

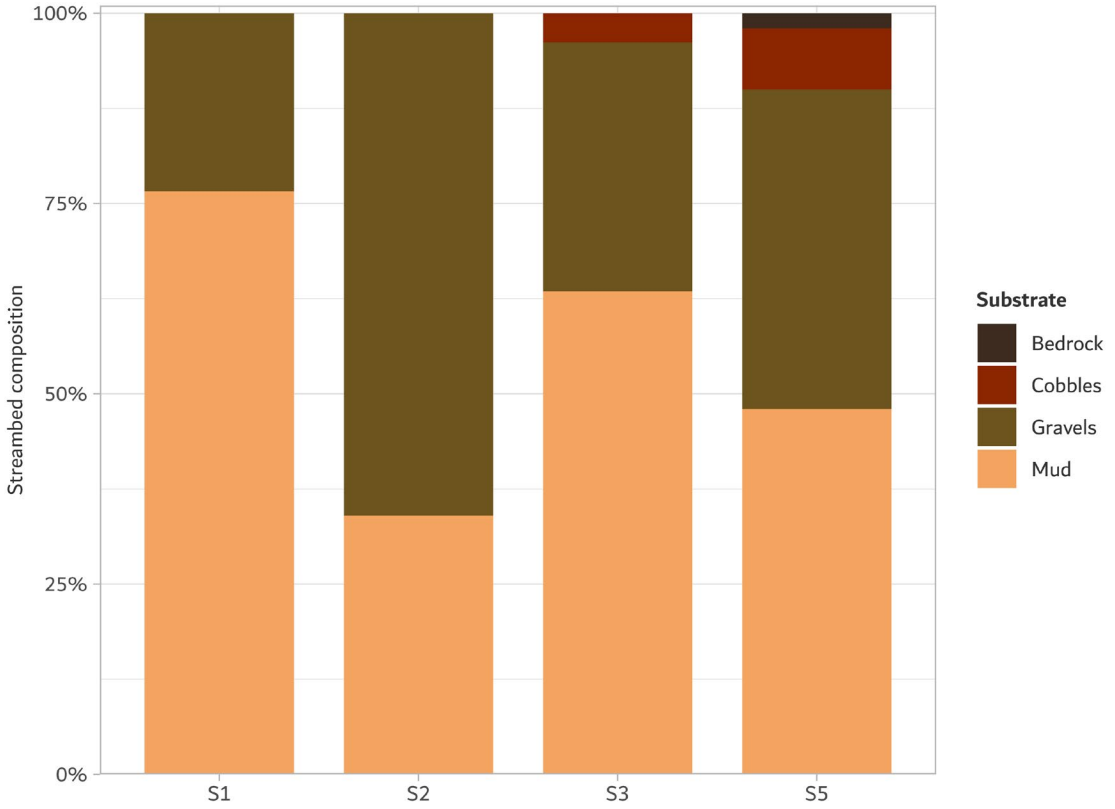

Figure 8. Streambed composition (%) across sites for the 2026 survey.

4.3 Water Quality

Spot water quality measurements were taken at each freshwater site during the 2026 survey. These data are summarised in Table 7 and compared to historical ranges.

Table 7. Water quality measurements obtained during the 2026 survey.

Site	Time	DO (g/m^3)	DO (%)	pH (unitless)	SPC	Temperature (°C)
1	2:35 pm	9.7 (6.4-10.9)	101 (70-104)	7.3	195 (74-192)	17.2 (9.5-22)
2	11:10 am	9.8 (7.5-11)	99 (76-97)	7.4	204 (62-198)	15.7 (9-18.8)
3	1:30 pm	9.7 (7.1-11)	99 (76-103)	7.4	202 (52-192)	16.3 (8.8-18.8)
5	4:20 pm	9.2 (8.3-10.2)	94 (83-97)	7.4	204 (58-195)	16.5 (13.4-17.8)

Notes: Historical ranges (min-max) shown in brackets; compete historical ranges were not available for pH; DO = dissolved oxygen and spec. cond. = specific conductance, which is conductivity at 25°C.

The key findings from the water quality data collected in 2026 were:

- DO concentrations at each site were within the NPS-FM Attribute Band A for 1-day minimum concentrations (i.e., ≥7.5 g/m^3), indicating conditions that are not expected to cause stress to aquatic organisms.
- The pH values for all sites were circumneutral and comparable between sites, including the Glen Forest tributary control site (Site 2).
- Specific conductance (i.e., conductivity at 25°C) recorded in 2026 for each site was slightly higher than the historical maximum but within typical ranges expected for freshwater NZ streams.
- Variations in temperature observed between sites were attributed to the time that spot water quality measurements were undertaken (i.e., in general, colder temperatures were observed earlier in the day). Surface water temperatures at all sites were low enough to pose minimal or no thermal stress to aquatic organisms (Davis-Colley *et al.* 2013).

Overall, the water quality results for 2026 did not indicate any adverse effects from the WWTP discharges.

5 MACROPHYTES

The macrophyte cover and community composition at each monitoring site, as visually assessed during the 2026 survey, is compared to historical data in Figure 9. The raw macrophyte data collected from the 2026 survey are provided in Appendix A. The key findings were:

- Site 1 continued to exhibit the greatest mean macrophyte cover (70%) and the highest community diversity, the most common of which was eel grass (*Vallisneria gigantea*). The high macrophyte cover at this site is attributable to the open, unshaded nature of the reach and the dominance of finer substrates (refer Section 4).
- Within the Glen Forest tributary (Site 2), macrophyte cover was minimal (1.5%) and reduced from the previous year. The community consisted of fool's watercress (*Apium nodiflorum*), water pepper (*Persicaria* sp.) and buttercup (*Ranunculus* sp.).
- Mean macrophyte cover at Site 3 in 2026 (26%) was comparable to previous years and the only recorded species was stonewort (*Nitella hookeri*).
- Macrophytes remained absent from Site 5, which may reflect high shading and recent erosion observed at this site.
- Overall, the observed differences between sites were considered to reflect the level of riparian shading and substrate available at each site.

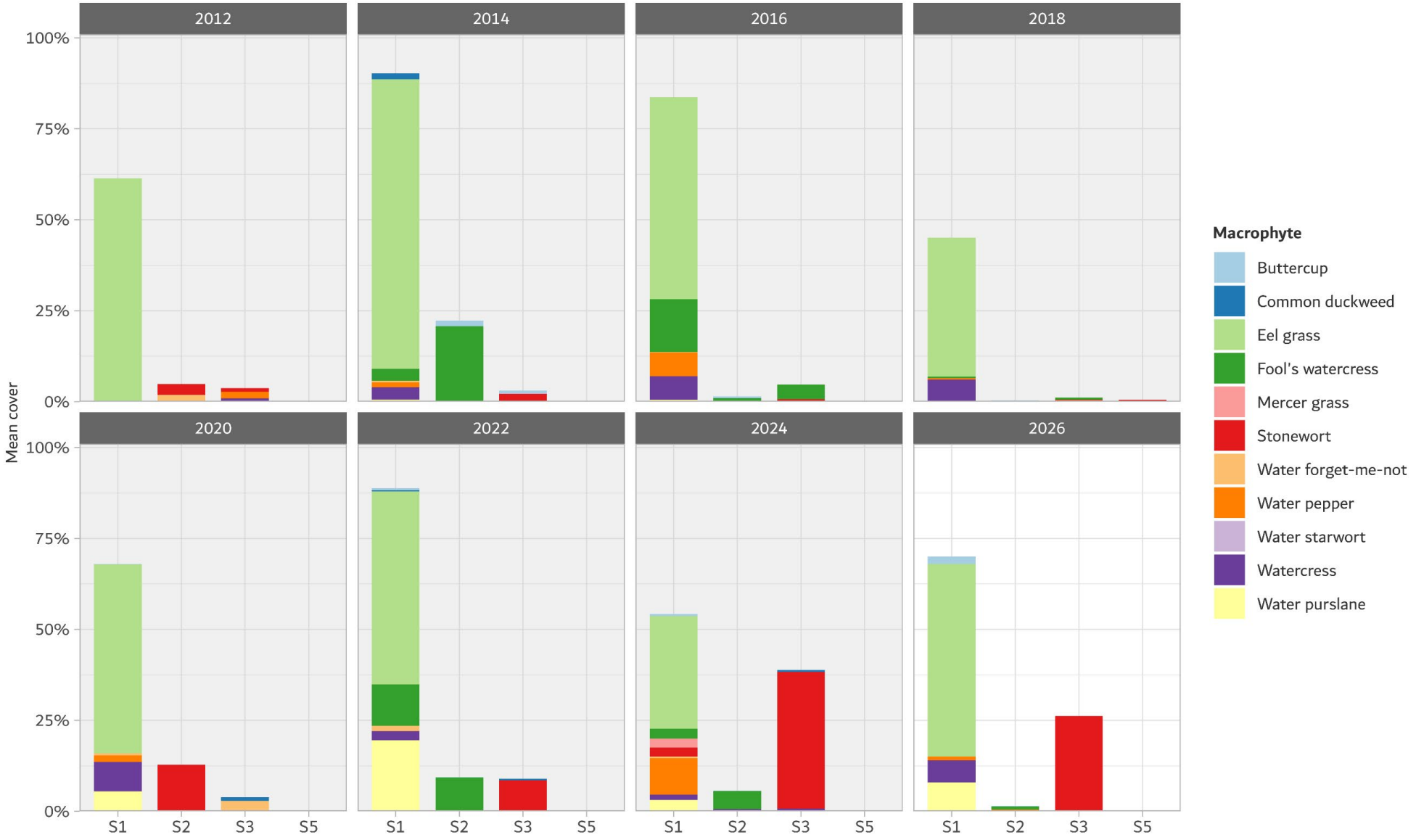

Figure 9. Mean macrophyte cover at each site within the Rautawa Stream and Glen Forest tributary, compared to historical data (shaded grey) from 2012 to 2024.

6 BENTHIC INVERTEBRATES

6.1 Community Composition

The mean macroinvertebrate community composition (%) at each monitoring site during the 2026 freshwater survey is presented by key taxonomic groups in Figure 10, alongside historical data from the previous four surveys (2018 - 2024). Raw macroinvertebrate data for the 2026 survey are included in Appendix B.

The key findings from the invertebrate community data are:

- Crustacea was the most dominant order at Site 1, with amphipods (*Paracalliope* sp.) being the most common taxon. This differs from recent survey results, in which Mollusca - specifically mud snails (*Potamopyrgus* sp.) - have been dominant. However, the relative abundance of Crustacea was comparable to that recorded at Site 1 in 2018.
- Diptera (i.e., true flies) was the most dominant order at Sites 2 and 5. These comprised mainly sandflies (*Austrosimulium*) at Site 2, while the most common Diptera taxa at Site 5 were non-biting midges (*Orthocladiinae* sp. and *Polypedilum* sp.) and mayflies (*Deleatidium* sp. and *Zephlebias* sp.).
- Consistent with previous years, Mollusca was the most dominant order at Site 3, and mud snails were the most commonly found taxon.
- Consistent with the last five surveys, Plecoptera (stoneflies) were absent from all sites.
- No Trichoptera (caddisflies) taxa were recorded at Site 5 during the 2026 survey. While this result coincided with increased erosion and sediment deposition associated with nearby tree-felling activities (refer Section 4.1), Trichoptera have historically represented only a small component of the community at this site, and other macroinvertebrate metrics, including EPT richness and percent EPT abundance, remained comparable with the other sites (refer Section 6.2).
- Overall, macroinvertebrate community composition differed between sites but remained broadly consistent with historical patterns, suggesting no substantial shift in community structure during the 2026 survey.

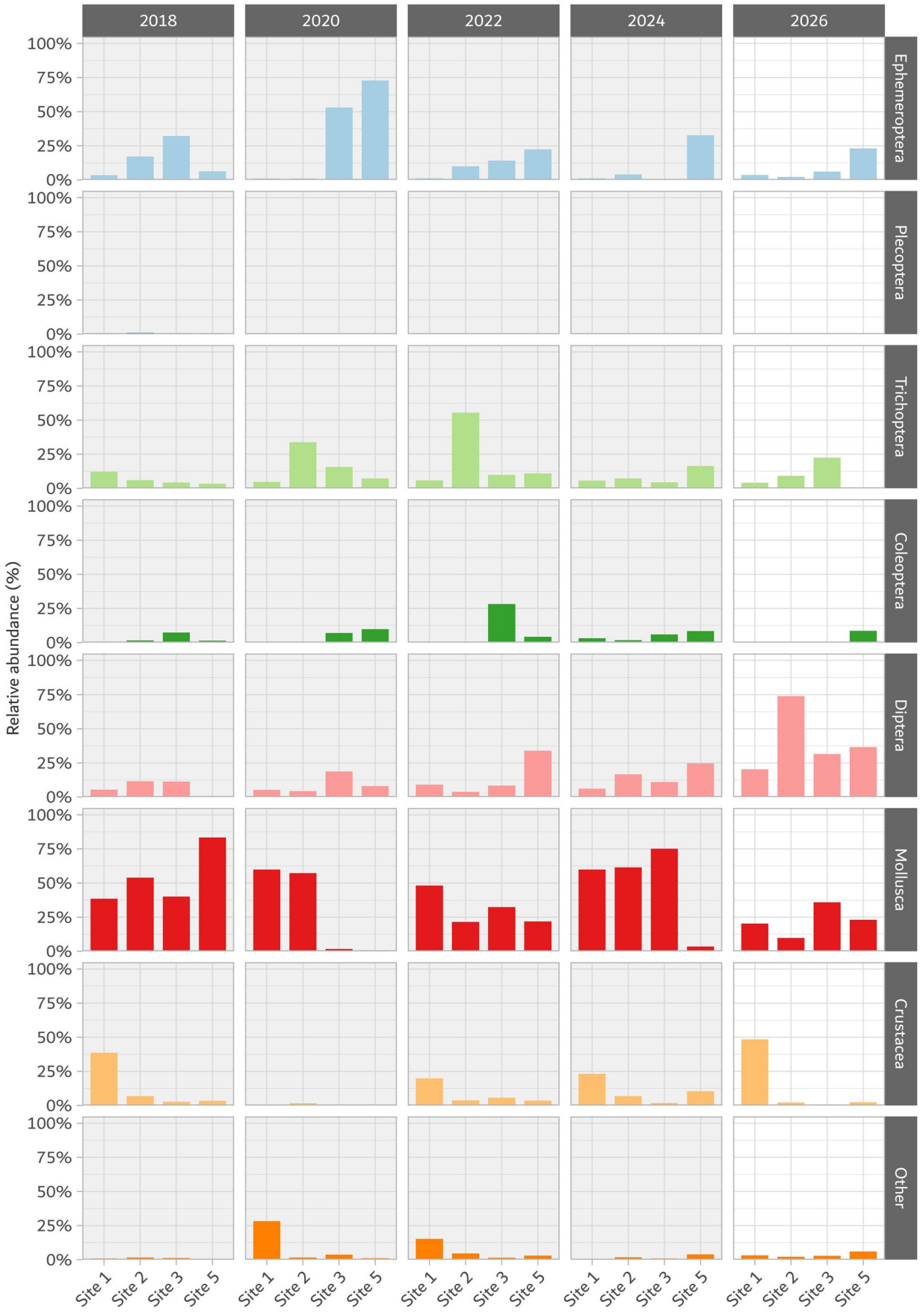

Figure 10. Mean relative abundance (%) of macroinvertebrates by key taxonomic groups in samples collected at each site during the last 5 surveys.

6.2 Biotic Indices

6.2.1 Overview

A summary of macroinvertebrate indices determined for each site based on samples collected during the 2026 survey is presented in Table 8. MCI and QMCI scores for the 2026 survey are presented in Figure 11 and compared to long-term scores in Figure 12. The interpretation of these data is discussed in more detail by key metrics in Sections 6.2.2 and 6.2.3.

Table 8. Macroinvertebrate community indices of samples collected during the 2026 survey.

Indices	Site 1	Site 2	Site 3	Site 5
Abundance	217	184	178	82
Taxa richness	17	16	16	18
EPT taxa richness	4	3	4	4
%EPT Abundance	6%	11%	8%	23%
MCI*	91	111	101	112
QMCI*	4.5	5.1	3.9	4.9
Dominant taxa**	*Paracalliope*	*Austrosimulium*	*Potamopyrgus*	*Potamopyrgus*

Notes: *Calculated using soft-bottom tolerance scores, based on observations of high sediment content during the 2026 survey and the sampling method employed (refer Section 2.2.5); **identified as the numerically dominant taxa in samples collected from each site.

6.2.2 Abundance, richness and EPT taxa

Key observations based on the abundance, taxa richness and EPT data were:

- Abundance was comparable between Sites 1, 2 and 3, but notably lower at Site 5.
- Both taxa richness and EPT taxa richness were comparable across sites, indicating similar community diversity.
- Percent EPT abundance was greatest at Site 5, reflecting higher relative abundances of Ephemeroptera taxa, such as mayflies in the *Deleatidium* genus.

6.2.3 MCI and QMCI

The key findings from the MCI and QMCI data were:

- During the 2026 survey, MCI scores fell within the NPS-FM attribute band B (Sites 2 and 5) or C (Sites 1 and 3). These scores indicate macroinvertebrate communities within Rautawa Stream and the Glen Forest tributary were consistent with mild to moderate organic pollution or nutrient enrichment (MfE 2025).
- QMCI scores, which account for the relative abundance of taxa, followed a similar pattern, with Sites 2 and 5 recording the highest scores. QMCI scores fell within NPS-FM Attribute Band C at all sites except Site 3, which was below the NBL of 4.5, reflecting a community that is largely composed of taxa insensitive to organic pollution or nutrient enrichment (MfE 2025).
- Both MCI and QMCI scores remained within the historical ranges recorded at each site.

- Although MCI scores at Site 5 have shown a slight decline over the monitoring record, the 2026 result was comparable with Site 2, which is situated upstream of irrigation discharges. No clear long-term trend in MCI was evident at the remaining sites, with scores variable over the monitoring record.
- QMCI scores have exhibited greater variability between surveys than MCI. However, the results indicate that community structure in 2026 was more comparable between sites than that observed during previous surveys. The monitoring record suggests a declining trend at Sites 3 and 5 since 2020, and a slight improvement at Sites 1 and 2.
- Overall, the MCI and QMCI scores indicate that macroinvertebrate community condition remained broadly consistent with previous surveys, comparable between Rautawa Stream and the Glen Forest tributary control site (Site 2), which lies outside the influence of land irrigation.

