



Incident Investigation Report:
UVT values below 45% limit (May-July 2024)

CONTROL SHEET

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| Document Title: | Investigation report - UVT values below 45% (May-July 2024) |
| Prepared by: | ██████████ |
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DOCUMENT CONTROL

| Version | Status | Date | Details of Revision |
|---------|--------|------------|----------------------------------------------------|
| 0 | Draft | 30/07/2024 | Draft for review. |
| 1 | Rev.1 | 01/08/2024 | Final version sent to WWL. |
| 2 | Final | 09/08/2024 | Final version sent to GWRC |
| 3 | Rev.2 | 06/09/2024 | Figure 6 expanded and two additional figures added |

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INCIDENT DETAILS

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|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date | May, June and July 2024 |
| Location | Porirua WWTP |
| Description | Condition 12D of the Resource consent WGN200229[36816] states that UV Transmissivity values recorded by the UVT probe located in the Duron UV system shall not reduce below 45%. This has occurred on a number of occasions throughout the months of May, June and July 2024- for details please see figures 1,2 & 3. A number of factors contributing to these events have been identified and the overview is provided in this report. |
| Cause | UVT value directly depends on the concentration of the suspended solids in the final effluent. There were three days during the May-July period where the concentration increased above the average values and Geometric Mean limit values of 30 g/m ³ were exceeded. Low UVT values during these days can be explained by the increased solids concentration in the final effluent. |
| | Due to mechanical issues with the Duron UV system penstock, the TAK UV system was used as a duty system. The UVT probe is positioned in the Duron UV channel and there have been periods of each day when there was no flow through the channel. This resulted in the UVT readings not being representative. The results of the daily concentrations of suspended solids and grab samples analysed for the UVT show good effluent quality confirming that the readings received from the probe are not representative.. |
| | Inspection of the instrument showed inaccurate scaling of the instrument. As a result of this, the values were consistently lower than real values negatively affecting the average values. |
| Actions | Although the Duron UV system is not reliable due to the mechanical issues with the effluent penstock, this system was in operation during hours when the plant is manned to maximise the time, when representative readings can be provided. |
| | A technician from the probe supplier supported the operational staff with the probe's operation troubleshooting. It has been identified that the scaling set during the original calibration was incorrect and therefore UVT values measured were not accurate (lower compared to the laboratory results). |
| Impacts | Breach of Resource Consent WGN200229 [36816], Condition 12D |

DETAILS OF THE NON-COMPLIANCE

The value of UV Transmissivity (UVT) is a parameter indicating cleanliness of water. The more impurities present in the water, the lower the UVT value is. For this reason, the UVT readings are mostly affected by suspended solids in the water; however, dissolved compounds have a negative effect on the UVT value as well.

Figure 1, 2 and 3 show rolling hourly average of UVT readings (collected at 5-minute intervals) for months of May, June and July 2024, respectively. Grey line in each figure shows the limit of 45% and all the orange points below this line are occasions when the UVT value was non-compliant.

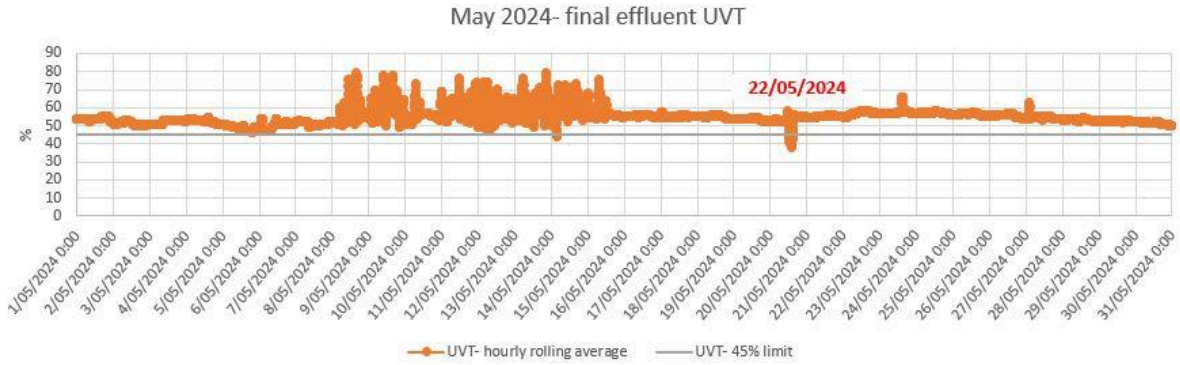


Figure 1- UVT values in the final effluent (May 2024)

