Ref: Porirua WWTP Ammonia nitrogen removal

To: [redacted] (WWL)

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Date: 10/12/2024

Introduction

Resource consent WGN200229 [36816] commenced in August 2024 defining new conditions regarding Total Ammonia Nitrogen monitoring and its effluent limits. Related conditions are as follows:

9A	The consent holder shall on at least one occasion each week, on a normal working day, obtain a representative 24-hour flow-proportioned composite sample of the wastewater from the location identified in accordance with condition 6. This sample shall be analysed for Total Ammonia Nitrogen.
30B	If the annual process model re-run predicts that the concentration of total ammonia nitrogen in the treated wastewater will exceed the threshold in condition 33 (b) within 5 years, then within 3 years the consent holder shall complete a project to design and commit funding for a WWTP upgrade or improvement intended to maintain the concentration of total ammonia nitrogen within the threshold in condition 33 (b). Notes: 1. For the purpose of this condition, 'design' means designed to a level of detail that would enable construction or implementation without the need for further design to be undertaken. 2. The option designed under condition 30B will be considered as part of the Monitoring and Technology Review process under condition 33 (b), if such a review is triggered by the concentration of total ammonia nitrogen in wastewater samples.
33	The monitoring and technology review and report required under conditions 31 and 32 shall be completed and submitted to the Manager for certification that it complies with the requirements of conditions 31 and 32: a. Within 12 calendar months of the ecological survey reports, required under condition 29, being submitted to the Manager; and b. Within 9 calendar months of the concentration of total ammonia nitrogen exceeding 6 g/m3 in more than 5 of 26 consecutive wastewater samples required to be collected and analysed under condition 9A.

To comply with the requirements given by the Resource consent following data overview was prepared.

Effluent quality monitoring

24-hour flow-proportioned composite sample of the final effluent at Porirua WWTP has been collected with a weekly frequency and analysed for Total Ammonia Nitrogen (further just N-ammon) by the third party contractual laboratory. Results of the analysis were provided and evaluated in Quarterly reports. Data collected since the Total Ammonia Nitrogen requirement is in place are depicted in figure 1 below. The complete data set is provided in Appendix I.

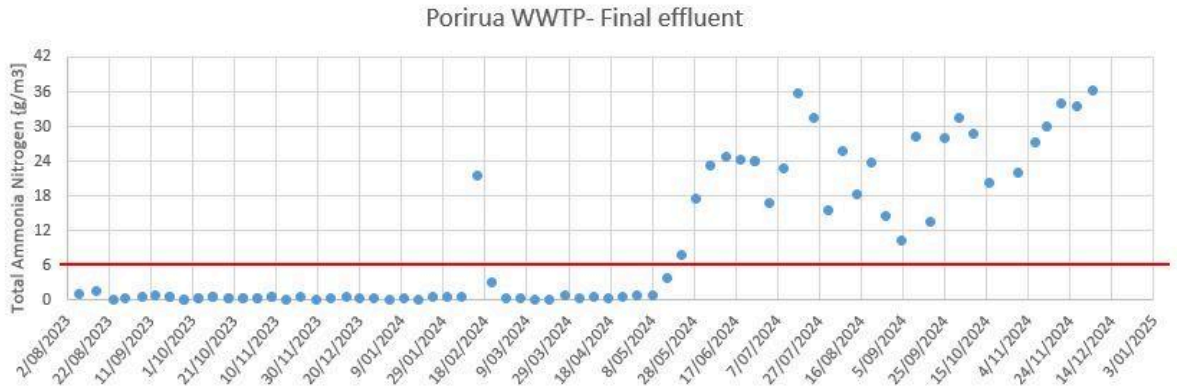

Figure 1 Effluent N-ammon concentrations at Porirua wastewater treatment plant

Data trend shows a significant increase in the Ammonia Nitrogen concentrations that occurred in May 2024. To provide an explanation on this increase, an investigation was initiated.

