Incident Investigation Report: Porirua Faecal Coliforms Non-Compliance (8-9 July and 22-24 July 2024)

CONTROL SHEET

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INCIDENT DETAILS

Dates	8-9 July 2024 and 22 - 24 July 2024
Location	Porirua WWTP
Description	According to Condition 35(A) of the Resource Consent WGN200229 [36816], Porirua WWTP became non-compliant with faecal coliforms count in the final effluent. The faecal coliforms were above 2000 cfu/100mL limit on two or more consecutive days from 7th until 8th July 2024 and from 22nd until 24th July 2024. The geometric means of daily results were as follows: 7 July - 12,410 cfu/100mL 8 July - 3,391 cfu/100mL 22 July - 2,045 cfu/100mL 23 July - 2,145 cfu/100mL 24 July - 7,348 cfu/100mL
Cause	Effluent penstock of the Duron UV system failed on 5 June and to achieve reliable operation of the disinfection step, TAK UV system was put in operation as a duty system. However, the data show that the TAK UV system has a lower disinfection efficiency which appears as one of the contributing factors to the increased faecal coliforms in the final effluent.
	Pre-UV faecal coliforms counts were elevated during the month of July compared to the 2024 year's average. This resulted in increased load on the UV system.
	During 22-24 July, Total Suspended Solids concentration in the final effluent was slightly above the average values. In combination with lower TAK system performance, this could have contributed to the increased faecal coliforms counts. It is important to note, that the increase in TSS was only minor without negative effect on the final compliance for TSS in the final effluent.
Actions	Investigation conducted and cleaning frequency of the TAK UV system was increased.
	Corrective actions were defined and details are provided on page 12.
Impacts	Breach of Resource Consent WGN200229 [36816], Condition 35(A)
	Potential contamination of the coastal marine area (CMA) that could impact human health.

TIMELINE

The following is a list of events and when they occurred:

Date	Event
5 June 2024	Duron UV system effluent penstock failed. TAK operation initiated during unmanned site hours
21 June 2024	TAK UV system lamps clean performed
2 July 2024	Duron UV system lamps clean performed
8 July 2024	Daily results Geometric Mean exceeded limit of 2000 cfu/100 ml (12410 cfu/100 ml)
9 July 2024	Daily results Geometric Mean exceeded limit of 2000 cfu/100 ml (3391 cfu/100 ml)
22 July 2024	Daily results Geometric Mean exceeded limit of 2000 cfu/100 ml (2045 cfu/100 ml)
23 July 2024	Daily results Geometric Mean exceeded limit of 2000 cfu/100 ml (2145 cfu/100 ml)
24 July 2024	Daily results Geometric Mean exceeded limit of 2000 cfu/100 ml (7348 cfu/100 ml)

PROCESS/QUALITY CONTROLS

Factors described below were considered to contribute to the increased faecal coliforms counts.

UV disinfection system performance

Figure 1 shows pre-UV faecal coliforms counts during the month of July. Orange line represents an average value for the year 2024 (201,269 cfu/100 ml).
Pre-UV faecal coliforms counts are analysed twice a week (Tuesdays and Thursdays) and during the investigated period (8-24 July) the average value increased significantly which indicates increased demands on the UV disinfection systems. Log removal was calculated when data available and results show that on 9 July, the log removal was 3 indicating very good UV performance however the final faecal coliforms count was above the limit of 2000. The pre-UV sample for this day shows a value of 4,000,000 cfu/100 mL which is a significant increase and can explain why the UV system was not able to achieve the below-limit value. Log removal value from 23 July shows value of 2, which is under the expected optimum removal indicating other contributing factors. One of which is increased suspended solids content (details below).