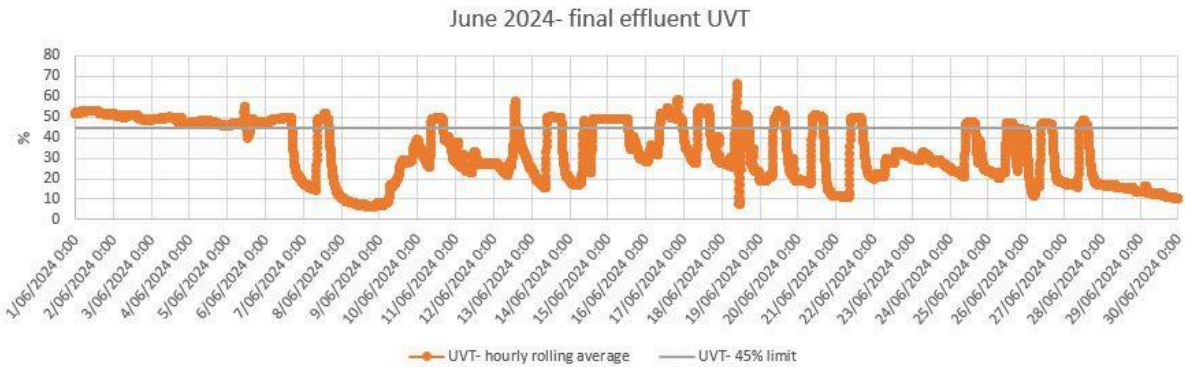


Figure 2- UVT values in the final effluent (June 2024)

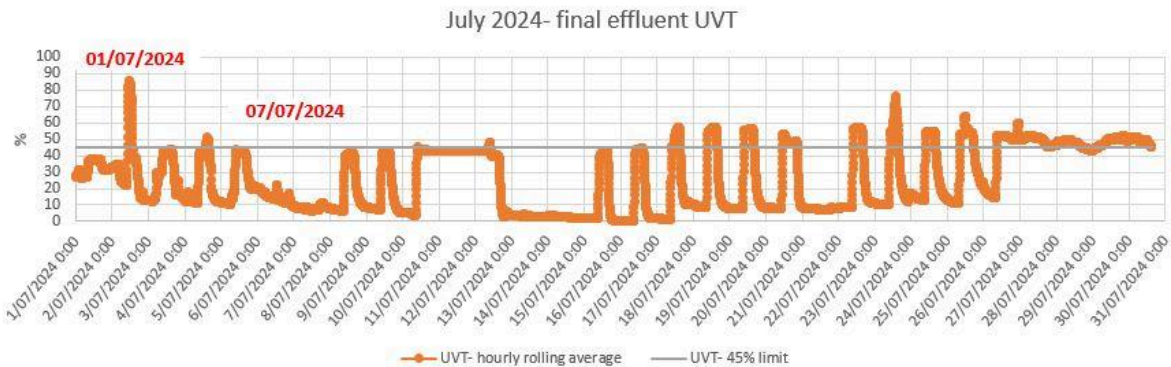


Figure 3- UVT values in the final effluent (July 2024)

PROCESS/QUALITY CONTROL

Section below provides a summary of the contributing factors to the low UVT readings.

Final effluent quality

Suspended Solids

Figure 4 shows daily results for the Suspended Solids concentration in the final effluent. The grey line indicates the 30 g/m³ limit which defines the limit for the 90 days Geometric mean. Please note this value is not a limit for daily results; however, for this purpose, it was used as a reference value. Increased values of the suspended solids occurred on 22nd May, 1st July and 7th July 2024. The values were 86, 75 and 37 g/m³ respectively. Increased suspended solids on these days likely align with low UVT values.