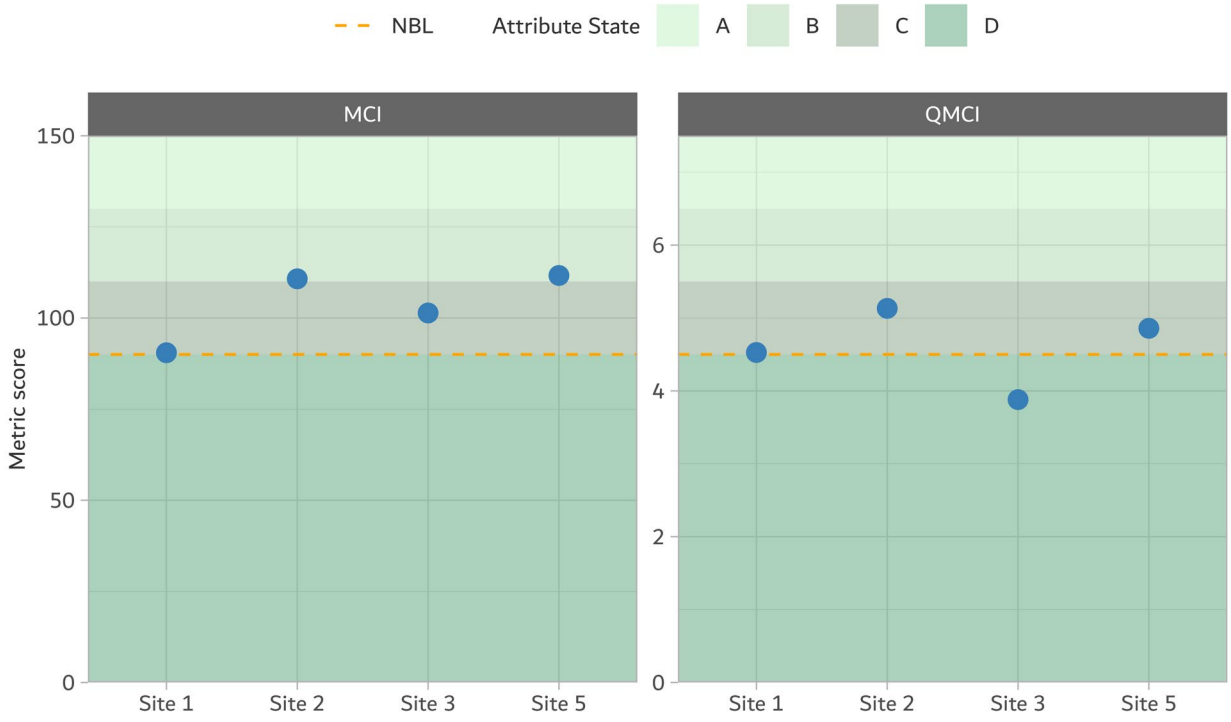

Figure 11. MCI and QMCI scores of samples collected at each freshwater site during the 2026 survey.

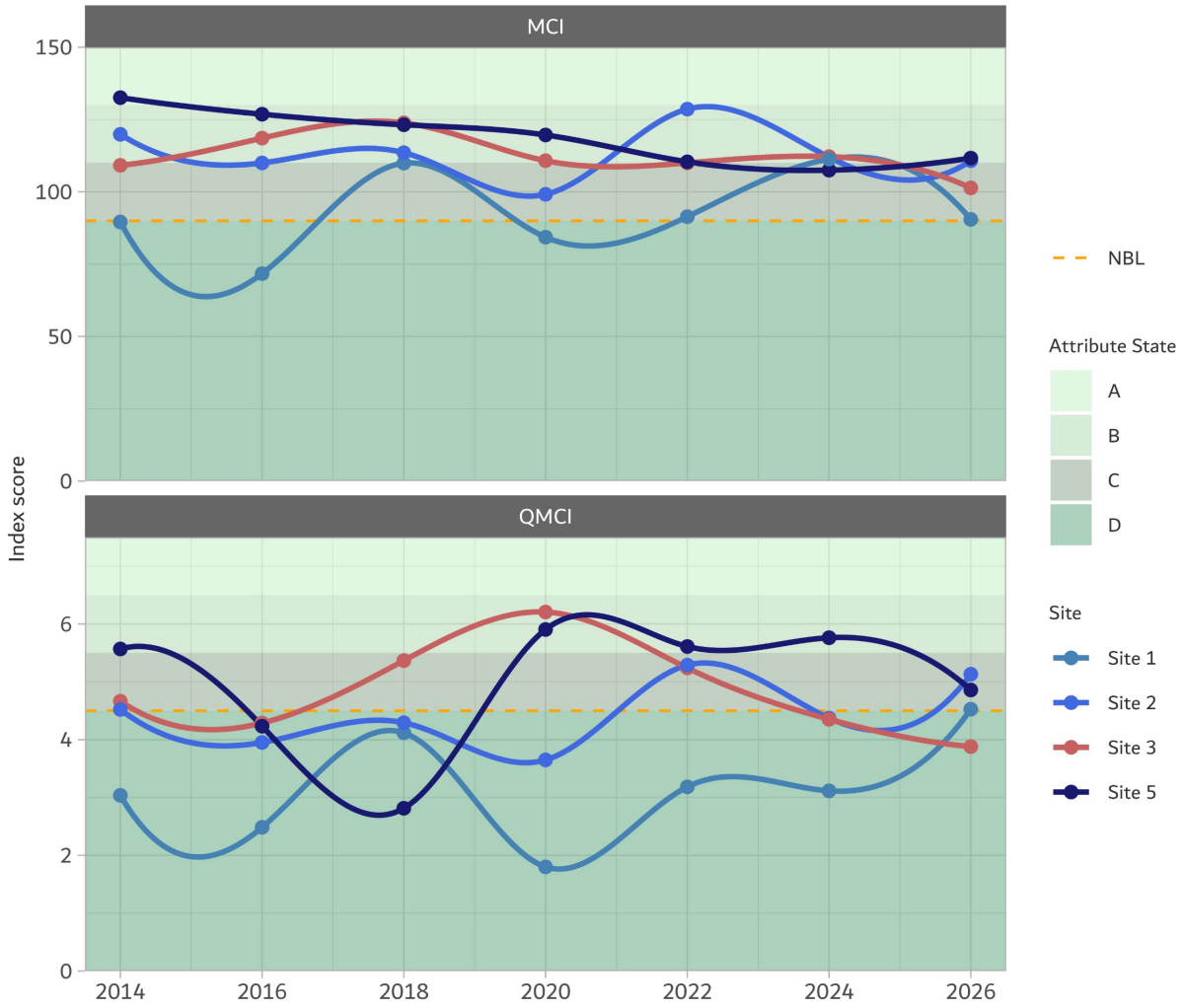

Figure 12. Long-term MCI and QMCI scores for each freshwater site between 2014 and 2026 [7].

[7] MCI and QMCI calculation methods have varied between survey years at some sites (hard-bottom versus soft-bottom), reflecting differences in substrate type and sampling methodology. Consequently, apparent changes in scores may reflect methodological differences as well as changes in ecological condition.

7 FISH COMMUNITIES

The fish data collected from the Rautawa Stream and Glen Forest tributary sites in the 2026 survey are summarised in Table 9 and compared to historical data[8] in Figure 13. The raw data are included in Appendix C. The key findings were:

- A total of seven distinct fish species were caught across the four sites surveyed in 2026. Fish species richness was notably lower at Site 3, but comparable between Sites 1, 2, and 5.
- The species recorded in the 2026 survey were largely consistent with those caught in previous years, though torrentfish (*Cheimarrichthys fosteri*), which have not been caught since 2012, were recorded at Sites 2 and 5.
- Inanga (*Galaxias maculatus*), a species listed as 'Threatened – Nationally Vulnerable' (Dunn *et al.* 2025) were recorded at Sites 1 and 5.
- The most common species observed were Cran's bully (Gobiomorphus basalis) and banded kōkopu (Galaxias fasciatus).
- Fish abundance was highest at Site 1 and lowest at Site 2, likely reflecting differences in water depth and habitat availability between sites.
- Fish IBI scores for each site fell within NPS-FM attribute band A, indicating high integrity fish communities with habitat and migratory access subject to minimal degradation (MfE 2025).
- Site 3 recorded the lowest fish IBI score in 2026 and showed a slight decline relative to recent surveys. Conversely, scores at Sites 2 and 5 have generally increased since 2020, with the 2026 results among the highest recorded.
- Overall, the fish community data were largely comparable between sites and historical results, indicating no adverse effect associated with the operation of the WWTP.

[8] Historical Fish IBI scores shown in Figure 13 have been recalculated using the Ministry for the Environment Fish IBI Calculator (MfE 2023) to enable direct comparison with the 2026 survey. Consequently, scores may differ slightly from those presented in previous reports due to updates to the calculation tool and scoring implementation.

Table 9. Fish (and kōura) abundance and species richness recorded in the 2026 survey.

Fish	Conservation status*	Site 1	Site 2	Site 3	Site 5
Longfin eel	At Risk - Declining	5	1	0	1
Cran's bully	At Risk – Naturally Uncommon	33	8	19	12
Inanga	Threatened – Nationally Vulnerable	15	0	0	3
Redfin bully	At Risk – Naturally Uncommon	4	3	8	4
Torrentfish	At Risk – Naturally Uncommon	2	0	0	4
Shortfin eel	Not Threatened	1	1	0	0
Banded kokopu	At Risk – Naturally Uncommon	0	9	9	29
Unidentified eel	-	3	2	0	2
Species Richness* **		**6**	**6**	**2**	**6**
Abundance**		**63**	**24**	**36**	**55**
Kōura	-	4	2	6	5

Notes: *from Dunn *et al.* (2025); **excluding koura counts; and ***excluding unidentified eel and kōura counts.

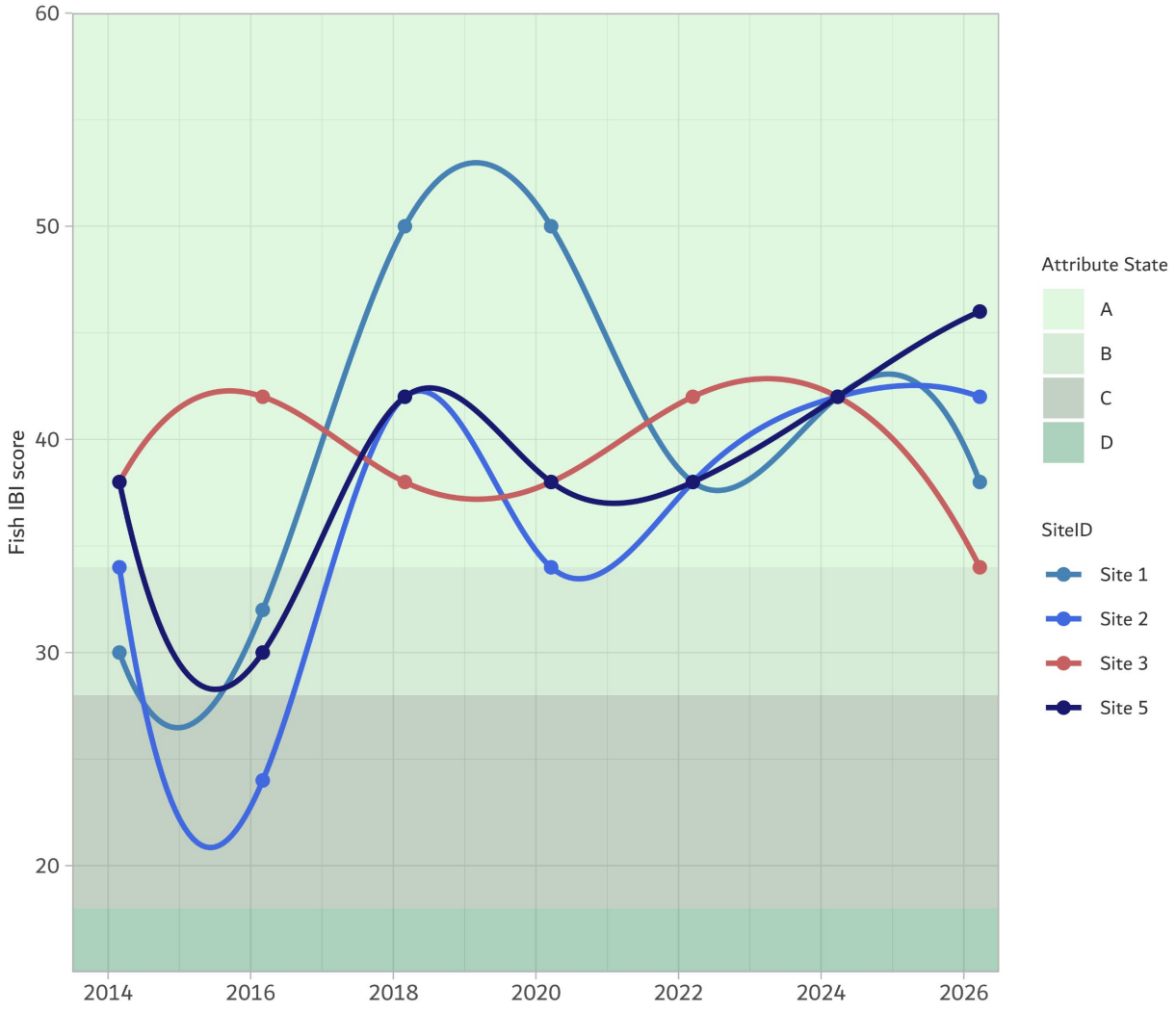

Figure 13. Fish IBI scores at each site between 2014 and 2026.

8 MARINE MACROALGAE AND SHELL COVER

A summary of the results of the 2026 percentage cover estimates for shell and macroalgae are presented in Table 10. Percent shell cover is presented alongside historical data in Figure 14. Open circles represent the percent cover of each quadrat, while filled circles represent the annual mean percent cover. Photographs of each survey quadrat are included in Appendix D, and the raw data are presented in Appendix E. The key findings from the 2026 survey were:

- Macroalgal cover was absent or very low across all transects in 2026. Where macroalgae were present (at Transects 2 and 3, closest to the shoreline), cover was inconsistent, resulting in high variability between quadrats.
- Shell cover varied between transects, with the highest mean cover recorded at Transect 2 (equivalent to an overall dominance Class 4; refer Section 2.2.7) and the lowest at Transect 3 (overall dominance Class 1).
- Compared with previous surveys, shell cover at Transect 2 was the highest recorded to date, while shell cover at the remaining transects remained within historical ranges.
- Despite the availability of shell substrate suitable for macroalgal attachment, macroalgal cover remained consistently low across the intertidal zone. This indicates there is no evidence of nutrient-induced macroalgal proliferation associated with irrigation discharges from the WWTP.

Table 10. Estimated shell and macroalgal cover at the transects surveyed in 2026.

Location	Shell Cover (%)				Macroalgae Cover (%)			
	n	Mean	St. dev	95% CI	n	Mean	St. dev	95% CI
Transect 1	24	17.1	20.5	8.7	24	0	0	0
Transect 2	24	29	17.4	7.3	24	0.4	1.6	0.7
Transect 3	24	4.6	2.5	1.1	24	0.3	1.5	0.6

Notes: St. dev is standard deviation; 95% CI is 95% confidence interval; n is number of observations (i.e., four quarters of each of the six quadrats).

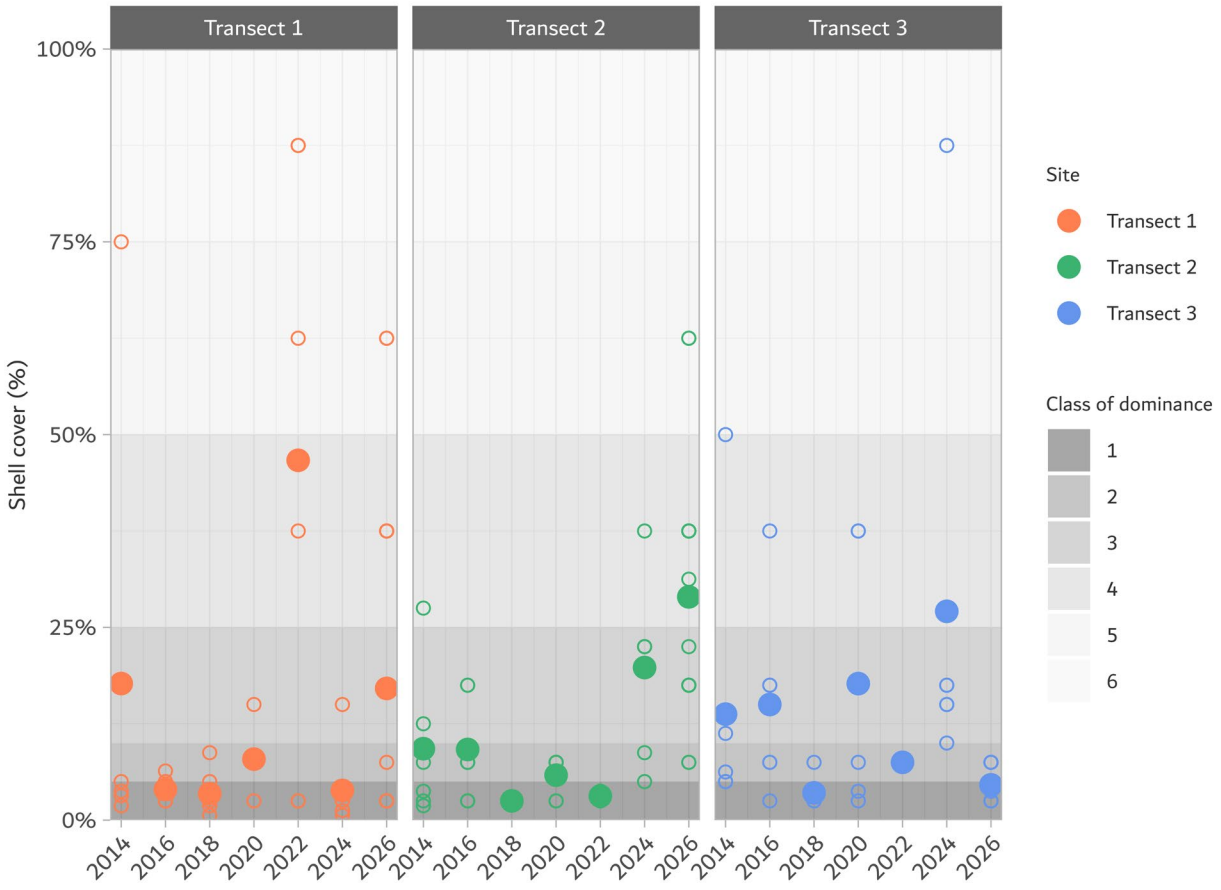

Figure 14. Estimated shell cover at marine transects between 2014 and 2026.

9 SUMMARY

Habitat

Physical habitat characteristics were broadly consistent with previous surveys and reflected natural differences between sites. Increased erosion and fine sediment deposition were observed at Site 5, likely associated with nearby forestry activities. Spot water quality measurements were comparable with historical conditions and within ranges expected to support healthy aquatic communities.

Macrophytes

Macrophyte communities remained broadly consistent with previous surveys, with differences between sites reflecting riparian shading and substrate conditions. No significant changes were observed that would suggest an ecological response to WWTP irrigation discharges.

Macroinvertebrates

Macroinvertebrate community composition and biotic indices were broadly consistent with previous surveys. While some interannual variability was evident, there was no indication of a sustained decline in macroinvertebrate community condition or adverse effects attributable to WWTP irrigation.

Fish communities

Fish communities continued to support high-integrity fish communities. Although Fish IBI scores varied between surveys, there was no evidence of a sustained decline in community composition or abundance.

Marine

Macroalgal cover remained absent or very low across the intertidal monitoring area despite the availability of suitable shell substrate. Shell cover was generally within historical ranges, and there was no evidence of nutrient-induced macroalgal proliferation associated with WWTP irrigation discharges.

Conclusion

Overall, the 2026 monitoring results indicate that the ecological condition of both the freshwater and marine receiving environments has remained broadly consistent with previous surveys. Results at sites potentially influenced by land irrigation were generally comparable to, or within the range of, those recorded at the control site on the Glen Forest tributary, indicating no clear adverse effect associated with WWTP irrigation discharges.