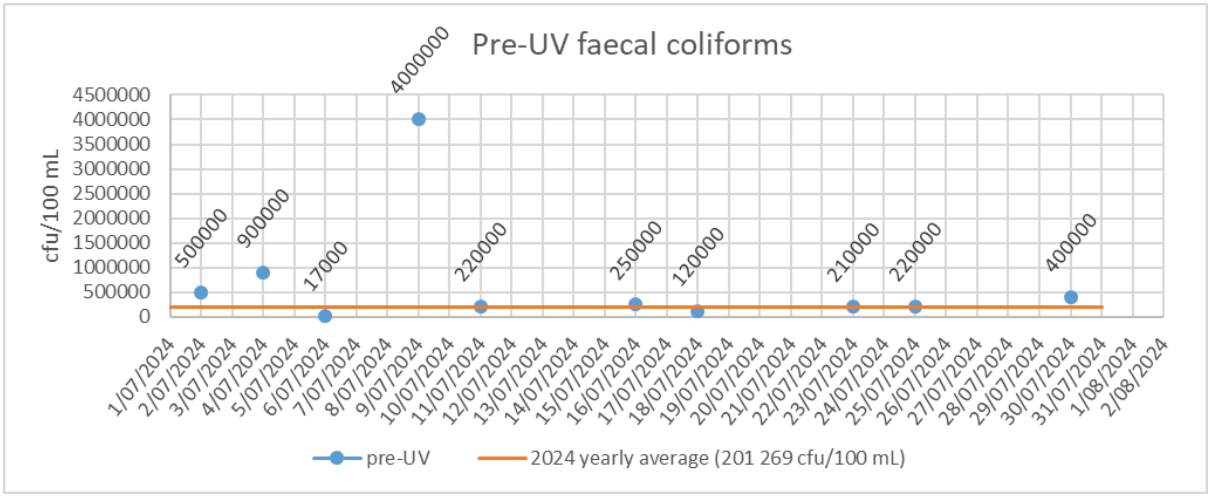

Figure 1: Pre-UV coliforms

Table 1 provides a summary of results for pre-UV and post-UV faecal coliforms counts and log removal calculations.

Table 1: Pre-UV coliforms

Date	pre-UV (cfu/100 ml)	pre-UV (cfu/100 ml)	Log removal
8 July 2024		12410	
9 July 2024	4000000	3391	3.1
22 July 2024		2045	
23 July 2024	210000	2145	2.0
24 July 2024		7348	

One of possible explanations for the increased pre-UV counts can be lower dissolved oxygen (DO) concentrations in the biological treatment step. Trends for DO were analysed and no significant change for July was noticed. See figure 2 below.

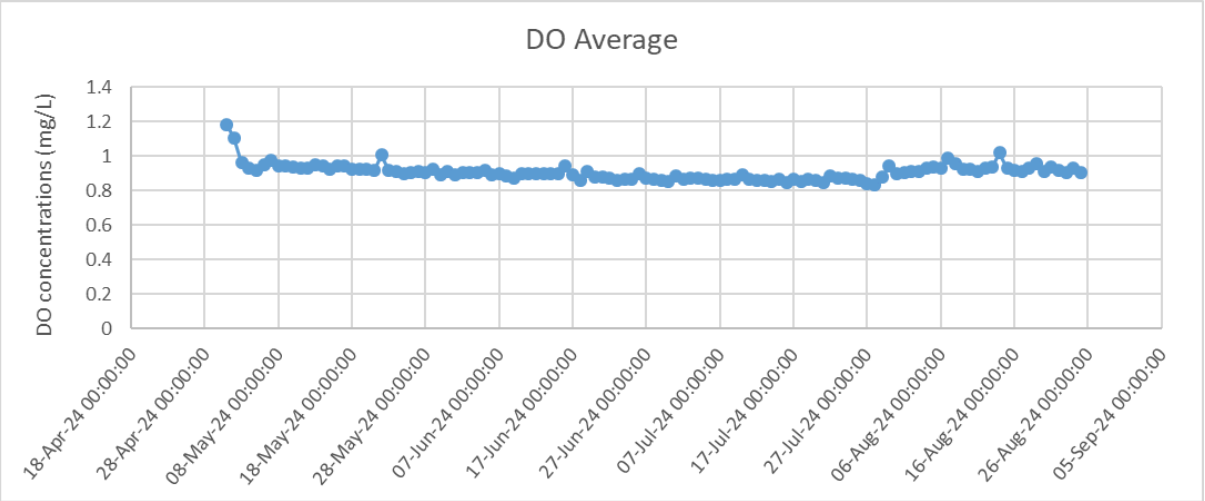

Figure 2: Dissolved Oxygen (DO) concentrations

Effluent quality

Total suspended solids content

UV removal efficiency is directly dependent on the final effluent quality. Solids present in the wastewater absorb the UV light reducing pathogens' removal efficiency. Final effluent quality results for the 8 and 9 July do not show a decrease in the effluent quality. Results for 22-24 July show slightly increased values of TSS. Considering that the disinfection efficiency of the TAK system is overall lower compared to the Duron system, this minor increase can significantly contribute to TAK's lower performance. Please note, that even though the concentrations of TSS were higher than normal, the effluent quality remained compliant with no significant negative effect on the GeoMetric Mean or Percentile values of TSS.