Data accuracy confirmation

To confirm accuracy of the laboratory results, sampling campaign was conducted and duplicate samples of influent and effluent were collected and sent to a different accredited laboratory. Results are provided in Table 1 showing that there is no significant difference.

Table 1- Sampling campaign results

Date	Eurofins laboratory		Hills laboratory	
	Inlet	Effluent	Inlet	Effluent
20/11/2024	37.4	31.2	40	31
21/11/2024	36.8	35.2	35	34
24/11/2024	37.5	35.6	36	35
25/11/2024	37.6	34.5	38	36
26/11/2024	38.5	34.8	37	35
27/11/2024	37.0	33.3	39	36
28/11/2024	35.8	33.6	37	34

N-ammon laboratory methodology was changed in May 2024 by the external laboratory which coincides with the N-ammon values increase. To exclude any potential change in sensitivity of the method, N-ammon results received for other sites in the plants in Wellington region were analysed. Trends for the N-ammon results in effluent from Moa Point, Western and Seaview wastewater treatment plants are depicted in figure 3. Results are inconclusive and further investigation of the increase is required.

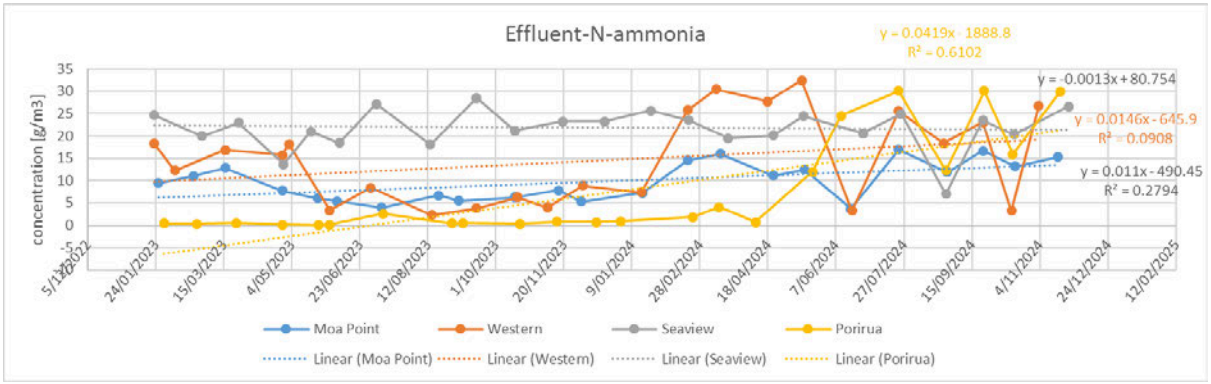

Figure 3 Effluent N-ammon concentrations across Wellington region wastewater treatment plants

Influent N-ammon concentrations

On a monthly basis, influent entering the plant is analysed for N-ammon. One of the factors evaluated during the investigation were the inlet concentrations of N-ammon. Values collected since January 2023 showed average concentrations of 32 g/m3. No significant increase since May 2024 which would correlate with the increased effluent concentrations indicating decrease in removal efficiency was observed.