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Appendix A
Macrophyte Data

Table A1. Raw macrophyte data recorded at the Rautawa Stream and Glen Forest tributary sites in the March 2026 survey.

Site	Transect	Percent cover											
		Rorippa sp.	*Apium nodi-florum*	*Nitella hook-eri*	*Vallisneria gigantea*	*Persicaria sp.*	*Myosotis caespitosa*	*Lemna minor*	*Ranunculus sp.*	*Ludwigia palustris*	*Nasturtium of-ficinale*	*Callitriche stagnalis*	*Paspalum distichum*
S1	1	0	0	0	40	0	0	0	0	5	0	0	0
S1	2	0	0	0	100	0	0	0	0	0	0	0	0
S1	3	0	0	0	60	0	0	0	5	35	0	0	0
S1	4	0	0	0	100	0	0	0	0	0	0	0	0
S1	5	0	0	0	30	0	0	0	0	10	60	0	0
S1	6	0	0	0	40	5	0	0	5	10	0	0	0
S1	7	0	0	0	0	0	0	0	0	0	0	0	0
S1	8	0	0	0	100	0	0	0	0	0	0	0	0
S1	9	0	0	0	20	5	0	0	10	20	0	0	0
S1	10	0	0	0	40	0	0	0	0	0	0	0	0
S2	1	0	5	0	0	0	0	0	2	0	0	0	0
S2	2	0	0	0	0	0	0	0	0	0	0	0	0
S2	3	0	1	0	0	0	0	0	0	0	0	0	0
S2	4	0	0	0	0	0	0	0	0	0	0	0	0
S2	5	0	0	0	0	0	0	0	0	0	0	0	0
S2	6	0	0	0	0	0	0	0	0	0	0	0	0
S2	7	0	0	0	0	0	0	0	0	0	0	0	0
S2	8	0	0	0	0	0	0	0	0	0	0	0	0
S2	9	0	2	0	0	5	0	0	0	0	0	0	0
S2	10	0	0	0	0	0	0	0	0	0	0	0	0
S3	1	0	0	60	0	0	0	0	0	0	0	0	0
S3	2	0	0	40	0	0	0	0	0	0	0	0	0
S3	3	0	0	20	0	0	0	0	0	0	0	0	0
S3	4	0	0	30	0	0	0	0	0	0	0	0	0
S3	5	0	0	80	0	0	0	0	0	0	0	0	0
S3	6	0	0	20	0	0	0	0	0	0	0	0	0
S3	7	0	0	5	0	0	0	0	0	0	0	0	0

Site	Transect	Percent cover											
		Rorippa sp.	*Apium nodi-florum*	*Nitella hook-eri*	*Vallisneria gigantea*	*Persicaria sp.*	*Myosotis caespitosa*	*Lemna minor*	*Ranunculus sp.*	*Ludwigia palustris*	*Nasturtium of-ficinale*	*Callitriche stagnalis*	*Paspalum distichum*
S3	8	0	0	5	0	0	0	0	0	0	0	0	0
S3	9	0	0	2	0	0	0	0	0	0	0	0	0
S3	10	0	0	0	0	0	0	0	0	0	0	0	0
S5	1	0	0	0	0	0	0	0	0	0	0	0	0
S5	2	0	0	0	0	0	0	0	0	0	0	0	0
S5	3	0	0	0	0	0	0	0	0	0	0	0	0
S5	4	0	0	0	0	0	0	0	0	0	0	0	0
S5	5	0	0	0	0	0	0	0	0	0	0	0	0
S5	6	0	0	0	0	0	0	0	0	0	0	0	0
S5	7	0	0	0	0	0	0	0	0	0	0	0	0
S5	8	0	0	0	0	0	0	0	0	0	0	0	0
S5	9	0	0	0	0	0	0	0	0	0	0	0	0
S5	10	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B
Macroinvertebrate Data

Table B1. Raw macroinvertebrate data for samples collected at the Rautawa Stream and Glen Forest tributary sites during the March 2026 survey.

Phylum or subphylum	Class or subclass	Order	Family	Taxa	MCI hb	MCI sb	Site 1	Site 2	Site 3	Site 5
Crustacea	Malacostraca	Amphipoda	Paracalliopiidae	Paracalliope	5	5.5*	104	1	0	0
Arthropoda	Insecta	Diptera	Simulidae	Austrosimulium	3	3.9	39	61	14	7
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Zephlebia	7	8.8	3	2	7	8
Hexapoda	Insecta	Diptera	Tipulidae	Zelandotipula	6	3.6	1	0	0	0
Hexapoda	Insecta	Collembola	Collembola	Collembola	6	5.3	1	2	0	1
Hexapoda	Insecta	Trichoptera	Hydroptilidae	Oxyethira	2	1.2	4	0	36	0
Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	2	3.2	1	21	3	12
Hexapoda	Insecta	Diptera	Dixidae	Paradixa	4	8.5	3	15	23	2
Chelicerata	Arachnida	Acari		Acari	5	5.2	5	1	0	2
Hexapoda	Insecta	Ephemeroptera	Leptophlebiidae	Neozephlebia scita	7	7.6	4	0	0	1
Hexapoda	Insecta	Trichoptera	Leptoceridae	Triplectides	5	5.7	5	17	4	0
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Potamopyrgus	4	2.1	42	18	64	19
Crustacea	Eumalocostraca	Decapoda	Atyidae	Paratya	5	3.6	1	3	1	2
Mollusca	Gastropoda		Planorbidae	Ferrissia	3	2.4	1	0	0	0
Hexapoda	Insecta	Ephemeroptera	Leptophlebiidae	Deleatidium	8	5.6	1	2	2	9
Hexapoda	Insecta	Hemiptera	Veliidae	Microvelia	5	4.6	1	1	2	0
Mollusca	Gastropoda	Basommatophora	Physidae	Physella	3	0.1	1	0	0	0
Annelida	Clitellata	Arhynchobdellida	Hirudinidae	Hirudinida	3	1.2	0	0	2	0
Hexapoda	Insecta	Diptera	Chironomidae	Polypedilum	3	8	0	36	11	6
Hexapoda	Insecta	Diptera	Chironomidae	Tanytarsini	3	4.5	0	0	1	3
Hexapoda	Insecta	Diptera	Chironomidae	Tanypodinae	5	6.5	0	1	4	0
Hexapoda	Insecta	Ephemeroptera	Leptophlebiidae	Austroclima sepia	9	6.5	0	0	2	1
Nemertea				Nemertea	3	1.8	0	0	1	0
Hexapoda	Insecta	Coleoptera	Elmidae	Elmidae	6	7.2	0	1	1	5
Hexapoda	Insecta	Diptera	Chironomidae	Maoridiamesa	3	4.9	0	2	0	0
Chelicerata	Arachnida	Araneae	Pisauridae	Dolomedes	5	6.2	0	0	0	1
Hexapoda	Insecta	Coleoptera	Hydraenidae	Hydraenidae	8	6.7	0	0	0	1
Vestimentifera	Oligochaeta	Oligochaeta	Oligochaeta	Oligochaeta	3	1.2	0	0	0	1
Hexapoda	Insecta	Coleoptera	Scirtidae	Scirtidae	8	6.4	0	0	0	1

Notes: MCI-hb is the indicator value for hard bottom streams; MCI-sb is the indicator value for soft bottom streams; *in the absence of an official MCI-sb score assigned to Paracalliope, a general amphipod value of 5.5 was used in MCI/QMCI calculations, as per Landcare Research guidance.

Appendix C
Fish Data

Table C1. Raw fish data at Rautawa Stream and Glen Forest tributary sites in the March 2026 survey.

Site	Method	Fish	Abundance	Length (mm)
S1	Gee Minnow	Longfin eel	1	1000
S1	Gee Minnow	Crans bully	9	35-55
S1	Gee Minnow	Inanga	5	75-85
S1	Gee Minnow	Unidentified eel	1	80
S1	Fyke net	Longfin eel	4	700-1200
S1	Fyke net	Crans bully	21	20-60
S1	Fyke net	Redfin bully	4	50-85
S1	Fyke net	Inanga	8	60-85
S1	Fyke net	Torrentfish	1	95
S1	Electric fishing	Shortfin eel	1	400
S1	Electric fishing	Crans bully	3	30-70
S1	Electric fishing	Inanga	2	75-105
S1	Electric fishing	Unidentified eel	2	90-120
S1	Electric fishing	Torrentfish	1	85
S1	Trapping & electric fishing	Koura	4	-
S2	Gee Minnow	Crans bully	5	45-60
S2	Gee Minnow	Banded Kokopu	3	65-85
S2	Fyke net	Longfin eel	1	500
S2	Fyke net	Crans bully	3	30-50
S2	Fyke net	Redfin bully	2	60-75
S2	Fyke net	Banded kokopu	4	65-115
S2	Fyke net	Unidentified eel	1	130
S2	Electric fishing	Shortfin eel	1	200
S2	Electric fishing	Redfin bully	1	80
S2	Electric fishing	Banded kokopu	2	60-120
S2	Electric fishing	Unidentified eel	1	100
S2	Fyke net	Koura	1	-
S2	Electric fishing	Koura	1	-
S3	Gee Minnow	Redfin bully	3	50-80
S3	Fyke net	Crans bully	19	25-50
S3	Fyke net	Redfin bully	5	50-85
S3	Fyke net	Banded kokopu	9	55-105
S3	Trapping & electric fishing	Koura	6	-
S5	Gee Minnow	Crans bully	3	25-30
S5	Gee Minnow	Redfin bully	2	50-70
S5	Gee Minnow	Banded kokopu	21	25-145
S5	Gee Minnow	Torrentfish	2	60-90
S5	Fyke net	Longfin eel	1	600
S5	Fyke net	Unidentified eel	1	80
S5	Fyke net	Crans bully	7	20-60
S5	Fyke net	Redfin bully	2	55-65
S5	Fyke net	Banded kokopu	8	40-170
S5	Fyke net	Inanga	3	40-60
S5	Electric fishing	Unidentified eel	1	120
S5	Electric fishing	Crans bully	2	30
S5	Electric fishing	Torrentfish	2	55-60
S5	Gee Minnow	Koura	2	-
S5	Fyke net	Koura	3	-

Appendix D
Quadrat Photos

a)



b)



c)



d)



e)



f)



Figure D1. Transect 1 quadrats, pictured during the March 2026 survey at distances of a) 2 m, b) 4 m, c) 6 m, d) 8 m, e) 10 m and f) 12 m along the transect.

a)



b)



c)



d)



e)



f)



Figure D2. Transect 2 quadrats, pictured during the March 2026 survey at distances of a) 2 m, b) 4 m, c) 6 m, d) 8 m, e) 10 m and f) 12 m along the transect.

a)



b)



c)



d)



e)



f)



Figure D3. Transect 3 quadrats, pictured during the March 2026 survey at distances of a) 2 m, b) 4 m, c) 6 m, d) 8 m, e) 10 m and f) 12 m along the transect.

Appendix E
Marine Shell and Macroalgal Data

Table E1. Raw shell and macroalgal cover data recorded at the Kawakawa Bay intertidal transects during the March 2026 survey.

Transect	Quadrat	Quarter no	Shells (%)	Macroalgae (%)
1	1	a	2.5	0.0
1	1	b	2.5	0.0
1	1	c	2.5	0.0
1	1	d	2.5	0.0
1	2	a	2.5	0.0
1	2	b	2.5	0.0
1	2	c	2.5	0.0
1	2	d	2.5	0.0
1	3	a	2.5	0.0
1	3	b	2.5	0.0
1	3	c	2.5	0.0
1	3	d	2.5	0.0
1	4	a	7.5	0.0
1	4	b	2.5	0.0
1	4	c	2.5	0.0
1	4	d	17.5	0.0
1	5	a	62.5	0.0
1	5	b	62.5	0.0
1	5	c	37.5	0.0
1	5	d	37.5	0.0
1	6	a	37.5	0.0
1	6	b	37.5	0.0
1	6	c	37.5	0.0
1	6	d	37.5	0.0
2	1	a	62.5	0.0
2	1	b	17.5	0.0
2	1	c	37.5	0.0
2	1	d	7.5	0.0
2	2	a	37.5	0.0
2	2	b	7.5	0.0
2	2	c	62.5	2.5
2	2	d	37.5	0.0
2	3	a	7.5	0.0
2	3	b	17.5	0.0
2	3	c	17.5	0.0
2	3	d	17.5	0.0
2	4	a	37.5	0.0
2	4	b	62.5	7.5
2	4	c	37.5	0.0
2	4	d	37.5	0.0
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2	5	b	37.5	0.0
2	5	c	37.5	0.0
2	5	d	17.5	0.0
2	6	a	17.5	0.0
2	6	b	17.5	0.0
2	6	c	17.5	0.0

Transect	Quadrat	Quarter no	Shells (%)	Macroalgae (%)
2	6	d	7.5	0.0
3	1	a	2.5	0.0
3	1	b	2.5	0.0
3	1	c	2.5	0.0
3	1	d	2.5	0.0
3	2	a	2.5	0.0
3	2	b	2.5	0.0
3	2	c	2.5	0.0
3	2	d	7.5	0.0
3	3	a	7.5	0.0
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3	6	a	2.5	0.0
3	6	b	7.5	0.0
3	6	c	2.5	0.0
3	6	d	7.5	0.0

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Kawakawa Bay Wastewater Treatment Plant
2026 Stormwater Audit Report

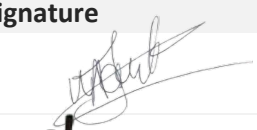
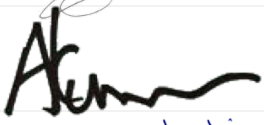
Final - September 2026

Watercare

QUALITY INFORMATION

Document	2026 Stormwater Audit Report
Date	29 September 2026
Name and position of originator	Matt Conley, Senior Environmental Scientist
Report directory	Watercare Services Limited\Te Taiao - Documents\CMS\Compliance\Drafts\Annual Reports\2025-26\Southeast\DTKAW

REVISION HISTORY

Rev	Revision Date	Name	Position	Signature
1	08/08/2026	Michiel Jonker	Environmental Care Manager	
2	21/09/2026	Ash Kumar	Operations Controller	
2	21/09/2026	Rohan Bhatia	Wastewater Production Manager South	

APPROVED

Date	Name	Position	Signature
29/09/2026	Michiel Jonker	Environmental Care Manager	

CONSENT CHANGE AND MONITORING HISTORY

Change type	Description	Effective date	Reference / condition	Reporting / monitoring implications
Reporting deadline	A variation of consent 30830 and other associated consents changed the annual performance reporting deadline from 31 May to 30 September.	6/12/2013	19	Annual reports, including the results of the stormwater audit, submitted to Auckland Council by 30 September annually.
Approved assessor	Chris Garton (WSL environmental scientist) approved as an assessor by Auckland Council.	2017	16	Annual audits completed by Chris Garton.
Approved assessor	Emma Baker (WSL environmental scientist) approved as an assessor by Auckland Council.	2022	16	Annual audits completed by Emma Baker.
Approved assessor	Matt Conley (WSL senior environmental scientist) approved as an assessor by Auckland Council.	2026	16	Annual audits completed by Matt Conley

EXECUTIVE SUMMARY

Resource consent DIS60262712 (30830) authorises the diversion and discharge of stormwater from the Kawakawa Bay Wastewater Treatment Plant. This consent also authorises the discharge of contaminants onto or into land or water from an industrial or trade process (the treatment plant).

This report has been prepared to meet the requirements under condition 16 which states:

> *That the site shall be audited on an annual basis by a professionally registered auditor, or an alternative assessor approved by the Manager, to assess compliance with the SWEMP and all other conditions of this consent.*

The audit was undertaken on 13 July 2026 by a council approved auditor. The stormwater infrastructure was generally found to be in good condition and operating as intended. The audit identified no physical deficiencies in the stormwater management system. Compliance with the Emergency Spill Response Plan requirements was also reviewed, including spill-response training, equipment, and response to the wastewater overflow event that occurred on 21 January 2026.

TABLE OF CONTENTS

1 Introduction 1
1.1 Background 1
1.2 Approach 1
2 Audit findings 2
2.1 Stormwater infrastructure overview 2
2.2 Swales 1, 2 and 3 2
2.3 Western swale drains 3
2.4 Drain outflow culverts 3
2.5 Dry pond and swale 4 4
2.6 Stormwater filter cartridge 5
2.7 Hazardous substances 5
2.8 Stormwater incidents 6
3 Consent conditions review 7
3.1 Summary 7
3.2 Consent compliance 7
3.2.1 Compliance criteria 7
3.3 Consent conditions and compliance 8

Appendix A. Site as-built drawings
Appendix B. Emergency spill response training register and spill kit inspection

LIST OF FIGURES

Figure 2-1: Swales for the Kawakawa Bay Wastewater Treatment Plant 2
Figure 2-2: Western swales for the Kawakawa Bay Wastewater Treatment Plant 3
Figure 2-3: Drain outflow culverts at Kawakawa Bay Wastewater Treatment Plants 4
Figure 2-4: Swale 4, looking away from dry storage pond 5
Figure 2-5: Dry storage pond 5
Figure 2-6: Hazardous substances tanks at Kawakawa Bay Wastewater Treatment Plant 5
Figure 2-7: Portable chemical bund and spill kit at Kawakawa Bay Wastewater Treatment Plant 6

1 INTRODUCTION

1.1 Background

Resource consent DIS60262712 (30830) authorises the diversion and discharge of stormwater from the Kawakawa Bay Wastewater Treatment Plant (WWTP). This consent also authorises the discharge of contaminants onto or into land or water from an industrial or trade process (the treatment plant).

This report has been prepared to meet the requirements under condition 16 which states:

> *That the site shall be audited on an annual basis by a professionally registered auditor, or an alternative assessor approved by the Manager, to assess compliance with the SWEMP and all other conditions of this consent.*

This audit was conducted by senior environmental scientist Matt Conley. Auckland Council approval for Matt to conduct the audit was granted in January 2026 by Council Monitoring Officer Bing Zhang in their role as the Manager for this consent.

1.2 Approach

The audit occurred on Monday 13 July 2026. The method for this audit was the same as previous audits.

The inspection assessed the site facilities and operational procedures regarding the relevant conditions of consent DIS60262712, Appendices B2 and B3 of the Operations Management Plan (OMP), and as-built drawings 120722-SW100, 120722-SW113, and 120722-SW110-AB. The as-built drawings were used for referencing locations only. As-built compliance was confirmed in previous audits.

The main aspects of compliance audited were:

- The chemical storage facilities
- The emergency response plan and procedures
- The condition of stormwater pipe outlets
- The single cartridge stormwater filter
- The swales
- The dry storage pond.

2 AUDIT FINDINGS

2.1 Stormwater infrastructure overview

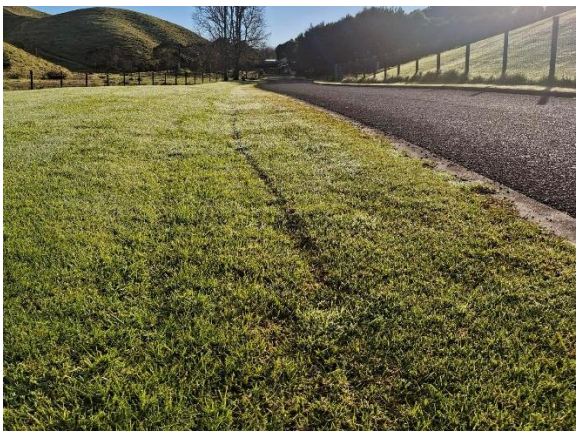
The stormwater infrastructure for the treatment plant comprises four engineered swales, one dry pond, and one single cartridge stormwater filter. Stormwater 360 installed the filter in 2009.