Table 2: Effluent quality

Date	Total Suspended solids (g/m3)			Biochemical Oxygen Demand- 5 days (g/m3)			UVT- lab (%)
	Daily results	90 days GeoMean	90 days 90th Percentile	Daily results	90 days GeoMean	90 days 90th Percentile	
8 July 2024	6	7.1	7.0	7	9.8	24.1	65
9 July 2024	6	7.1	7.0	5	9.9	24.1	64
22 July 2024	14	7.1	12.1	15	11.4	25.2	63
23 July 2024	15	7.2	13.1	15	11.6	25.2	63
24 July 2024	21	7.3	14	12	11.6	25.2	63

UV Transmittance

Effluent UVT is a parameter which provides information on the final effluent quality. As the UVT probe used for monitoring is located in the Duron system only, it has not provided representative readings due to the channels' changeovers. Consequently, the values cannot be reliably used in this investigation. A separate investigation providing more details on the UVT probe was submitted on 12 August 2024. The laboratory results for UVT (grab samples) do not show any significant decrease in the effluent quality.

Effluent flows

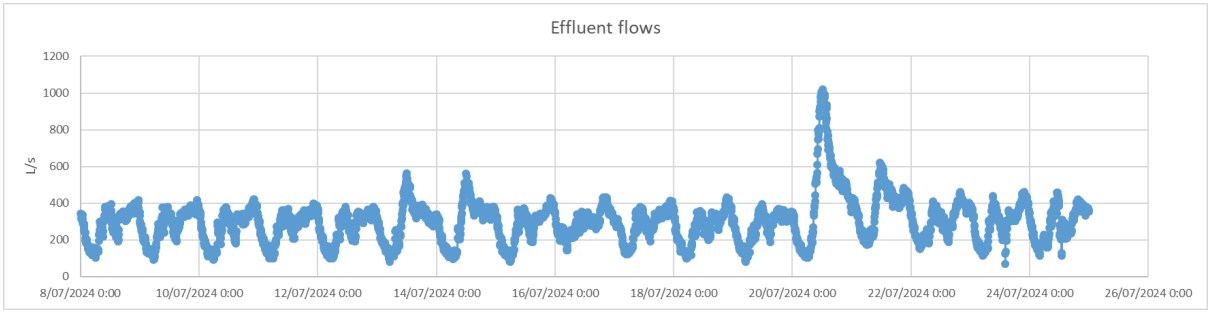

Figure 3: Effluent flows for July 2024

Flows during the investigated period were of average values. High flow events may be a contributing factor to decreased effluent quality; however, considering the average flows aligned with stable effluent quality, it is expected that the higher flows did not have a negative effect on the UV disinfection performance.

ABSENT / FAILED DEFENCES

Duron and TAK UV system operation

After technical issues with the Duron UV System effluent penstock on 5 June, the penstock i.e. operation of the Duron UV system was deemed unreliable. To minimise the risk of non-disinfected discharge, TAK UV system was put on duty when the plant was unmanned. The Duron UV system has been in operation when the site is manned.

Based on the data for the year 2024, there is a difference in the UV systems removal efficiency. Average log removal values are 3.2 and 2.2 for Duron and TAK UV systems respectively indicating lower disinfection performance of the TAK system.

To maintain consistent conditions during the samples collection, the sample is collected from the duty channel (TAK) and the UV system changeover is performed subsequently.

Both UV systems are operated with 100% output to provide maximum disinfection efficiency possible (see figure 4).