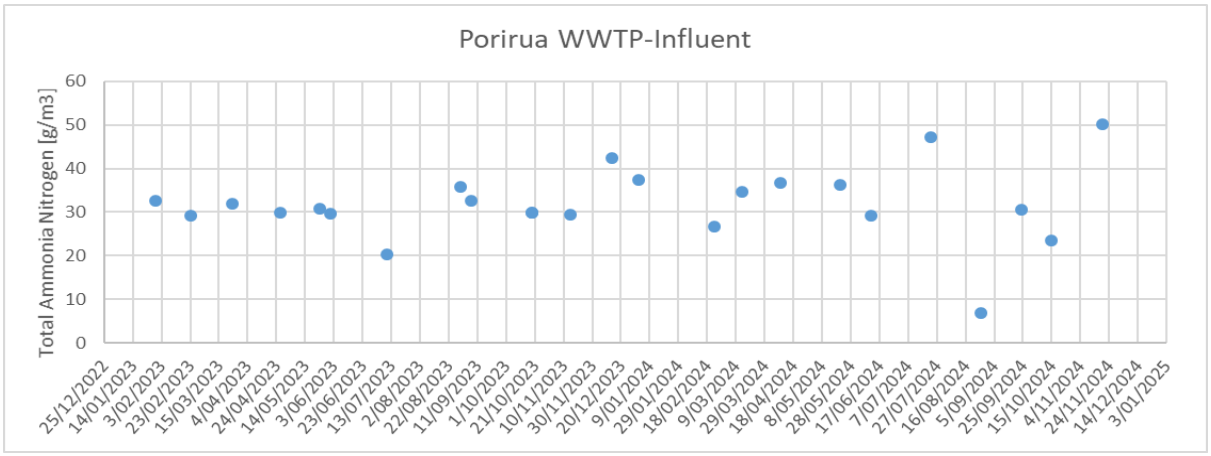

Figure 2 Influent N-ammon concentrations at Porirua wastewater treatment plant

Process parameters monitoring

Significant operation parameters affecting the nitrogen removal such as dissolved oxygen concentration in the biological treatment step, activated sludge age and content of essential nutrients were evaluated. Emphasis was put on any possible change that occurred in May 2024.

Dissolved oxygen

DO trends for the past year were evaluated. Trend for DO average setpoint (taking readings from probes C&D (see aeration basin diagram in Picture 1) is given in figure 4.No significant changes were made during the first 6 months of 2024. Figure 5 shows trends for individual DO probes in the basin. Readings from probes A and B have been stable throughout the reporting period. However, an increase in readings on probe C was observed in contrast to decrease in readings from probe D.