Three of the swales are adjacent to the road and run from the front gate to the treatment plant. The fourth swale was built around the western side of the treatment plant to divert surface flow from the adjacent hillslope around the plant rather than through it. Appendix A provides as-built drawings of the stormwater infrastructure.

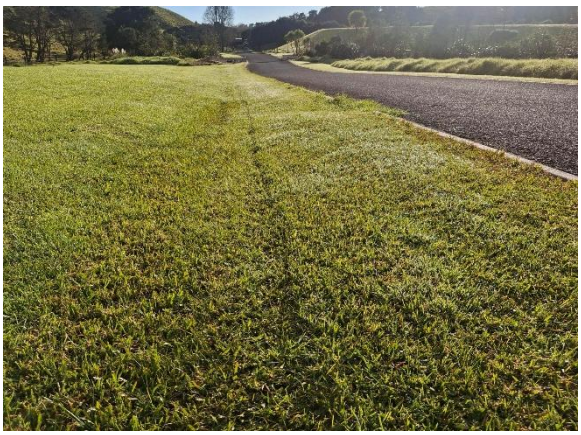
2.2 Swales 1, 2 and 3

Figure 2-1a -c are photos of the stormwater swales. Previous audits have established that the stormwater infrastructure was constructed in general accordance with the as-built drawings (ITP audit, Babbington and Associates (2004) Ltd., 2012). Modifications to swales 2 and 3 were previously made to facilitate the flow of road runoff into the swales at the appropriate locations. No further design modifications have been made.

On the day of the audit, the swales were in good condition and have been maintained to a high standard.



A: Swale 1, looking downhill towards front gate



B: Swale 2, looking downhill towards front gate



C: Swale 3, looking downhill towards front gate

Figure 2-1: Swales for the Kawakawa Bay Wastewater Treatment Plant

2.3 Western swale drains

The western swale diverts runoff from the hill west of the treatment plant around the plant to two drains. These drains are on the northern and southern ends of the treatment plant and pipe the water under the road to outlets east of the treatment plant. Figure 2-2 includes photos of both drains.

The diversion reduces the volume of stormwater entering the treatment plant (see Appendix A for as-built drawings). On the day of the site visit, the swale drain appeared to be in good condition and was performing well. The proportion of bare earth remained similar to previous audits, keeping sediment levels entering the drains minimal. Additionally, the vegetation between the swales and the stream aims to further improve stormwater quality.



A: Drain and gate from northern aspect of western swale



B: Drain and grate from southern aspect of the western swale

Figure 2-2: Western swales for the Kawakawa Bay Wastewater Treatment Plant

2.4 Drain outflow culverts

The drain overflow culverts receive water from the western swale and the Stormwater 360 filter. The outlets in Figure 2-3a – Figure 2-3c show these culverts have been maintained to a high standard and were not overgrown or blocked.



A: Stormwater 360 cartridge outlet



B: Southern aspect of western swale outlet



C: Northern aspect of western swale

Figure 2-3: Drain outflow culverts at Kawakawa Bay Wastewater Treatment Plants

2.5 Dry pond and swale 4

Swale 4 and the dry pond receive flow from the treatment plant and the adjacent roads. This flow enters the roadside grates at the northern end of the treatment plant. The stormwater travels through swale 4 and into the dry pond. Swale 4 is a small swale at the mouth of the dry pond which provides initial filtering of the flow.

The pond is designed to temporarily store and attenuate stormwater during a rain event. The pond also provides water quality treatment through the process of extended detention. Between rain events this pond is normally dry. At the time of the audit the pond was visibly dry. The discharge from the manhole is piped to an overland flow path to the east of the plant.

During the audit, the dry pond and swale 4 were found to be in good condition and maintained to a high standard as seen in Figure 2-4 and Figure 2-5. The sides of the swale are steep, and the base is very soft. The condition of the vegetation in the swale and the dry pond was appropriate and would provide the desired filtering of stormwater.



Figure 2-4: Swale 4, looking away from dry storage pond



Figure 2-5: Dry storage pond

2.6 Stormwater filter cartridge

The stormwater cartridge is at the southern end of the treatment plant. Stormwater 360, who installed the cartridge, recommends biennial maintenance of the stormwater filter cartridge. On 13 July 2026, the filter's associated infrastructure was in good condition and no cleaning or repairs were required. The most recent clean and inspection of the filter was undertaken in June 2026.

2.7 Hazardous substances

During the audit, all the potentially environmentally harmful substances were being stored appropriately. The hazardous substances routinely stored onsite are diesel, molasses and citric acid.

The diesel is contained in a concrete bund in accordance with condition 9 of the resource consent. The bund was in good condition and all the rainwater release valves were closed. The molasses is kept in a tank on the gravel bed. These are shown in Figure 2-6. The bunded sodium hypochlorite tank next to the membrane tank is only used when membranes are being cleaned and remains empty at all other times. This tank was empty on the day of the audit.



A: Diesel storage tank in concrete bund



B: Molasses tank

Figure 2-6: Hazardous substances tanks at Kawakawa Bay Wastewater Treatment Plant

In the workshop container at the southern end of the treatment plant, a moveable bund stores any remaining chemicals. Within the moveable bund, the chemicals are stored in separate trays for acids and bases.

The emergency spill response kit is stored in a yellow wheelie bin inside the control room. This equipment, along with the two bags of sawdust, is inspected annually, with the last inspection on 4 May 2026 (Appendix B). Environmentally hazardous substances are checked weekly as part of the scheduled checks performed by staff onsite. Records of these inspections are kept in the weekly log sheets. Emergency spill response training procedures are in place with staff undertaking spill training exercises annually. Appendix B provides a copy of the most recent spill training exercise register, undertaken on 5 February 2026.



A: Portable chemical bund in workshop container



B: Emergency spill kit in control room

Figure 2-7: Portable chemical bund and spill kit at Kawakawa Bay Wastewater Treatment Plant

2.8 Stormwater incidents

During a rain event on 21 January 2026 an error with the SCADA system for the wastewater network to the plant resulted in a fault with the network vacuum pump station. The fault caused wastewater to continue pumping to the plant despite the plant balancing tanks reaching capacity. The fault could not be resolved remotely and had to be stopped manually at the plant. By time the site was attended, the balancing tanks had overflowed screened wastewater.

The overflow dispersed over the gravel between the balancing tanks and spilled onto the site road. From the road, the overflow drained to a downgradient cesspit that connects to swale 4 and the dry pond to the east of the plant. All wastewater that entered the dry pond was contained; there was no discharge from the dry pond at the time, and no wastewater entered the Rautawa Stream.

The alarm was received at 5:27pm and was cleared by 8:45pm, sucker trucks were bought to site to remove additional water from the balancing tanks. By time the fault had been cleared and levels subsided, an estimated volume of 22 m^3 had entered the dry pond. The water level within the dry pond was not visible above the vegetation; therefore, it was unable to be removed from the pond. The pond was visibly dry the following day, therefore, the wastewater soaked to ground. For completeness, swale 4 and the dry pond have a combined area of approximately 500 m^2, therefore, the estimated spill volume would equate to a depth of approximately 4cm across this area.

The SCADA fault was investigated by Watercare's digital team where a wiring error was identified that prevented pump interlocking. An electrical contractor was engaged to resolve the issue and no further incidents have since occurred. Auckland Council was notified of the spill on 23 January 2026.

3 CONSENT CONDITIONS REVIEW

3.1 Summary

The stormwater system at the Kawakawa Bay Wastewater Treatment Plant is being maintained to a high standard and observed to be operating well. The swales, dry pond and their culverts were all maintained adequately. The western swale is functioning well, with minimal sediment entering the drains. Any sediment that may enter the drains is unlikely to enter the stream due to the vegetation between the two which aims to improve the stormwater quality.

The environmentally hazardous chemicals were being stored appropriately, and the spill kit was fully stocked and available for use in the event of an emergency.

Section 3.2 is a condition-by-condition comparison. The site was fully compliant with the conditions of consent DIS60262712.

3.2 Consent compliance

3.2.1 Compliance criteria

Grading	Explanation
NA	Not applicable
NE	The consent condition has not been exercised
NI	The consent conditions was not assessed or inspected
Category 1	The consent condition has been complied with
Category 2 - Minor	The consent condition has not been complied with as per the following categories: 2A - Information Self-monitoring or one-off information is incomplete or outstanding 2B - Technical The item has not been constructed, maintained or operated correctly 2C - Combination of 2A and 2B
Category 3 - Moderate	The consent has not been complied with by one or both of the following: - Potential or adverse effect on the environment - Repeat Category 2 non-compliance
Category 4 - Major	The consent has not been complied with by one or both of the following: - Potential or adverse effect on the environment - Repeat Category 3 non-compliance

3.3 Consent conditions and compliance

Number	Condition	Grade	Comment/Action required
1	That the servants or agents of the Council shall be permitted access to the relevant parts of the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.	1	
2	That the Consent Holder shall design, build and operate the plant and associated processes in accordance with the documentation submitted to the Council as part of application number 30830, where not amended by the conditions of this resource consent. No alterations shall be made to the plant or processes that do not, or are not likely to, comply with the provisions of this consent, a regional rule, or regulations under the Resource Management Act 1991.	1	
3	That the final design of the stormwater management system shall be submitted to the Manager for written approval prior to the commencement of construction works. The final design shall be in accordance with Application Number 30830 and as shown on the Harrison Grierson Consultants Limited plans and calculations received 20 November and 27 November 2006. The final design details shall include, but not be limited to: i) An assessment of downstream receiving environment in relation to flood levels within the catchment during a 100 Year ARI rainfall event; ii) Treatment efficiency calculations; iii) Flow attenuation calculations; iv) Flood calculations, overland flow paths; v) Design drawings, inlet, outlet, long section and cross sections; vi) Catchment plans detailing the area draining to the devices; and vii) Outfall locations and design in accordance with TP10.	1	
4	That the Consent Holder shall construct the stormwater management system as shown in documentation approved under Condition 3. Any amendments that may affect capacity of performance of the stormwater management system shall be approved by the Manager in writing, prior to construction. In particular, this requires that the following stormwater management works are constructed for the following catchment areas and design standards (as defined by TP10 and TP108)	1	

Number	Condition	Grade	Comment/Action required
	Works Access Road and Treatment Plant. **Catchment area- impervious** 3900m2 **Catchment area- pervious** **Design Standard** 75% TSS removal 2 and 10 Year ARI peak flow attenuation to predevelopment levels. Extended detention of the 34.5mm rainfall event.		
5	That notwithstanding Conditions 3 and 4 the Consent Holder shall ensure that the stormwater management system is constructed and maintained so as to minimise erosion, risk of obstruction of the waterway and hazards to safety.	1	
6	That the Consent Holder or their agent shall arrange and conduct a preconstruction site meeting between ARC and all relevant parties, including the site stormwater engineer, with regard to the stormwater management works for the site, prior to the construction of any infrastructure works on the site. Any resulting amendments to the stormwater management system may be reviewed by the ARC at the time and may be approved in accordance with Condition 3 and 4 above.	NA	
7	That the Consent Holder shall ensure that all storage containers on site shall be covered to prevent rainwater entry.	1	
8	That the Consent Holder shall ensure that all waste compactors and bins shall be located and operated in such a manner as to prevent leachate/wastes from leaking from the bins and entering the stormwater system.	1	
9	That the Consent Holder shall ensure that all environmentally hazardous substances shall be stored in a manner that prevents the entry of rainwater into the container, and when the quantity exceeds that used for domestic purposes, in a secondary containment device (such as a bund) where: i) The device is constructed of impervious materials that are resistant to chemical attack from the substances contained therein; ii) The device is designed, constructed and managed so that uncontaminated stormwater runoff is prevented from flowing into the contained area;	1	The diesel container is sealed to the outside atmosphere. The chemicals in the storage container bund are stored in sealed appropriate containers and it is not possible for rain to enter the bund. Emergency spill response procedures are in place, training is conducted with all

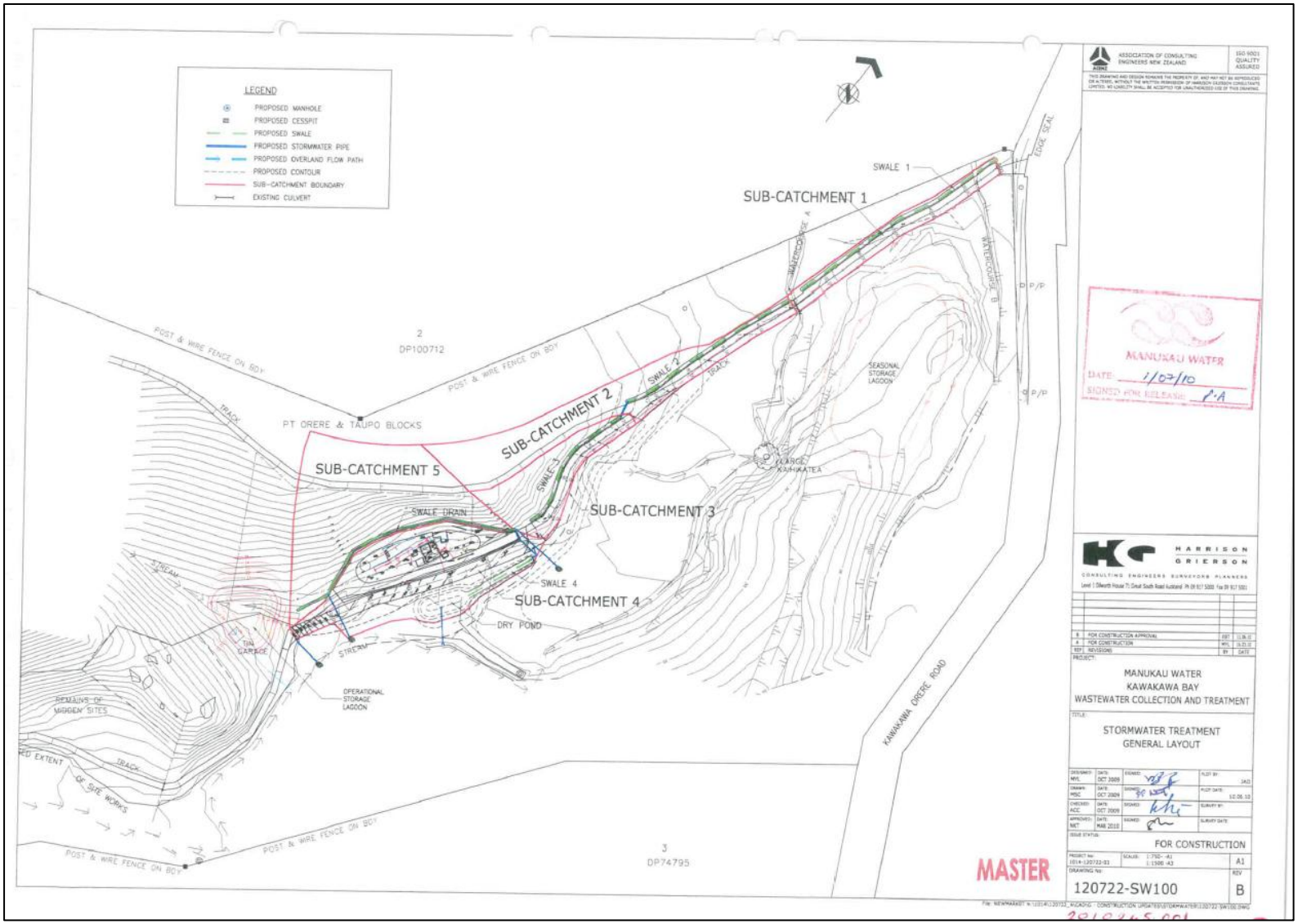
Number	Condition	Grade	Comment/Action required
	iii) There shall be a mechanism/protocol for determining, prior to draining, if any fluid collected in the containment device is contaminated; and iv) In the event of a leak or spill within the containment device, a procedure shall be prepared to dispose of all contaminated water and leaked product.		relevant staff members on an annual basis, and the spill kit is fully checked every 12 months.
10	That the Consent Holder shall ensure that all on-site vehicle refuelling facilities with a total storage capacity of greater than 5000 litres shall be contained and housed under cover, and/or surrounded by a drain that drains to an appropriately designed and sized stormwater treatment and spill containment device fitted with a shut-off valve.	NA	No storage greater than 5,000 L
11	That the Consent Holder shall ensure that the site is operated and managed in accordance with all components of the Stormwater Environmental Management Plan (SWEMP) as specified in Condition 21	1	
12	That the Consent Holder shall ensure that all spills are stopped, contained and cleaned up as soon as practicable in accordance with the procedures detailed in the Emergency Spill Response Plan required by Condition 20.	1	One spill on 26 January 2026, managed in accordance with management plan requirements.
13	That the Consent Holder shall at all times operate, maintain, supervise, monitor and control all processes on site so that discharges authorised by this consent are maintained at the minimum practicable level.	1	Equipment in sound working condition.
14	That the Consent Holder shall ensure that any discharge of contaminants onto or into land from the activity is avoided, remedied or mitigated to ensure no contaminants from the site in the soil or runoff are present at a concentration that is, or is likely to be, detrimental to human health or the environment.	1	The stormwater system was operating as designed.
15	That the Consent Holder shall ensure that, for stormwater flows in excess of the capacity of the primary systems, secondary flow paths shall be provided and maintained to allow surplus stormwater from critical storms, up to the 100 year ARI event, to discharge with the minimum of nuisance and damage.	1	
16	That the site shall be audited on an annual basis by a professionally registered environmental auditor, or an alternative assessor approved by the Manager, to assess compliance with the SWEMP and all other conditions of this consent.	1	Audit carried out in July 2026 by an approved assessor.
17	Where the audit required by Condition 16 results in satisfactory compliance for three consecutive years, the audit requirement will change to a biennial basis. In the event of non-compliance at any time with the conditions specified in this consent the audit shall revert back to an annual basis.	1	Full compliance achieved for more than three consecutive years. However, stormwater

Number	Condition	Grade	Comment/Action required
			audits continue on an annual basis.
18	All information required under this consent will be consistent with the requirements of Consent 30833 and in particular the requirements within the Operations Management Plan of Consent 30833. Further, all Plans required under this consent will be included as an appendix to the Operations Management Plan as required by Consent 30833.	1	All plans are present as appendices to the Operations Management Plan (OMP).
19	That an annual Performance Report detailing and summarising the plant performance and consent compliance and with the SWEMP shall be submitted to the Manager every by 31 May each year. The report will be consistent with that required in the Operations Management Plan. This checklist forms part of this report.	1	Annual Performance Reports are now submitted by the 30th of September as approved by Auckland Council in December 2013. The Performance Report has been submitted on time.
20	That the Consent Holder shall ensure that an Emergency Spill Response Plan (ESRP) shall be developed. This Plan will be an appendix to the Operations Management Plan as required by Consent 33143 and shall include: i) A schedule of inspection to ensure environmentally hazardous ii) Protocols/methods for identifying and stopping any discharge and ensuring that future events of this nature do not occur; iii) Emergency containment and clean-up procedures; iv) Appropriate spill kits to allow containment and/or absorption of spilled material and the identification of their locations; v) Appropriate signage to identify the location of spill kits and the actions to be taken in the event of a spill; vi) Action to minimise any adverse effects on the environment, public health and safety, including action to take if the spilled material has reached any public stormwater system and/or any waterbody; vii) Methods for disposal of spilled materials and any other contaminated materials used in the spill clean-up; viii) Training of personnel in adequate identification of materials and correct operating procedures to avoid or minimise the likelihood of spills; ix) Up-to-date and accurate copies of all site drainage plans showing location of the final discharge point of the site stormwater system to any public stormwater system and/or any watercourse;	1	

Number	Condition	Grade	Comment/Action required
	x) A procedure for notifying as soon as practicable the ARC's 24 hour emergency response service in the event of any spill on site that results in contamination of any stormwater system, waterbody, or into land; xi) A procedure to ensure that all spill kits and spill response equipment are inspected and maintained fully stocked and in good working condition, and xii) xii) A procedure for reviewing and revising, where necessary, the spill response plan, particularly after a spill or emergency situation, to prevent a recurrence.		
21	That the Consent Holder shall ensure that a Stormwater Environmental Management Plan (SWEMP) is submitted to the Manager for review. The Manager will advise the Consent Holder in writing if any aspects of the SWEMP are considered to be inconsistent with this consent. i) The identification of the specific activities and contaminants associated with the industrial or trade processes on-site that have the potential to adversely impact the receiving environment; ii) Documented procedures and methods to be used to manage the environmental risk from these activities and to ensure that the contaminants identified avoid contacting stormwater runoff. These should include but not be limited to; a) The operation and maintenance of all environmentally hazardous substance storage facilities and compounds in accordance with Condition 9. b) An Emergency Spill Response Plan in accordance with Condition 20. c) The methods, procedures and frequencies for undertaking periodic testing of the Emergency Spill Response Plan (at least twice per annum) and recording the performance and outcomes from this testing. d) The identification of staff training needs and the establishment of appropriate staff induction and training procedures. e) Procedures and methods to be used to manage the environmental risk associated with the activities of any contractors working on the site. iii) An Operation and Maintenance Plan for the site's stormwater system, which shall be submitted to the Manager for written approval within 30 days of the completion of the installation of the stormwater management system. The Operation and Maintenance Plan shall include, but not be limited to: a) Operational details and maintenance requirements for all components of the site's stormwater system including all swales, the pond and outfall structures under typical and storm flow conditions; b) Frequency of regular and one-off (e.g. post storm) maintenance and inspections; c) General inspection checklists for all aspects of the stormwater system;	1	Stormwater Management covered by Appendices B2 and B3 of the Kawakawa Bay WWTP OMP.