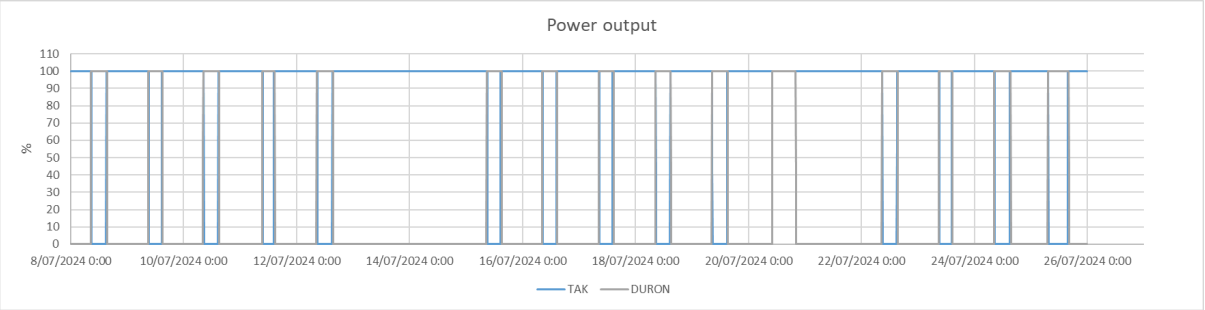

Figure 4: Power outputs for Duron and TAK UV systems

INDIVIDUAL - HUMAN FACTORS/TEAM ACTIONS

The preventive maintenance tasks dedicated to both UV systems have been performed as required.

As part of regular operational duties additional cleaning activities were performed in conjunction with the scheduled PM tasks.

Training of the new operators has been ongoing since December 2023 and confidence in their skills and familiarity with daily tasks have been constantly increasing. No issues have been identified in the team actions.

ORGANISATIONAL FACTORS

Maintenance

Regular cleaning of the UV lamps is necessary to maintain the required UV system performance.

The TAK UV system is currently an assist system and therefore it's cleaning frequency is once a month. Last clean of the TAK system was performed on 21 June 2024 so that the performance of the UV system should not be impaired.

Training

There are two new operators employed at the Porirua site, who are currently undergoing on-site training. One of the organisational plans involves an ongoing extended training campaign for everyone in the operations and maintenance team. The training will create an ongoing learning process for the team and create a consistent approach to undertaking maintenance tasks which should minimise potential for human error while performing the tasks assigned.

Standard Operating Procedures (SOPs) are also being reviewed. The SOP for the cleaning of the UV has been added to the SOP register that covers the routines and all the necessary steps for the cleaning of the UV.

CORRECTIVE ACTIONS

The corrective actions after the Faecal Coliforms spikes are:

Corrective Action	Reference of issue on captured system or Defect raised	Responsibility	Measurement
Xylem engaged to return to site, run a full investigation on the cause of the Duron penstock fault and eliminate the cause so the Duron system can operate reliably.	The Duron system has been having technical issues which has been ongoing since the 26th of January 2024. The penstock issues were to be resolved initially by Xylem on the 12th but got delayed until the 15th of February 2024. Xylem fixed the penstock issue on the 15th.	Plant Coordinator	Rivo
TAK system refurbishment. TAK system condition assessment was conducted and quotations for refurbishment have been received. Proposal for WWL is being prepared	Lower removal efficiency compared to the Duron UV system	CAPEX	Project to be approved and completed
TAK System has been added to fortnightly) Preventive Maintenances	The TAK lamps were cleaned once a month since this UV system is not considered to be a duty system. However, because of the increased frequency of its use, the cleaning frequency shall be changed to fortnightly during the period the TAK UV system is used as a Duty system.	Northern Team Leader & Plant coordinator	Rivo documented - SoP record in BMS, and toolboxed to operations staff
Sampling while the Duron UV system is in operation	Results show that the Duron UV system has higher removal efficiency compared to the TAK system.	Northern Team Leader & Plant coordinator	Rivo documented - SoP record in BMS, and toolboxed to operations staff

CONCLUSION

- Due to the mechanical issues with the Duron UV channel effluent penstock, the TAK UV system has been used as a duty system during the hours when the plant is not manned.
- To maintain comparable conditions during the sampling, the sample is collected from the running TAK system and the switchover to Duron is performed subsequently.
- Data analysis (year 2024) shows that the Duron UV system has a higher removal efficiency compared to the TAK UV system therefore this can be one of the contributing factors to the increased faecal coliforms counts in the final effluent.
- Data analysis showed that during the month of July pre-UV faecal coliforms counts increased above this year's average indicating higher load on the UV system. Significant increase was observed especially on 9 July.
- From the effluent parameters analysis minor increase in TSS concentrations was observed during the 22-24 July period. Even though this increase was not significant and had no effect on the final compliance of these parameters, combination with lower disinfection efficiency of the TAK system could result in non-compliant values of faecal coliforms in the final effluent.