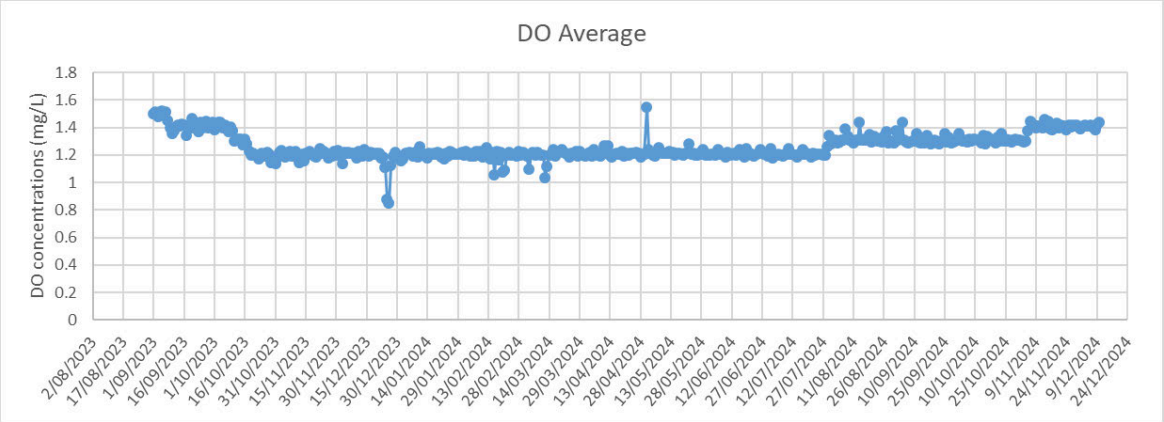

Figure 4 Dissolved Oxygen trends-average

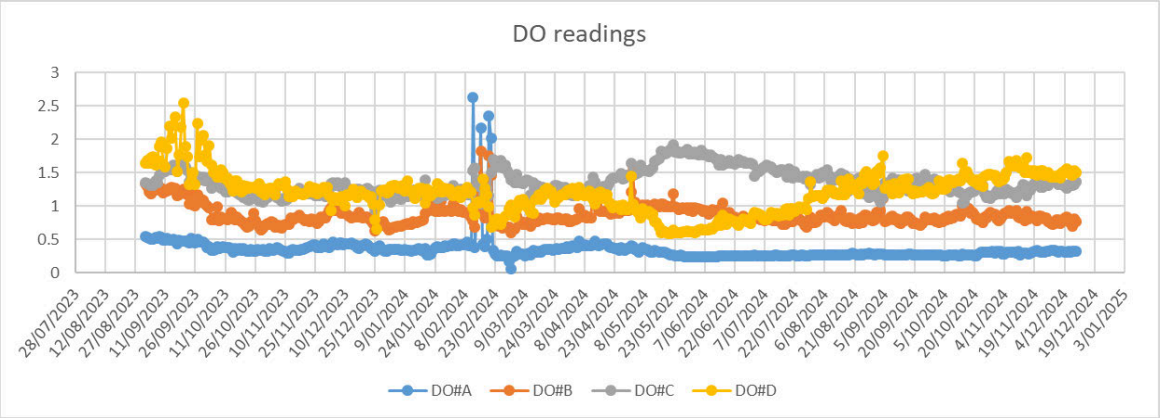

Figure 5 Dissolved Oxygen trends-individual DO probes

Trend for mass supply to the aeration basin (figure 6) shows decreasing values. This is an expected result of diffuser clean performed in February 2024.

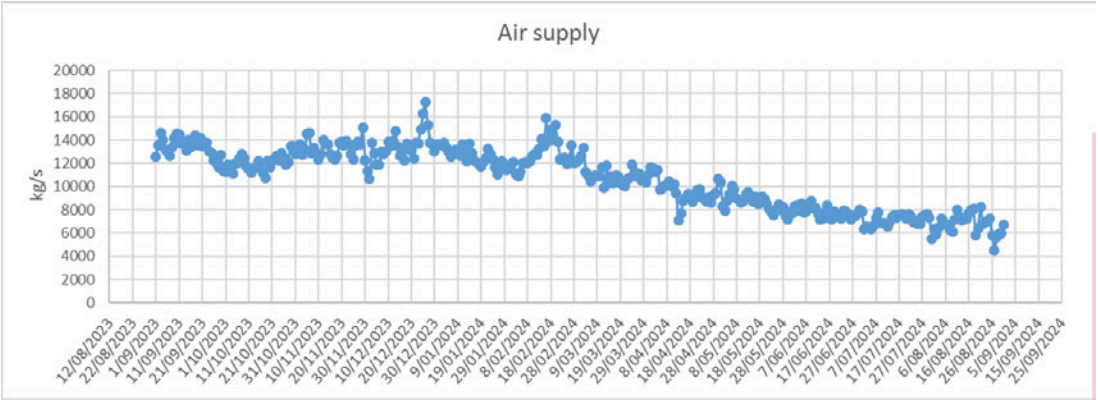

Figure 6 Air supply to the aeration basin

Activated sludge age

Due to possible increased concentrations of solids back to the aeration basin, two ways of sludge age calculations are used. One first calculation considers solids removed via waste stream (excluding the possible return via thickener overflow) while the second calculation includes possible return of solids from the thickener). Decrease in the sludge values have been observed however even the low values of 7 days should allow for nitrogen removal.

Table 2- Sludge age calculations

Month	Sludge age (days)- average		Sludge age (days)- geomean	
	Excluding the return stream	Considering the return stream	Excluding the return stream	Considering the return stream
September 23	23	11	21	10
October 23	18	15	18	13
November 23	22	13	22	13
Dec 23	21	12	21	11
Jan 24	16	14	16	12
Feb 24	14	34	14	30
Mar 24	15	23	14	20
April 24	15	12	14	11
May 24	14	16	14	14
June 24	11	11	11	9
July 24	14	13	13	10
August 24	15	9	15	8
September 24	14	8	14	8
October 24	14	11	14	10
November 24	12	7	12	7

Nutrients availability

To achieve a good nitrogen removal ratio of COD, Nitrogen and Phosphorus (100:5:1) shall be maintained. Trends for these parameters are depicted in figure 7. Nitrogen portion of the ratio have increased compared to COD and P. However samples analysed for these parameters are collected once a month and additional data analysis is required to confirm significance of this change.