Number	Condition	Grade	Comment/Action required
	d) Details of the person or body who will hold responsibility for the on-going operation, maintenance and monitoring of the stormwater system and the organisational structure which will support this process. iv) Staff responsibilities for all procedures and methods contained within the SWEMP; v) Appropriate internal site auditing requirements to ensure performance of all components of the SWEMP; vi) A method by which the SWEMP is reviewed by management to ensure its continuing suitability, adequacy and effectiveness; and vii) Reporting procedures and frequencies for all aspects of performance of site environmental management.		
22	That the conditions of this consent may be reviewed by the Manager, pursuant to Section 128 of the Resource Management Act 1991, by the giving of notice pursuant to Section 129 of the Act in June 2008 and every two years thereafter.	NA	

Appendix A. Site as-built drawings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PROPOSED MANHOLE
PROPOSED CESSPIT
PROPOSED SWALE
PROPOSED STORMWATER PIPE
PROPOSED OVERLAND FLOW PATH
PROPOSED CONTOUR
SUB-CATCHMENT BOUNDARY
EXISTING CULVERT
SUB-CATCHMENT 1
SUB-CATCHMENT 2
SUB-CATCHMENT 3
SUB-CATCHMENT 4
SUB-CATCHMENT 5
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SWALE 2
SWALE 3
SWALE 4
SWALE DRAIN
DRY POND
SEASONAL STORAGE LAGOON
OPERATIONAL STORAGE LAGOON
KAWAKAWA ORERE ROAD
PT ORERE & TAUPO BLOCKS
POST & WIRE FENCE ON BDY
TRACK
STREAM
2 DP100712
3 DP74795
MANUKAU WATER
DATE: 1/07/10
SIGNED FOR RELEASE
HARRISON GRIERSON
MANUKAU WATER
KAWAKAWA BAY
WASTEWATER COLLECTION AND TREATMENT
STORMWATER TREATMENT
GENERAL LAYOUT
FOR CONSTRUCTION
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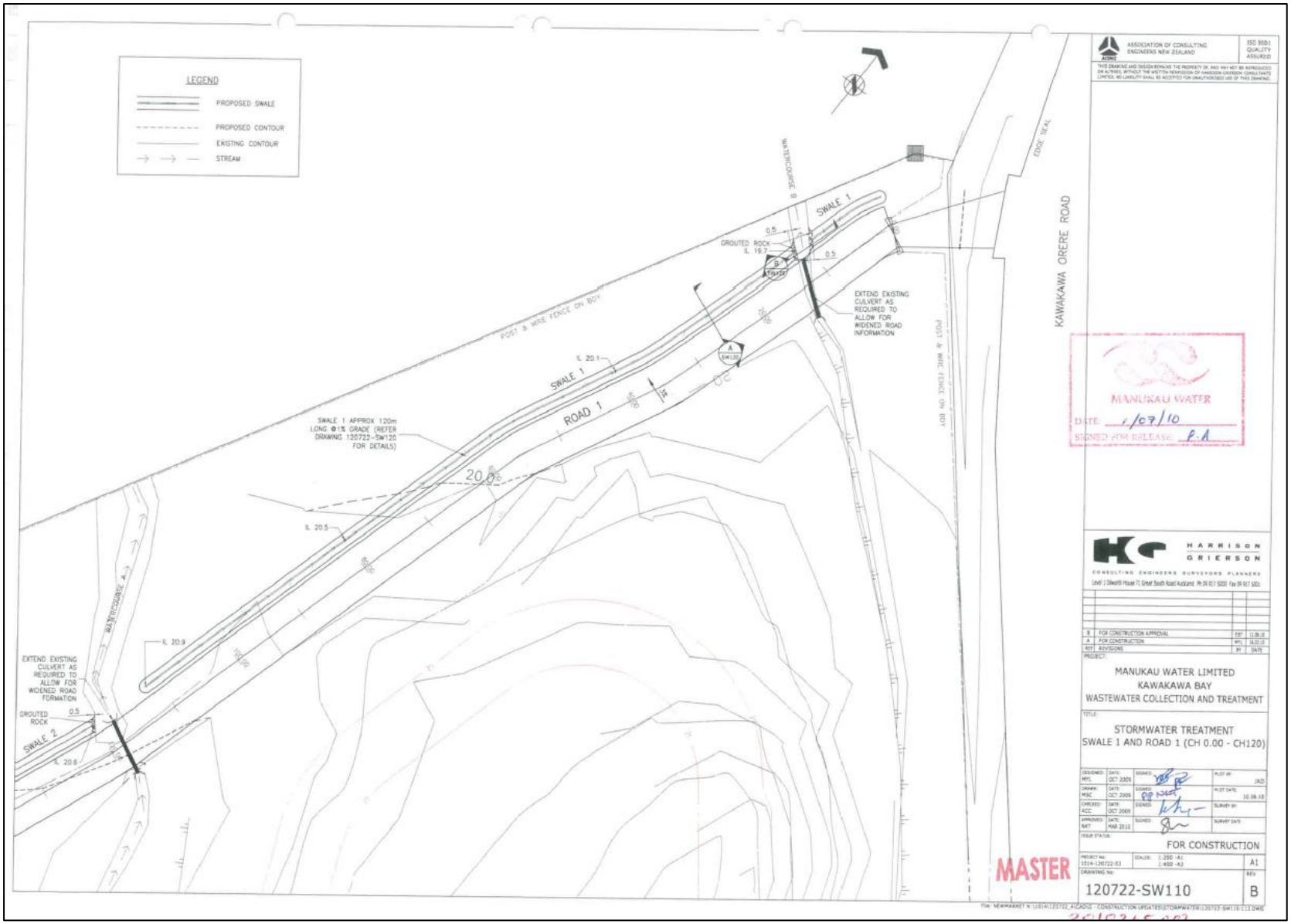
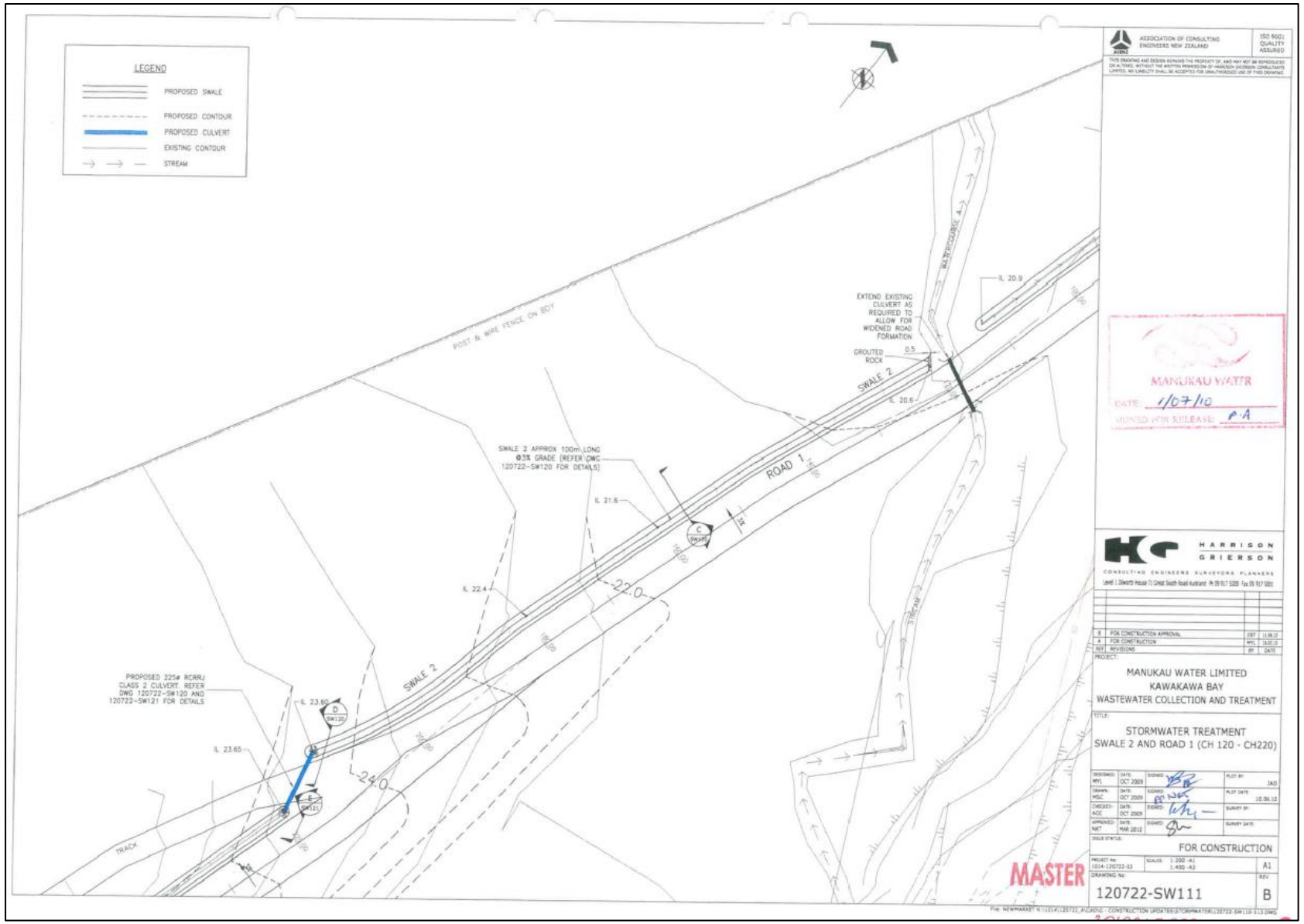
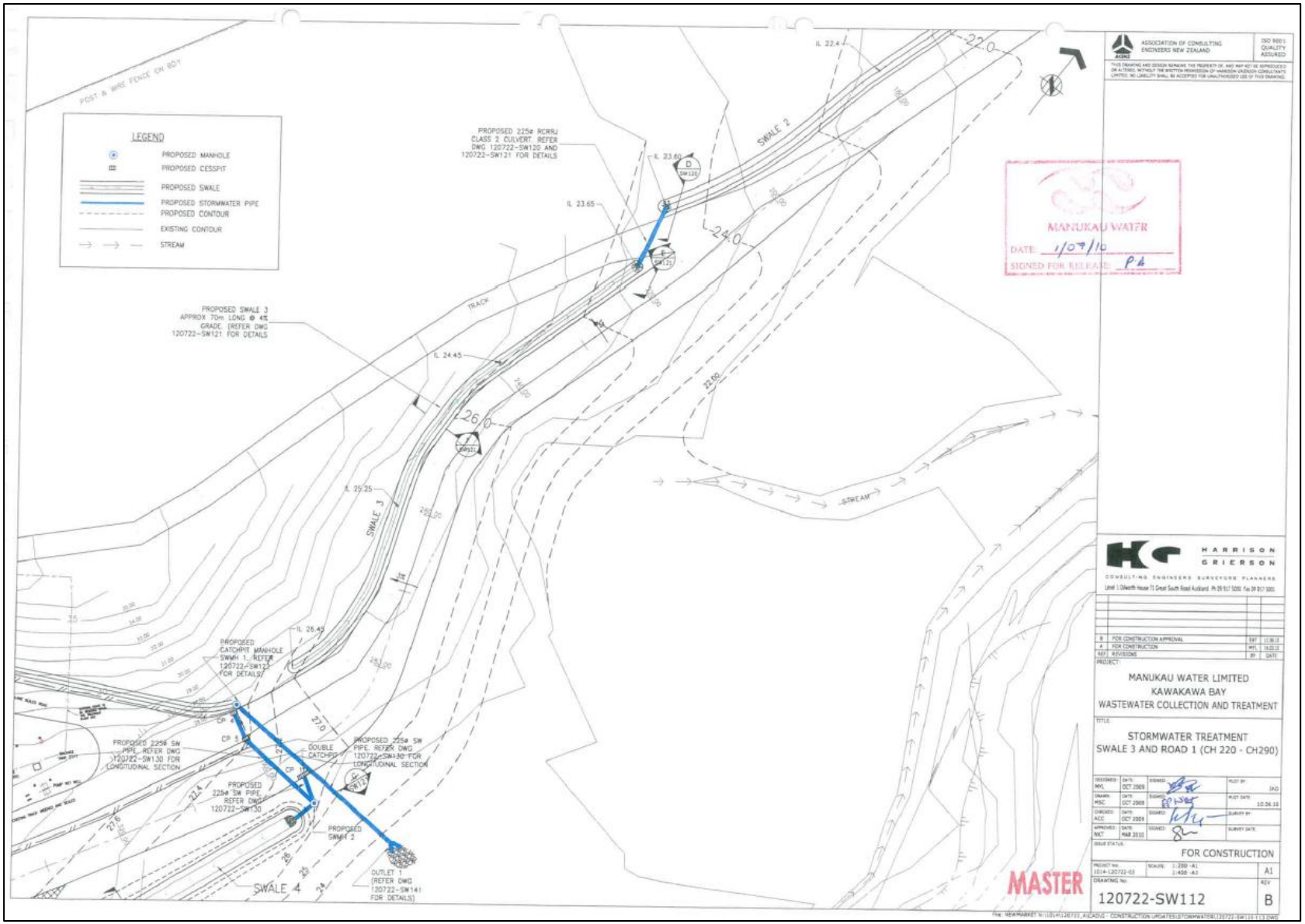
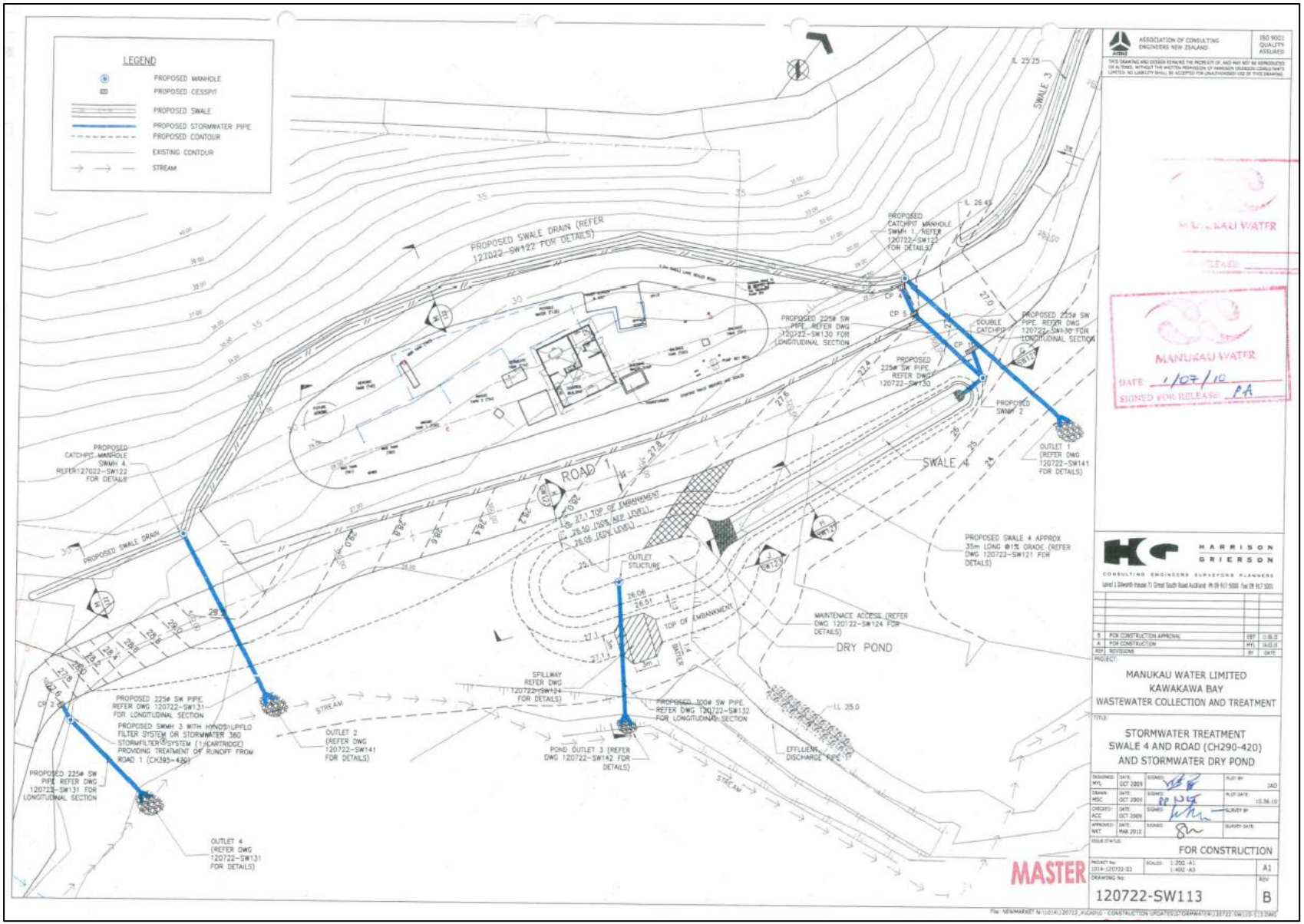

LEGEND
PROPOSED SWALE
PROPOSED CONTOUR
EXISTING CONTOUR
STREAM
KAWAKAWA ORERE ROAD
SWALE 1
ROAD 1
SWALE 2
GROUTED ROCK
EXTEND EXISTING CULVERT AS REQUIRED TO ALLOW FOR WIDENED ROAD FORMATION
SWALE 1 APPROX 120m LONG @1% GRADE (REFER DRAWING 120722-SW120 FOR DETAILS)
POST & WIRE FENCE ON BDY
WATERCOURSE B
WATERCOURSE A
MANUKAU WATER
DATE 1/07/10
SIGNED FOR RELEASE
HARRISON GRIERSON
MANUKAU WATER LIMITED
KAWAKAWA BAY
WASTEWATER COLLECTION AND TREATMENT
STORMWATER TREATMENT
SWALE 1 AND ROAD 1 (CH 0.00 - CH120)
FOR CONSTRUCTION
MASTER
120722-SW110
B


LEGEND
PROPOSED SWALE
PROPOSED CONTOUR
PROPOSED CULVERT
EXISTING CONTOUR
STREAM
EXTEND EXISTING CULVERT AS REQUIRED TO ALLOW FOR WIDENED ROAD FORMATION
GROUTED ROCK
SWALE 2
ROAD 1
SWALE 2 APPROX 100m LONG @3% GRADE (REFER DWG 120722-SW120 FOR DETAILS)
PROPOSED 225ø RCRRJ CLASS 2 CULVERT. REFER DWG 120722-SW120 AND 120722-SW121 FOR DETAILS
IL 20.9
IL 20.5
IL 21.6
IL 22.4
IL 23.60
IL 23.65
22.0
24.0
POST & WIRE FENCE ON BDY
TRACK
MANUKAU WATER
DATE: 1/07/10
ACCEPTED FOR RELEASE: P.A
HARRISON GRIERSON
MANUKAU WATER LIMITED
KAWAKAWA BAY
WASTEWATER COLLECTION AND TREATMENT
STORMWATER TREATMENT
SWALE 2 AND ROAD 1 (CH 120 - CH220)
FOR CONSTRUCTION
MASTER
120722-SW111
B


LEGEND
PROPOSED MANHOLE
PROPOSED CESSPIT
PROPOSED SWALE
PROPOSED STORMWATER PIPE
PROPOSED CONTOUR
EXISTING CONTOUR
STREAM
POST & WIRE FENCE ON BDY
PROPOSED 225ø RCRRJ CLASS 2 CULVERT. REFER DWG 120722-SW120 AND 120722-SW121 FOR DETAILS
PROPOSED SWALE 3 APPROX 70m LONG @ 4% GRADE. (REFER DWG 120722-SW121 FOR DETAILS
SWALE 2
SWALE 3
SWALE 4
TRACK
STREAM
PROPOSED CATCHPIT MANHOLE SWMH 1. REFER 120722-SW122 FOR DETAILS)
PROPOSED 225ø SW PIPE. REFER DWG 120722-SW130 FOR LONGITUDINAL SECTION
PROPOSED 225ø SW PIPE. REFER DWG 120722-SW130
DOUBLE CATCHPIT
PROPOSED SWMH 2
OUTLET 1 (REFER DWG 120722-SW141 FOR DETAILS)
MANUKAU WATER
DATE: 1/09/10
SIGNED FOR RELEASE:
HARRISON GRIERSON
MANUKAU WATER LIMITED
KAWAKAWA BAY
WASTEWATER COLLECTION AND TREATMENT
STORMWATER TREATMENT
SWALE 3 AND ROAD 1 (CH 220 - CH290)
FOR CONSTRUCTION
MASTER
120722-SW112
B


LEGEND
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PROPOSED SWALE
PROPOSED STORMWATER PIPE
PROPOSED CONTOUR
EXISTING CONTOUR
STREAM
PROPOSED SWALE DRAIN (REFER 120722-SW122 FOR DETAILS)
PROPOSED CATCHPIT MANHOLE SWMH 1 (REFER 120722-SW122 FOR DETAILS)
PROPOSED 225ø SW PIPE REFER DWG 120722-SW130 FOR LONGITUDINAL SECTION
PROPOSED 225ø SW PIPE REFER DWG 120722-SW130
PROPOSED SWMH 2
OUTLET 1 (REFER DWG 120722-SW141 FOR DETAILS)
SWALE 3
SWALE 4
ROAD 1
PROPOSED CATCHPIT MANHOLE SWMH 4 REFER120722-SW122 FOR DETAILS
PROPOSED SWALE DRAIN
OUTLET STUCTURE
TOP OF EMBANKMENT
PROPOSED SWALE 4 APPROX 35m LONG @1% GRADE (REFER DWG 120722-SW121 FOR DETAILS)
MAINTENACE ACCESS (REFER DWG 120722-SW124 FOR DETAILS)
DRY POND
SPILLWAY REFER DWG 120722-SW124 FOR DETAILS)
PROPOSED 300ø SW PIPE REFER DWG 120722-SW132 FOR LONGITUDINAL SECTION
EFFLUENT DISCHARGE PIPE
PROPOSED 225ø SW PIPE REFER DWG 120722-SW131 FOR LONGITUDINAL SECTION
PROPOSED SWMH 3 WITH HYNDS UPFLO FILTER SYSTEM OR STORMWATER 360 STORMFILTER SYSTEM (1 CARTRIDGE) PROVIDING TREATMENT OF RUNOFF FROM ROAD 1 (CH395-480)
OUTLET 2 (REFER DWG 120722-SW141 FOR DETAILS)
POND OUTLET 3 (REFER DWG 120722-SW142 FOR DETAILS)
OUTLET 4 (REFER DWG 120722-SW131 FOR DETAILS)
MANUKAU WATER
DATE 1/07/10
SIGNED FOR RELEASE: AA
HARRISON GRIERSON
MANUKAU WATER LIMITED
KAWAKAWA BAY
WASTEWATER COLLECTION AND TREATMENT
STORMWATER TREATMENT
SWALE 4 AND ROAD (CH290-420)
AND STORMWATER DRY POND
FOR CONSTRUCTION
MASTER
120722-SW113
B

Appendix B. Emergency spill response training register and spill kit inspection

		Training file No.	

Training register

Project name		Project No.	
Equipment / Plant/ section covered by training	Evacuation (fire) 11:23 am ERP training for all sites (desktop Spill training all sites (desktop)		

Attendance register

Name	Signature	Name	Signature
Lasanthi Jayasundara			
Jason S-Coley			
Chris Sinclair			
JONATHAN CHOO			
Robin Mash			
Vijy Vinod			
Sameer Hassan			

Training references material	Training completed
	Training Provider
	Iris Tsoanthe
	Date 2/10/25

Training file No.	

Training register

Project name		Project No.	
Equipment / Plant/ section covered by training	Emergency Response Plan Training DTPUK, DTCBO, DTKAW, DTBEA, DTWHK		

Attendance register

Name	Signature	Name	Signature
Lasanthi J			
JONATHAN C			
Vrju Vinod			
Sanjeeth Reddy			
Sam. Malalasekera			
Ash Kumar			

Training references material	Training completed
	Iris Tscharntke
	Training Provider
	Iris Tscharntke
	Date 5/2/2026

Spill Kit Checklist

Date: 04/05/2026

Process Tech: JONATHAN CINCO

Plant (Circle 1): DTBEA **DTKAW** DTPUK DTWHK DTCBO

Item	Qty Needed	Qty in kit
Wheelie Bin	1	1
Sand Bags or Saw Dust Bags	2	1
Absorbant Mats	20	20
Absorbant Socks	6	2
Rubber Mats	4	0
Brush and Shovel	1	1
XXL Chemical Suit	2	1
Chemical Gloves	1 pair	1
Face Sheild	1	1
Goggles	1	1
Half Mask (with Filters)	1	1
Rubbish Bags	4	4
Cones	6	4
Barrier Tape	1	1

Signed:

Kawakawa Bay effluent treatment site soil monitoring report 2026

August 2026

Anthony Ward, Ahkil Sam Son

Bioeconomy Science Institute Maiangi Taiao

Contract Report registration number: 2627-0025

Prepared for: Watercare Services Ltd

Disclaimer

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Bioeconomy Science Institute

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Group Portfolio Leader – Land Resources and Climate Change
Bioeconomy Science Institute

Contents

Summary iv
1 Introduction 1
2 Objectives 1
3 Methods 1
4 Results and discussion 5
5 Conclusions 9
6 Recommendations 9
7 Acknowledgements 9
8 References 9

Appendix 1 – Consent conditions 11
Appendix 2 – Transect locations and field reference points used for sampling at the Kawakawa Bay effluent treatment site 12
Appendix 3 – Complete soil analysis results for composite soil samples collected from the Kawakawa Bay effluent treatment site 13

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Summary

Project and client

- Watercare Services Limited (Watercare Ltd) engaged the Bioeconomy Science Institute Maiangi Taio (BSI) to assess soil chemical properties at the Kawakawa Bay effluent treatment site (ETS) to fulfil consent requirements associated with their wastewater land application.

Objectives

From established transects:

- collect and analyse soil samples for selected chemical properties
- discuss the results and any changes in soil chemical status
- provide recommendations based on the monitoring results.

Methods

- Sampling was undertaken along seven 20 m long established transects at the Kawakawa Bay ETS. This included 6 wastewater-irrigated transects and an unirrigated reference transect. Transect locations were located first with a handheld GPS, then by reference to sprinkler heads.
- Soil samples were collected at approximately 0 m, 10 m, and 20 m along each transect from a depth of 0–15 cm using a soil corer. The samples were then composited for analysis.
- Soil samples were analysed for pH, electrical conductivity (EC), Olsen phosphorus (Olsen P), phosphate retention (P retention), cation exchange capacity (CEC), exchangeable cations, base saturation, and anaerobically mineralisable nitrogen (AMN) by the BSI Environmental Chemistry Laboratory in Palmerston North.
- Soil pH, Olsen P, and anaerobically mineralisable nitrogen (AMN) results were interpreted using the New Zealand State of the Environment soil quality monitoring guidelines. Electrical conductivity (EC), cation exchange capacity (CEC), exchangeable cations, phosphate retention, base saturation, calculated sodium adsorption ratio (SAR), and exchangeable sodium percentage (ESP) values were interpreted using accepted guidelines (listed in detail in the full report).

Results

- Soil pH values were within the expected range for the soil class and land use.
- Olsen P concentrations were within the target range for plantation forestry soils.
- Exchangeable cation concentrations were predominantly within the very low to medium ranges, consistent with the soil class and land use.
- SAR values were below the threshold associated with soil structural degradation and are unlikely to pose a risk to soil structure.
- ESP values were generally within the sodic soil range (i.e. these soils contained high levels of exchangeable sodium relative to other ions).
- AMN concentrations were generally above the minimum target level for plant growth.

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Conclusions

- Soils are considered sodic at the Kawakawa Bay ETS and may require improvement to prevent soil structural damage.
- There are currently no soil chemical properties that are of immediate concern for ongoing wastewater application.

Recommendations

- Based on our assessments we recommend that Watercare Services Ltd should:
  - continue monitoring soil and wastewater chemistry, particularly sodium levels
  - consider applying gypsum to reduce sodicity and improve soil structure
  - consider measuring soil hydraulic conductivity to support irrigation management.

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1 Introduction

As part of resource consent monitoring for wastewater irrigation at the Kawakawa Bay effluent treatment site (ETS), Watercare Services Limited (Watercare Ltd) engaged the Bioeconomy Science Institute Maiangi Taiao (BSI) to determine a range of soil chemical properties at three sampling locations along each of seven previously established 20 m transects.

Watercare Ltd have a consent from Auckland Regional Council (ARC) to allow the discharge of treated domestic wastewater from the Kawakawa Bay Community Treatment Plant onto the ground at their pine forested Kawakawa Bay ETS (Appendix 1). Soil samples have been collected and analysed from the Kawakawa Bay ETS since 2011, with the BSI (as Manaaki Whenua – Landcare Research [MWLR])[1] collecting and analysing samples since 2014, every 2 years around late autumn to early winter.

This report summarises the 2026 soil analysis results and compares with previous data collected. Previously soil physics samples were collected for dry bulk density measurements. However, following previous recommendations from MWLR (McLeod 2022), bulk density measurements were discontinued in 2024 as they were not required by consent nor were they providing relevant information.

2 Objectives

From established transects:

- collect and analyse soil samples for selected chemical properties
- discuss the results and any changes in soil chemical status
- provide recommendations based on the monitoring results

3 Methods

Soil sampling at the Kawakawa Bay effluent treatment site (ETS) was undertaken on 13 May 2026.

Samples were collected along seven previously established 20 m transects (KKCT5, KKRL3, KKMP1, KKMC4, KKUD2, KKHill1, and KKHill2). Six transects received wastewater irrigation, while KKCT5 remained unirrigated and was used as a reference transect.

Previously, KKCT5 has been designated as a control transect. However, it is not a true control transect because it is located on a different landform from the irrigated transects and is therefore likely to have a different soil type with potentially different physical characteristics, such as water infiltration rates. As such, KKCT5 is referred to in this report as the unirrigated reference transect.

[1] On 01 July 2025 Landcare Research New Zealand Ltd became the New Zealand Institute for Bioeconomy Science Ltd; Manaaki Whenua – Landcare Research (MWLR) operates as an internal group within this Institute, which is less formally known as the Bioeconomy Science Institute Maiangi Taiao or Bioeconomy Science Institute (BSI).

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The transects were initially located by a handheld Garmin 64sx Global Positioning System (GPS) unit (Figure 1) and then identified by reference to the distance and direction from labelled sprinklers (Appendix 2). The start locations of the individual transects are shown in Figure 2.



Figure 1. Example of a labelled sprinkler used to identify and locate transects with the pine forest at the Kawakawa Bay effluent treatment site.

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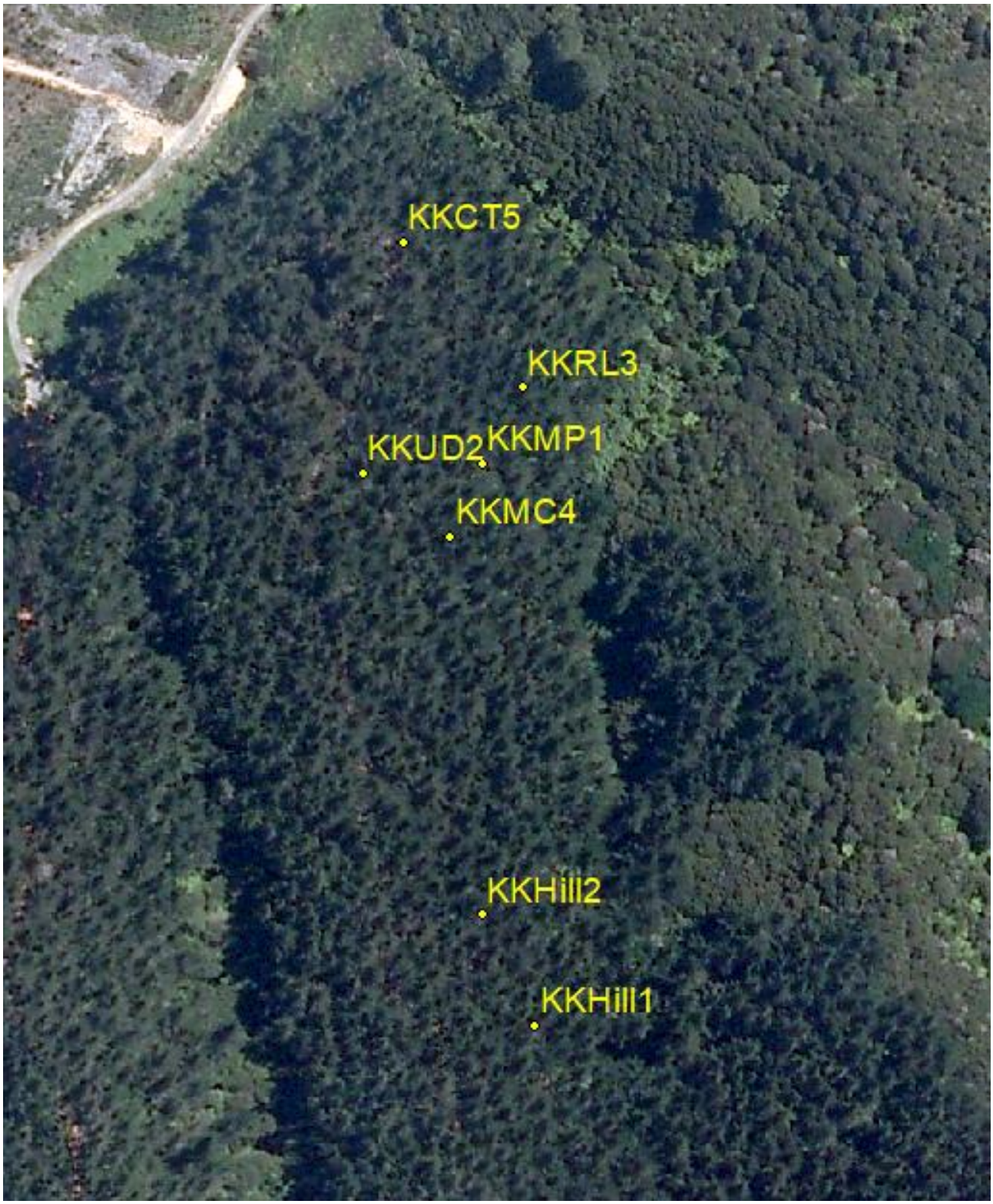

Figure 2. Start locations of the seven monitoring transects within the pine forest at the Kawakawa Bay effluent treatment site.

Soil cores were collected at approximately 0, 10, and 20 m along each transect using a 25 mm diameter soil corer to a depth of 15 cm. Each core was placed in a labelled plastic bag for subsequent compositing and analysis. Samples from the three sampling points along each transect were combined to form a single composite sample, which was stored at 4°C overnight before being dispatched to the BSI Environmental Chemistry Laboratory, Palmerston North, for analysis.

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Samples were analysed for pH, electrical conductivity (EC), Olsen phosphorus (Olsen P), phosphate retention, exchangeable cations (sodium [Na^+], calcium [Ca^{2+}], potassium [K^+], and magnesium [Mg^{2+}]), cation exchange capacity (CEC), base saturation (BS), and anaerobically mineralisable nitrogen (AMN).

Sample results were used to calculate the sodium adsorption ratio (SAR) using the following equation:

$$SAR = Na^+ / \sqrt{0.5 * (Ca^{2+} + Mg^{2+})}$$

The sodium adsorption ratio (SAR) is a measure of the relative concentration of sodium compared with calcium and magnesium in the soil. It is a useful indicator of the potential accumulation of exchangeable sodium (Na^+) in irrigated soils and the associated risk to soil structure. Soil SAR values greater than 6 may indicate an increased risk of clay dispersion, reduced water infiltration, and long-term soil structural degradation (Laurenson & Houlbrooke 2011; Hill Laboratories 2024).