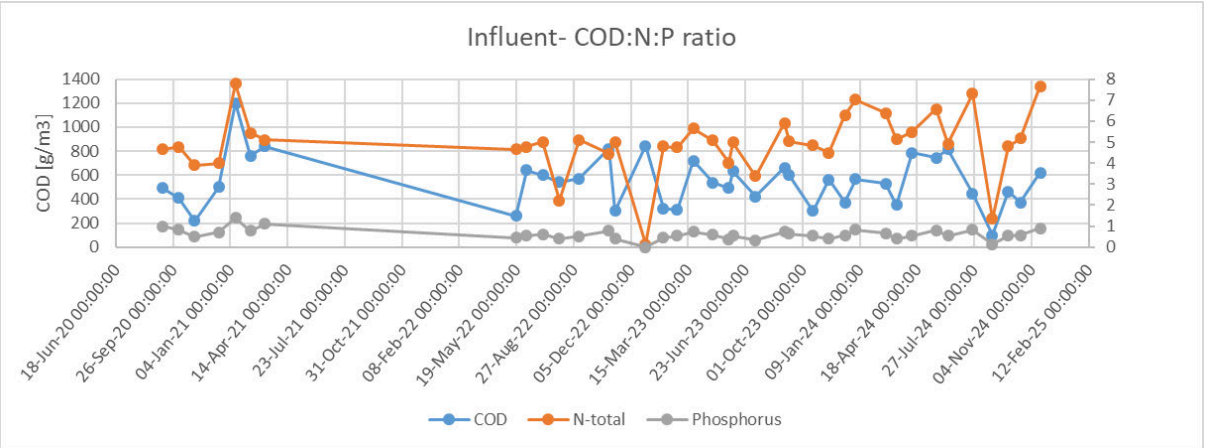

Figure 7 Trends for COD, Total Nitrogen and Phosphorus concentration

Planned process adjustments

- To achieve decrease in the N-ammon concentrations in the effluent, DO setpoints of 1.4 mg/L in the aeration basin is on the lower end of required range. It is suggested to gradually increase the setpoint targeting value of 1.7 mg/L.
- Adjustments of the manual valves in the aeration basin to confirm design aeration patterns for nitrogen removal.

Appendix I.

SamplingPoint	Test Name	Parameter Name	Date	Value
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	7/02/2024	0.52
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	14/02/2024	21.6
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	21/02/2024	3.1
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	28/02/2024	0.26
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	6/03/2024	0.25
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	13/03/2024	0.08
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	20/03/2024	0.13
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	27/03/2024	0.91
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	3/04/2024	0.37
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	10/04/2024	0.65
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	17/04/2024	0.28
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	24/04/2024	0.51
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	1/05/2024	0.92
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	8/05/2024	0.95
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	15/05/2024	3.97
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	22/05/2024	7.73

POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	29/05/2024	17.6
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	5/06/2024	23.3
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	12/06/2024	24.9
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	19/06/2024	24.2
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	26/06/2024	24
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	26/06/2024	24
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	3/07/2024	16.8
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	10/07/2024	22.9
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	17/07/2024	35.7
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	24/07/2024	31.4
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	31/07/2024	15.6
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	7/08/2024	25.7
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	14/08/2024	18.2
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	28/08/2024	14.6
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	4/09/2024	10.4
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	11/09/2024	28.3
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	18/09/2024	13.5
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	25/09/2024	28

POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	2/10/2024	31.6
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	9/10/2024	28.8
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	16/10/2024	20.4
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	30/10/2024	22.1
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	7/11/2024	27.2
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	13/11/2024	30.1
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	20/11/2024	33.9
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	27/11/2024	33.5
POR_EFF_C_1W : Porirua Effluent Composite 1Week	Ammonia Nitrogen | DA	Ammonia nitrogen	5/12/2024	36.3