Sample results were also used to calculate the exchangeable sodium percentage (ESP) using this equation:

$$ESP = \frac{Exchangeable\ Na^+}{(Ca^{2+} + Mg^{2+} + K^+ + Na^+)} \times 100$$

Exchangeable sodium percentage reflects the proportion of exchangeable sodium (Na^+) relative to the soil's cation exchange capacity (CEC) and is commonly used to assess the potential effects of sodium on soil structure. The ESP rating categories used in this report are presented in Table 1. According to Laurenson and Houlbrooke (2011), soils with an ESP greater than 6% are considered sodic[2] and may be at increased risk of clay dispersion, reduced permeability, and soil structural degradation.

Table 1. Exchangeable sodium percentage (ESP) ratings used to assess soil sodicity
(Source: Adapted from University of New South Wales 2024.)

	Classification				
	Non-sodic	**Sodic**	**Moderately sodic**	**Strongly sodic**	**Very strongly sodic**
ESP rating	<6	6–10	10–15	15–25	>25

Target ranges used for New Zealand State of the Environment soil quality monitoring for soil pH, Olsen P, and anaerobically mineralisable nitrogen (AMN) are provided by Cavanagh et al. (2023). The remaining soil chemistry parameters, including electrical conductivity, cation exchange capacity, exchangeable cations, phosphate retention, and base saturation, were interpreted using criteria from Blakemore et al. (1987) and Hill Laboratories (2024). In general, lower guideline values indicate conditions where soil productivity may be constrained, whereas upper guideline values reflect thresholds associated with environmental impacts, such as contaminant accumulation or elevated sodium concentrations resulting from wastewater land application.

[2] The ESP of >6% means they contain high levels of exchangeable sodium relative to other ions.

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4 Results and discussion

Table 2 shows the results for selected soil chemical properties for composite soil samples collected from 0–15 cm depths along each transect. Complete soil analysis results are provided in Appendix 3.

pH values: These ranged from 4.6 to 5.9. Excluding the unirrigated reference transect (KKCT5), which had a pH of 4.6, all irrigated transects were within the target range (pH 5.0–6.0) recommended for plantation forestry soils by Cavanagh et al. (2023).

Electrical conductivity: This ranged from 0.05 to 0.09 deciSiemens per metre (dS/m) and fell within the normal range (0.05–0.3 dS/m) for field soils according to Hill Laboratories (2024).

Olsen P concentrations: These ranged from <2 to 17 mg/kg. Excluding the unirrigated transect (KKCT5), which had a concentration of <2 mg/kg, all irrigated transects were within the target range (5–30 mg/kg) for plantation forestry soils recommended by Cavanagh et al. (2023). On average, Olsen P concentrations were slightly lower than those measured in 2024, which were noted to be elevated relative previous monitoring years.

Phosphate retention values: These ranged from 31% to 75%, with medium phosphate retention (30–60%) at KKCT5, KKRL3, KKMP1, KKMC4, KKHill1, and KKHill2, and high phosphate retention (60–80%) at KKUD2 (Hill Laboratories 2024). Because phosphate retention is an intrinsic soil property, it is not expected to change substantially in response to wastewater irrigation. The observed differences between sites were therefore most likely due to natural variation in soil properties, together with sampling location and depth.

Exchangeable calcium concentrations: These ranged from 0.9 to 4.5 cmol(+)/kg. Excluding the unirrigated transect (KKCT5), where the concentration was very low (<2 cmol(+)/kg), all irrigated transects had low calcium concentrations (2–5 cmol(+)/kg) (Blakemore et al. 1987).

Exchangeable magnesium concentrations: These ranged from 0.99 to 2.32 cmol(+)/kg. Excluding the unirrigated transect (KKCT5), which had a concentration of 0.99 cmol(+)/kg and was marginally below the medium range (1–3 cmol(+)/kg), all irrigated transects had medium magnesium concentrations (Blakemore et al. 1987).

Exchangeable potassium concentrations: These ranged from 0.27 to 1.19 cmol(+)/kg, with very low concentrations (<0.3 cmol(+)/kg) at KKCT5 and KKMC4, low concentrations (0.3–0.7 cmol(+)/kg) at KKRL3, KKMP1, KKHill1, and KKHill2, and high concentrations (1.0–2.0 cmol(+)/kg) at KKUD2 (Blakemore et al. 1987).

Exchangeable sodium concentrations: These ranged from 0.18 to 0.65 cmol(+)/kg. Excluding the unirrigated transect (KKCT5), which had a low concentration (0.1–0.3 cmol(+)/kg), all irrigated transects had medium sodium concentrations (0.3–0.7 cmol(+)/kg) (Blakemore et al. 1987).

Monitoring exchangeable sodium is important in wastewater irrigation systems because wastewater often contains elevated sodium concentrations. Over time, sodium can accumulate in the soil and, when present in excess relative to other cations, it can displace calcium and magnesium ions from exchange sites. This process can cause clay dispersion and degradation of soil structure, reducing aggregate stability and leading to a decline in hydraulic conductivity and water infiltration. Consequently, excessive sodium accumulation can have an adverse effect on both soil physical properties and long-term wastewater application performance.

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Sodium adsorption ratio (SAR) values: These ranged from 0.18 to 0.36, with low values (<1) across all transects. Excluding the unirrigated transects, KKCT5, SAR values showed little variation, ranging from 0.33 to 0.36. Overall, SAR values were generally lower than those recorded in 2024 and, importantly, all values were well below the threshold of 6, above which the risk of clay dispersion, reduced soil permeability, and long-term soil structural degradation may increase (Laurenson & Houlbrooke 2011; Hill Laboratories 2024).

Cation exchange capacity (CEC) values: These ranged from 12.5 to 23.7, corresponding to medium values (12–25) across all transects (Blakemore et al. 1987; Hill Laboratories 2024). The Ultic Soils at the Kawakawa Bay ETS are highly weathered and have typically experienced substantial leaching of exchangeable cations over time (Hewitt 2010). Consequently, exchangeable calcium, magnesium, potassium, and sodium concentrations were generally low to medium across the site. The combination of moderate clay content, which contributes to a medium CEC, and relatively low levels of exchangeable base cations helps explain the lower base saturation values observed at some transects.

Base saturation values: These ranged from 11% to 46%, with very low values (<20%) at KKCT5, low values (20–40%) at KKRL3, KKMP1, KKUD2, KKMC4, and KKHill1, and medium values (40–60%) at KKHill2 (Blakemore et al. 1987). These generally low base saturation levels are consistent with the highly weathered Ultic Soils at the site, where prolonged leaching has depleted exchangeable base cations and reduced their occupancy of soil exchange sites.

Exchangeable sodium percentage (ESP) values: These ranged from 7.7% to 10.0%, indicating that the soils were generally sodic (6–10%; Laurenson & Houlbrooke 2011). The ESP values at KKMC4 (10.0%) and KKHill2 (10.0%) were on the boundary between sodic and moderately sodic. Compared with 2024, ESP values generally declined, with previously elevated values (>10% ESP) decreasing towards the sodic range. The narrower range of ESP values in 2026 (7.7–10.0%) compared with 2024 (7.1–16.7%) suggests a reduction in soil sodicity across the monitored sites. However, the elevated ESP values still indicate a higher proportion of sodium relative to other exchangeable cations, such as calcium, magnesium, and potassium, and this may increase the risk of soil dispersion and structural decline over time.

A decline in hydraulic conductivity can occur when ESP values exceed 6% (Laurenson & Houlbrooke 2011). Although all transects were within the sodic range in 2026, ESP values generally decreased compared with 2024, suggesting a reduced risk of sodium-related impacts on soil structure. However, elevated ESP is not always a consequence of wastewater application, since sodicity can also arise from parent material and natural soil-forming processes.

The Ultic Soils present at the Kawakawa Bay ETS are highly weathered and strongly leached, resulting in relatively low concentrations of exchangeable base cations, while also having high clay contents (Hewitt 2010). These characteristics may contribute to inherently elevated ESP values. The comparatively high ESP values measured at the reference transect (KKCT5), despite being the lowest of all transects, suggests that a degree of sodicity is a natural feature of these soils. Nevertheless, the consistently higher ESP values observed across the wastewater-irrigated transects indicate that wastewater inputs are also likely to be contributing to sodium accumulation. Where sodicity becomes a concern, calcium amendments such as gypsum can be applied to replace exchangeable sodium and help maintain or improve soil structure (Laurenson & Houlbrooke 2011).

Given the potential for elevated ESP to adversely affect soil physical properties, consideration should be given to measuring soil hydraulic conductivity at the monitoring sites. This would help determine whether sodicity is affecting soil infiltration. A review of the wastewater irrigation

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application rate may also be warranted, as irrigation rates should not exceed the near-saturated hydraulic conductivity of the topsoil.

Anaerobically mineralisable nitrogen (AMN) concentrations: These were generally above the plantation forestry target level of 20 mg/kg across all the transects, ranging from 20 to 54 mg/kg (See Cavanagh et al. 2023 for target levels). KKHill1 was identified in 2024 as being below the target level at 18 mg/kg and potentially exhibiting a declining trend. However, the current AMN value of 19.8 mg/kg (rounded to 20 mg/kg) represents a slight increase and places the site on the target threshold. AMN values indicate the potential of soil to supply nitrogen to growing plants. While low levels of plant-available nitrogen can limit plant productivity, this is generally of greater concern in intensive cropping systems than in forestry environments (Cavanagh et al. 2023).

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Table 2. Selected soil chemical properties for composite soil samples collected from the Kawakawa Bay effluent treatment site.

Transect	pH	EC	Olsen P	P retention	Exch. Ca^{2+}	Exch. Mg^{2+}	Exch. K+	Exch. Na^{+}	CEC	Base saturation	AMN	SAR	ESP
	1:5 water	ds/m	mg/kg	%	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	%	mg/kg		%
KKCT5	**4.6**	**0.05**	**<2**	**53**	**0.9**	**0.99**	**0.27**	**0.18**	**22.4**	**11**	**23**	**0.18**	**7.7**
KKRL3	5.1	0.09	15	33	4.0	2.08	0.45	0.63	19.3	37	39	0.36	8.7
KKMP1	5.1	0.09	6	35	4.5	2.32	0.37	0.65	20.8	38	43	0.35	8.3
KKUD2	5.6	0.08	3	75	2.8	2.09	1.19	0.57	23.7	28	54	0.36	8.5
KKMC4	5.5	0.06	5	39	2.5	1.28	0.27	0.45	13.9	32	29	0.33	10.0
KKHill1	5.2	0.07	10	31	2.4	1.78	0.36	0.50	14.7	34	20	0.35	10.0
KKHill2	5.9	0.07	17	40	3.3	1.49	0.34	0.57	12.5	46	29	0.36	9.9

EC – electrical conductivity in deciSiemens per metre (dS/m); P – phosphate; Exch. – exchangeable cations in centimoles of positive charge per kg (cmol(+)/kg); CEC – cation exchange capacity; AMN – anaerobically mineralisable nitrogen; SAR – sodium adsorption ratio; ESP – exchangeable sodium percentage. Note**: KCTC5 is shown in bold** as it was the unirrigated reference transect.

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5 Conclusions

- Soils at the Kawakawa Bay ETS were generally sodic, with ESP values ranging from 7.7% to 10.0%. Although ESP values remained elevated, they were generally lower than in 2024.
- All other measured soil chemical properties were within acceptable ranges and are not considered to constrain continued wastewater irrigation.
- Given the sodic ESP values, measuring soil hydraulic conductivity may help determine whether sodicity is affecting infiltration. A review of irrigation application rates may also be warranted.
- Overall, the monitoring results indicate that the site remains suitable for continued wastewater irrigation, with soil sodicity requiring ongoing monitoring and management.

6 Recommendations

Based on our assessments we recommend that Watercare Services Ltd should:

- continue monitoring soil and wastewater chemistry, particularly sodium levels, to prevent excessive sodium accumulation in the soil
- consider applying a calcium source, such as gypsum ($CaSO_4$), to help improve soil structure and reduce sodicity
- consider measuring near-saturated hydraulic conductivity at the next sampling round to inform irrigation management.

7 Acknowledgements

Thank you to Watercare Ltd for arranging access to the sampling sites, and to BSI colleagues for their assistance with field sampling and chemical analyses

8 References

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Appendix 1 – Consent conditions

Land Disposal Area Soil Quality Monitoring

28. That soil samples, shall be taken from the land disposal area and a non-irrigated control area in accordance with the Monitoring Procedures required by Condition 41. The samples shall be analysed for the following parameters:

a)	pH	
b)	Nitrate	gN/m^3
c)	Phosphorus	gP/m^3
d)	Sodium	me/100gm
e)	Calcium	me/100gm
f)	Potassium	me/100gm

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Appendix 2 – Transect locations and field reference points used for sampling at the Kawakawa Bay effluent treatment site

Site	E	N	Notes
KKCT5 (0 m)	2703557	6468331	Start – Unirrigated reference transect.
KKCT5 (20 m)	2703554	6468353	End – Unirrigated reference transect.
KKUD2	2703543	6468252	West to east transect. Starts approximately 10 m southwest of sprinkler 7.1 and crosses sprinkler 9.1 at 18.5 m.
KKMC4	2703573	6468230	Transect runs northeast. Starts 5.5 m northeast of sprinkler 9.3 and ends 6.5 m southwest of sprinkler 11.2.
KKMP1	2703584	6468255	Transect runs east-northeast. Starts 6 m north of sprinkler 11.2 on the pipeline.
KKRL3	2703598	6468281	Transect runs southwest. Starts 5.5 m northeast of sprinkler 13.1 and ends 4 m north of sprinkler 11.1 near the pipeline.
KKHill1 (NW)	2703602	6468062	Approximately 2.5 m from 1.c4.3.
KKHill1(SE)	2703606	6468056	Approximately 2 m from C404.
KkHill2 (NW)	2703584	6468100	Approximately 2 m west of 1c.2.2.
KKHill2 (SE)	2703590	6468093	Approximately 3 m north of 1c.2.3.

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Appendix 3 – Complete soil analysis results for composite soil samples collected from the Kawakawa Bay effluent treatment site

Transect	Water content	Air dry soil water content	pH	EC	KCl-extractable		AMN	Olsen P	Phosphate retention	Exchangeable				CEC	Base saturation
					NO_3-N	NH_4-N				Ca	Mg	K	Na		
	% dry wt	%	1:5 water	1:5 dS/m	mg/kg	mg/kg	mg/kg	mg/kg	%	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	%
KKCT5	**37**	**2.3**	**4.6**	**0.05**	**<2**	**<2**	**23**	**<2**	**53**	**0.9**	**0.99**	**0.27**	**0.18**	**22.4**	**11**
KKRL3	46	2.0	5.1	0.09	<2	<2	39	15	33	4.0	2.08	0.45	0.63	19.3	37
KKMP1	59	2.1	5.1	0.09	<2	<2	43	6	35	4.5	2.32	0.37	0.65	20.8	38
KKUD2	57	3.3	5.6	0.08	<2	3	54	3	75	2.8	2.09	1.19	0.57	23.7	28
KKMC4	43	1.8	5.5	0.06	<2	3	29	5	39	2.5	1.28	0.27	0.45	13.9	32
KKHill1	41	1.8	5.2	0.07	<2	2	20	10	31	2.4	1.78	0.36	0.50	14.7	34
KKHill2	46	1.6	5.9	0.07	<2	7	29	17	40	3.3	1.49	0.34	0.57	12.5	46

EC – electrical conductivity in deciSiemens per metre (dS/m); P – phosphate; Exchangeable – exchangeable cations in centimoles of positive charge per kg (cmol(+)/kg); CEC – cation exchange capacity; AMN – anaerobically mineralisable nitrogen. Note**: KCTC5 is shown in bold** as it was the unirrigated reference transect.

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Appendix C. Compliance assessment

Assessment of compliance with consent conditions - discharge to air (#30829)

Condition Number	Consent Condition Kawakawa Bay Discharge to Air (#30829)	Compliance Rating	Comments
01	ARC agents may access the property at reasonable times to carry out inspections, surveys, tests, or measurements, or to take samples.	1	Compliant. Most recent inspection undertaken on 29 May 2024.
02	Consent Holder shall design, build and operate the plant and associated processes in accordance with the documentation submitted to the Council as part of application number 30829, where not amended by the conditions of this resource consent. No alterations shall be made to the plant or processes that do not, or are not likely to, comply with the provisions of this consent, a regional rule, or regulations under the RMA 1991.	1	Completed and confirmed by OMP.
03	Consent Holder shall ensure that the design, construction and operation of all plant and processes undertaken on site shall be in accordance with currently recognised good practice for wastewater treatment plants. In particular, the design of the plant shall ensure compliance with the provisions of this consent. Furthermore, the plant shall be designed and constructed so as to ensure that discharges of contaminants to air, in particular odour, are kept to a practicable minimum.	1	Completed and confirmed by OMP.
04	All operations which have the potential for dust emissions, including construction activities, shall be carried out in a manner which ensures that dust emissions are generally maintained at the minimum practicable level. Without limiting the generality of this condition, the Consent Holder shall suppress dust emissions by the application of water whenever weather conditions and activities are such that significant visible dust emissions may or do occur.	1	Ongoing.
05	Except during maintenance, cleaning, or other inspections, the inlet screens, and sludge storage tanks shall be kept closed to ensure fugitive discharges to atmosphere are kept to a minimum practicable level.	1	Ongoing.
06	Consent Holder shall maintain and operate the balance tanks so as to ensure that anaerobic conditions do not develop within the balance tanks. The balance tanks shall be kept closed, except during maintenance, cleaning or other inspections, to ensure fugitive discharges are kept to a minimum practicable level.	1	Ongoing.
07	All emissions control equipment shall be maintained in good working condition and shall be operating whenever the relevant part of the process is operating.	1	Ongoing.
08	All ducting and emissions control equipment shall be maintained in good condition and be free from leaks in order to prevent fugitive discharges to atmosphere.	1	Ongoing.

Condition Number	Consent Condition Kawakawa Bay Discharge to Air (#30829)	Compliance Rating	Comments
09	All relevant fans and ducting to air emission control equipment shall draw sufficient negative pressure to ensure that fugitive emissions are kept to a practicable minimum.	1	Ongoing.
10	The aeration pumps for the aerobic tanks shall draw sufficient air from the inlet screen enclosure to prevent the discharge of odour into air from this enclosure.	NE	Ongoing.
11	Screenings shall be disposed of off site to an appropriately authorised facility.	1	Screenings bags are taken to the Beachlands WWTP and collectively disposed to landfill.
12	No solid or liquid waste materials shall be disposed of on the site by open burning.	1	Compliant.
13	Consent Holder shall give consideration to wind direction and the proximity of neighbouring properties prior to undertaking any potentially odorous activities on the site.	1	Ongoing.
14	All sludge removal from the sludge storage tanks shall be carried out in a manner that minimises odour.	1	Ongoing using sucker truck and hoses.
15	Consent Holder shall at all times operate, maintain, supervise, monitor and control all processes on site so that emissions authorised by this consent are maintained at the minimum practicable level.	1	Ongoing.
16	Beyond the boundary of the site there shall be no odour, dust, particulate, smoke, ash or fume caused by discharges from the site which, in the opinion of an enforcement officer, is noxious, dangerous, offensive or objectionable.	1	Did not occur.
17	No discharges from any activity on site shall give rise to visible emissions, other than water vapour and steam, to an extent which, in the opinion of an enforcement officer, is noxious, dangerous, offensive, or objectionable.	1	Did not occur.
18	Beyond the boundary of the site there shall be no hazardous air pollutant caused by discharges from the site, which is present at a concentration that is, or is likely to be, detrimental to human health or the environment.	1	Did not occur.
19	Without limiting the generality of Conditions 15 to 18, the dissolved oxygen level within the aerobic treatment tank shall be maintained above 1 mg O/l at all times. Provision shall be made to aerate the seasonal lagoon in the event that offensive odour occurs.	1	Ongoing PLC controlled set point at 2 mg O_2/L.

Condition Number	Consent Condition Kawakawa Bay Discharge to Air (#30829)	Compliance Rating	Comments
20	A walkover inspection of the site shall be undertaken at least twice every week to identify any odours that may be originating from the site. Any evidence of significant odour shall be recorded and investigated. Where necessary, remedial actions shall be undertaken as soon as practicable to reduce odour discharges. The procedures for the walkover, recording of the results and any remedial actions taken shall be as specified in the AQMP.	1	Ongoing by the duty plant operator.
21	All information required under this consent will be consistent with the requirements of Consent 30833. and in particular the requirements within the Operations Management Plan of that consent. Further, all Plans required under this consent will be included as an appendix to the Operations Management Plan as required by Consent 30833.	1	Compliant.
22	All records, monitoring and test results that are required by the conditions of this consent shall be made available on request, during operating hours, to an enforcement officer and shall be kept for a minimum period of 12 months from the date of each entry.	1	Compliant.
23	Consent Holder shall notify an enforcement officer as soon as practicable in the event of any significant increase in the discharge of contaminants to air, which may result in adverse effects on the environment. In the event of an incident, shall provide a written report to the Manager within 7 days of the occurrence. The report shall give reasons for the incident, any remedial actions taken and any mitigation measures taken to prevent its reoccurrence.	1	Not required as condition trigger did not occur.
24	Consent Holder shall log all air quality complaints received. The complaint details shall include: a) date, time, location and nature of the complaint; b) weather conditions at the time of the complaint; c) name, phone number and address of the complainant, unless complainant refuses to supply these details; and d) any remedial actions undertaken.	1	No complaints received.
25	An annual Performance Report detailing and summarising the plant performance and consent compliance and with the Air Quality Management Plan (AQMP) shall be submitted to the Manager by 31 May each year. The report will be consistent with that required in the Operations Management Plan required by Consent 30833.	1	Compliant. Report submitted by 30 September to maintain consistency with Consent 30833.
26	Consent Holder shall prepare and maintain an AQMP, which specifies all management and operation procedures necessary to comply with the conditions of this consent. The AQMP shall include but not be limited to details listed in a) to h) of the consent condition.	1	Compliant. AQMP is an appendix of the OMP.

Condition Number	Consent Condition Kawakawa Bay Discharge to Air (#30829)	Compliance Rating	Comments
27	Consent Holder shall submit the AQMP to the Manager for review 3 months prior to exercising this consent. Any subsequent changes to the AQMP shall be submitted to the Manager within 1 month of the changes being made. The Manager will advise the Consent Holder in writing if any aspects of the AQMP are considered to be inconsistent with achieving the conditions of this consent.	1	No changes to AQMP since the last submission in July 2016.
28	Conditions of this consent may be reviewed by the Manager pursuant to Section 128 of the RMA 1991, by the giving of notice pursuant to Section 129, one year after the commissioning of the last component of the plant and in June every two years after.	1	Compliant.

Assessment of compliance with consent conditions - discharge to land (#30833)

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
01	ARC agents may access the property at reasonable times to carry out inspections, surveys, tests, or measurements, or to take samples.	1	Compliant. Most recent inspection undertaken on 29 May 2024.
02	Consent Holder shall, as far as practicable, design, construct and operate the plant and associated processes in accordance with the documentation submitted to the Council as part of Application Number 30833 and with the conditions of this consent. No alterations shall be made to the plant or processes that do not, or are not likely to, comply with the provisions of this consent, a regional rule, or regulations under the RMA 1991.	1	Compliant.
03	The maximum allowable discharge of treated domestic wastewater effluent to land is 800m^3/day but not exceeding irrigation rates given in Condition 16 when applied to areas shown on the drawing (Woodmetrics; 2007) contained in Appendix 1.	1	Daily discharge volumes were well below the consent maximum.
04	No new trade wastes, as defined in s 489 of the LGA 1974, that may compromise the treatment plant performance shall be permitted to be discharged into the treatment plant.	1	Covered by Trade Waste bylaw.
06	If subsurface archaeological evidence should be unearthed during construction (eg intact shell midden, hangi, storage pits relating to Maori occupation, or cobbled floors, brick or stone foundation, and rubbish pits relating to 19th C European occupation, or artefacts relating to Maori or European occupation), work should cease in the immediate vicinity of the remains. The Historic Places Trust, the project archaeologist and tangata whenua should be contacted so that appropriate action can be taken. The appropriate persons must be afforded a reasonable time to record and recover archaeological features and/or artefacts discovered before work may commence. If modification of an archaeological site is necessary, an Authority to modify must be applied for under s 12 of the NZ Historic Places Act 1993 (a legal requirement). In the event of human remains being uncoverde, work should cease in the immediate vicinity and the tangata whenua, Historic Places Trust and NZ Police should be contacted so that appropriate arrangements can be made.	1	Completed and the condition trigger did not occur during construction.
07	Consent Holder shall install a spray irrigation land disposal system within the Pine forest and future Eucalyptus plantings in the area shown on the drawing (Woodmetrics; 2007) contained in Appendix 1.	1	Completed and in operation.
08	Consent Holder shall install if necessary surface and/or subsurface diversion drains upslope from the wastewater land disposal systems to divert stormwater runoff away from the land disposal areas.	1	Stormwater diversion drains were not necessary.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
09	Consent Holder shall install soil moisture probes within the spray irrigation areas and record the soil moisture level in accordance with procedures specified in the Wastewater Disposal Area Management Plan as required by Condition 42 to allow determination of the suitability of soils for wastewater irrigation.	1	The soil moisture probes were installed and commissioned. A review found some probes continuously failing and the data collected not representative. The review was submitted to Council. Council approved that there was no further need to have the probes in place and that visual inspections were more beneficial.
10	Consent Holder shall fence the Glen Forest property to discourage access and appropriately signpost the area to warn that wastewater irrigation is undertaken on site.	1	Completed and signage in place.
11	An alternative power supply shall be installed with sufficient capacity to operate the primary processes of the treatment plant.	1	Completed and generator in place.
12	The design and installation of the wastewater treatment disposal system shall be carried out under the supervision of a chartered professional engineer experienced in wastewater treatment and land disposal systems.	1	Compliant.
13	Consent Holder shall retain a trained Wastewater Treatment Plant operator to operate the plant. The operator shall have undergone wastewater training and attained a minimum of "National Diploma in Wastewater Treatment" under the framework of the NZ Qualifications Authority (or equivalent to B Grade Operator) or with the equivalent qualification or experience, who has been approved in writing by the Manager, for the ongoing maintenance of the treatment and disposal systems.	1	Ongoing.
14	Consent Holder shall ensure that appropriate persons shall be available and shall respond as soon as practicable to any alarm sounding or to any other indication of an emergency arising from the wastewater treatment and disposal system 24/7. Contact information for appropriate personnel in the event of an alarm sounding shall be incorporated into the Operations Management Plan.	1	Ongoing.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
15	Consent Holder shall always operate the wastewater treatment system to maximise opportunities for discharge to land as permitted under this consent and only discharge to Rautawa Stream (as permitted under Consent 33143) when land disposal is not practicable.	1	Ongoing. No discharges required to Rautawa Stream during the reporting year 2025-2026.
16	Consent Holder shall irrigate the treated wastewater to land at area loading rates not exceeding the following rates. Consent Holder may apply to the Manager to increase these irrigation rates following further investigation required in Condition 33. Areal Irrigation Rates: slope angle (degrees) at 0-20: 2.6mm/day in summer, 1.7mm/day in winter. Slope angle at 20-30: 1.5mm/day in summer, 1.2mm/day in winter. Nominal Application Rate: 0.3mm/hour across the entire site.	1	Compliant.
17	Consent Holder shall ensure that the potential for runoff of irrigated wastewater into surface water is minimised.	1	Achieved through optimisation of irrigation blocks.
18	Consent Holder shall ensure that a minimum separation distance between the maximum throw from spray nozzles and any surface water and property boundaries shall be no less than 10.0 metres, unless monitoring undertaken in accordance with Condition 40 indicate adverse effects. The spray irrigation system shall be installed and operated to minimise spray drift under all weather conditions.	1	Spray system had been designed to meet the condition.
19	Consent Holder shall maintain the system in an efficient and professional manner, in accordance with the Operations Management Plan and the conditions of this permit, to ensure that if functions efficiently and subject to resource consent requirements shall ensure that any works necessary for this are undertaken.	1	Ongoing.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
20	Consent Holder shall: i) consult with tangata whenua and representatives of local residents (including the Kawakawa Residents Association) to facilitate the establishment of a Community Committee as soon as practicable after the consent becomes operative; ii) invite representatives from the following to attend meetings under this condition: Clevedon Community Board, Kawakawa Residents Association, Tangata whenua, community in general, Manukau Water Ltd, Manukau City Council, ARC; iii) the purpose of the Committee shall be to discuss matters relevant to the installation, operation and maintenance of the wastewater treatment system including, but without limitation, any concerns and complaints of residents and visitors and the timeliness and method of alleviating them; iv) Manukau Water Ltd shall ensure its representatives attend meetings of the Committee which should be held on a 6-monthly basis for the first 2 years and annually thereafter; v) at the meetings, Manukau Water Ltd shall disseminate information to the Committee about the oepration of the wastewater treatment system including the results of any monitoring and the timing and extent of any discharges of treated effluent to the Rautawa Stream; vi) the Community Committee set-up required by this condition is also required of Manukau Water Notice of Requirement No. 20 February 2007 and shall be the same.	1	Compliant.
21	The quality of treated wastewater as determined by the analyses required by Conditions 24, 25, 26 and 27 shall comply with the following standards: faecal coliforms - median no more than 1000cfu/100mls; e. coli - median no more than 1000cfu/100mls.	1	Compliant.
22	Consent Holder shall continuously measure and record effluent discharge flow volume to and from the treatment plant and to each part of the disposal field. The flow measuring device shall be capable of providing cumulative measurements to an accuracy of plus or minus 5% and shall be maintained in accordance with the manufacturer's specifications at all times.	1	Recorded in SCADA.
23	Stream sampling shall be undertaken in accordance with the Receiving Environment Monitoring Plan (REMP) required by Condition 40.	1	Ongoing sampling and testing at Stream Site 3 and 6. Site 7 was removed from the monitoring schedule as approved by Council.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
24	Consent Holder shall collect an effluent sample from the permeate tank at fortnightly intervals, in accordance with the Monitoring Procedures required by Condition 41. The sampling frequency may be decreased following at least one year of complete readings which satisfy the conditions of this consent, subject to written approval for a decreased monitoring frequency being provided by the Manager.	1	Our consent sampling is not scheduled fortnightly instead consent sampling is scheduled for every 2nd and 4th Wednesday. This sampling regime was established to facilitate the consistent sampling of the eight southern WWTPs.
25	The samples shall be analysed for the following parameters: a) nitrate gN/m3; b) dissolved reactive phosphorus gP/m3; c) faecal coliforms cfu/100ml; d) e. coli cfu/100ml; e) sodium mg/l; f) magnesium mg/l; g) calcium mg/l; h) pH; i) ammoniacal nitrogen mgN/l. Consent Holder shall sample for pH and Ammoniacal Nitrogen only for the months of May to October inclusive.	1	Ongoing.
26	All sample analyses shall be undertaken to the detection limits identified and the results reported in the units specified in the appended table (Appendix 2).	1	Ongoing.
27	Any samples collected shall be collected and analysed in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater", APHA, AWWA, WPCE, or equivalent approved in writing by the Manager.	1	Compliant.
28	Soil samples shall be taken from the land disposal area and a non-irrigated control area in accordance with the Monitoring Procedures required by Condition 41. The samples shall be analysed for the following parameters: a) pH; b) nitrate gN/m3; c) phosphorus gP/m3; d) sodium me/100gm; e) calcium me/100gm; f) potassium me/100gm.	1	Soil sampling and testing was conducted in May 2026 by the Bioeconomy Science Institute Maiangi Taiao. The next survey will be in 2028.
29	Consent Holder shall monitor and record daily rainfall levels within the proximity of the treatment plant and land disposal area at the same time of each day.	1	Ongoing
30	Consent Holder shall inspect the irrigation fields that are in use on every second week to ensure they are operating correctly.	1	Ongoing.
31	Consent Holder shall undertake detailed irrigation trials over at least a 2-year period to reassess the site specific irrigation application rates and regimes.	1	Trials completed in previous years and suspended until flows reach an average flow of 120 m^3/day.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
32	Within one month of commissioning the entire plant, the Consent Holder shall advise the Manager in writing that the works are completed and commissioned.	1	Completed by Fulton Hogan.
33	Consent Holder shall prepare an Operations Management Plan (OMP) for the entire wastewater collection, treatment and disposal system as required under Consents 31272, 30830, 30832, 30833, 33143. Any plan, report or procedure required under the above mentioned consents shall be incorporated into or included as an appendix to the OMP - refer to Appendix 3. For a list of specifications, see consent condition.	1	Final OMP Doc Ref 9 was issued in May 2012, revised 2015-2016.
34	Wastewater Inspection and Maintenance Procedure shall outline the inspection and maintenance practices and procedures to be adopted to ensure compliance with Consents 30833 and 33143. It shall as a minimum address the following: i) inspection and maintenance program, including schedules and logs, designed to verify the correct functioning of the whole wastewater treatment and disposal system; ii) identification of staff and/or contractor responsibilities; iii) quality control procedures.	1	Ongoing.
35	Consent Holder shall record all complaints received. Recorded details shall include name, date, nature of complaint, contact details, response time and outcome of the resolution.	1	Ongoing.
36	Consent Holder will provide IPENZ Producer Statements - PS1 and PS4, within 3 months of commissioning of the works that includes the treatment plant and disposal area.	1	Overridden by contract requirements.
37	Consent Holder shall supply to the Manager within 3 months of completion of the system drawings, which shall be certified as "As-Built" by a Chartered Engineer. The drawings shall include, but not be limited to: i) surveyed locations and elevations of all structures (pipes, drains, catchpits, treatment practices, discharge structure), which shall be measured to the nearest 0.1 metre with co-ordinates expressed in terms of the NZ Transverse Mercator and the LINZ datum; ii) plans and cross sections of all stormwater management devices, including confirmation of the Water Quality Volume, storage volumes and levels of any outflow control structure; iii) location, dimensions and levels of the major overland flowpaths including cross sections and long sections; iv) documentation of any discrepancies between the approved design plans and the As-Built drawings.	1	Completed.
38	Contingency Plan: Consent Holder shall develop a plan for contingency and incident response planning to avoid non-compliance with Consents numbered 31272, 30830, 30832, 30833, 33143 and shall as a minimum describe in detail the items listed in i) to vi) in the consent condition.	1	Completed.
39	Performance Report - see consent for details	1	Compliant.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
39a	Performance Report - An annual performance report to be submitted by 30 September each year and shall: i. Include all annual reporting requirements from Consents 31272, 30830, 30831, 30832, 30833, 33143 ii. Collate, analyse and interpret all relevant data and information for the year. iii. Include comment on general plant performance and any trends in changes in the discharge volume and/or the discharge quality standards over time. iv. Include a consideration of compliance with each consent condition. v. Make recommendations and submit timetable to rectify any non-compliance. vi. Be based upon a template included in the Operations Management Plan	1	Compliant.
40	Consent Holder shall develop and submit to the Manager for approval a comprehensive REMP that is designed to assess the effects on the Rautawa Stream and the Kawakawa Bay in the vicinity of the Stream outlet from the exercise of Consents 31272, 30830, 30831, 30832, 30833, 33143. Both public health and ecological aspects will be included with the Plan. The Plan shall enable the objective of determining the effects of effluent discharges on the receiving environment ecosystems of the Rautawa Stream and the CMA to be met. Particular emphasis will be placed upon investigation of the effects of nutrients. An annual Impact Assessment Report detailing the results and interpretation of the REMP shall be provided to the Manager by 30 September each year.	1	The annual Ecological Monitoring Rautawa Stream and Coastal Marine Area were undertaken in March 2026. Next monitoring is due in 2028.
41	Monitoring procedures: these procedures shall outline the practices and procedures with respect to monitoring and reporting of Consents 30833 and 33143 to be adopted to demonstrate ongoing compliance with the conditions of this consent and shall as a minimum address the following: i) location and type of monitoring equipment; ii) maintenance and calibration of monitoring equipment; iii) schedule and log of monitoring requirements; iv) methods and quality control procedures for sampling and analyses; identification of staff and or contractor responsibilities.	1	Completed.
42	Wastewater Disposal Area Assessment Plan: Consent Holder shall engage a consultant experienced in wastewater land disposal systems and soil quality to develop this Plan which will include: i) the requirements of the trial as required by Condition 31; ii) determination of the exchangeable sodium percentage and sodium absorption ratio; iii) assessment of the quality of the treated effluent discharged to land; iv) assessment of the effects that wastewater is having or may behaving on the quality of the soils within the disposal areas; v) assessment of the irrigation regime in general and the loading rates in particular; vi) a requirement for annual reporting within the Performance Report.	1	Completed.
43	Landscape and Planting Plan: prior to any works commencing on the site, Manukau Water Ltd shall prepare and submit to the Manager for approval a landscape plan for the site. See consent condition, items a) to d) for further detail.	1	Completed.

Condition Number	Consent Condition Kawakawa Bay Discharge to Land (#33083)	Compliance Rating	Comments
44	Conditions of this consent may be reviewed by the Manager pursuant to Section 128 of the RMA 1991, by the giving of notice pursuant to Section 129, one year after the commissioning of the last component of the plant and in June every two years after.	1	Compliant.

Appendix D. Data sources

Download location of environmental monitoring & operational data used in this report.

Category	Parameter	Source platform	Tag/ID
Effluent volume	N/A	Pi	DTKAW_49_FQ_150_VOLUMEDAY
Irrigation volume	EDF 1	Pi	DTKAW_49_FQ_150_B1VOLDAY
Irrigation volume	EDF 2	Pi	DTKAW_49_FQ_150_B2VOLDAY
Irrigation volume	EDF 3	Pi	DTKAW_49_FQ_150_B3VOLDAY
Irrigation volume	EDF 4	Pi	DTKAW_49_FQ_150_B4VOLDAY
Effluent quality	E. Coli	Pi	DTKAW_52_15_FE_ECOLMTEC
Effluent quality	Faecal Coliforms	Pi	DTKAW_52_15_FE_FC
Effluent quality	Nitrate	Pi	DTKAW_52_15_FE_NO3
Effluent quality	Calcium (Total)	Pi	DTKAW_52_15_FE_Ca-tot
Effluent quality	DRP	Pi	DTKAW_52_15_FE_DRP
Effluent quality	Mg(Total)	Pi	DTKAW_52_15_FE_Mg-tot
Effluent quality	Na(Total)	Pi	DTKAW_52_15_FE_Na-tot
Effluent quality	pH	Pi	DTKAW_52_15_FE_pH
Effluent quality	NH3-N	Pi	DTKAW_52_15_FE_TNH3N
Aerobic Tank DO	Dissolved Oxygen	Pi	DTKAW_45_AIT_040_PV