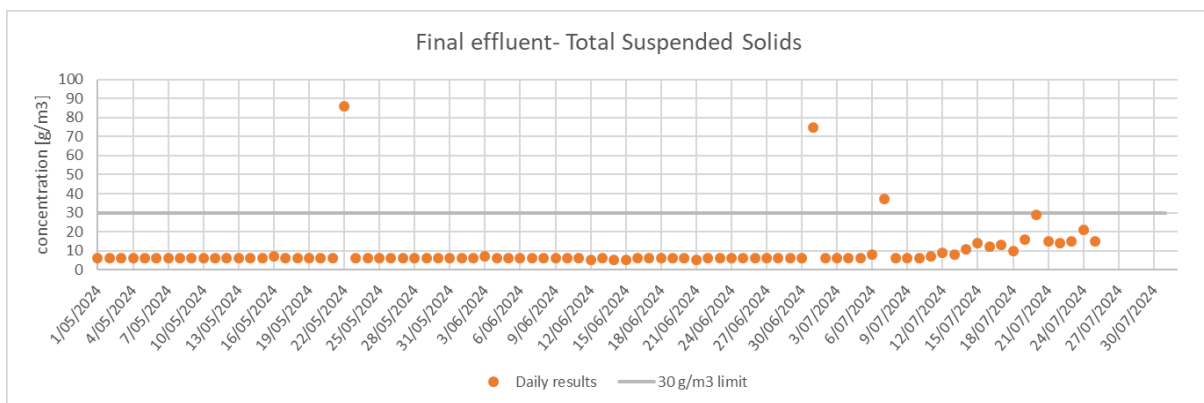


Figure 4- Total Suspended Solids values in the final effluent (May-July 2024)

UV transmissivity (lab analysis)

On a daily basis, a grab sample is collected from the effluent and analysed for the UV Transmissivity. Daily results are shown in Figure 4. From the trends provided in figures 1, 2 and 3, significant differences are observed between the probe online readings and laboratory analysis. Comparison of the grab sample results and the online readings indicated inaccuracy of the probe, and its performance was investigated further.

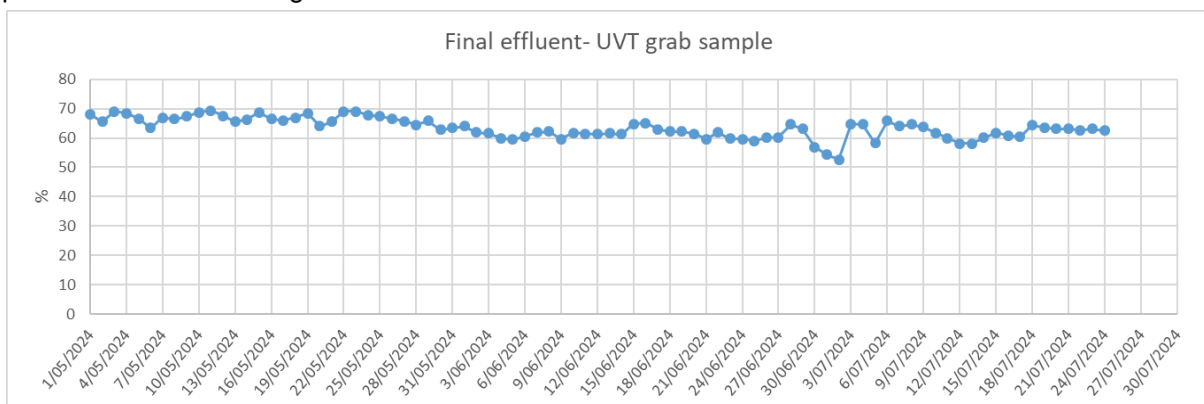


Figure 5- UVT values (daily grab samples) in the final effluent (May-July 2024)

Sludge blanket levels

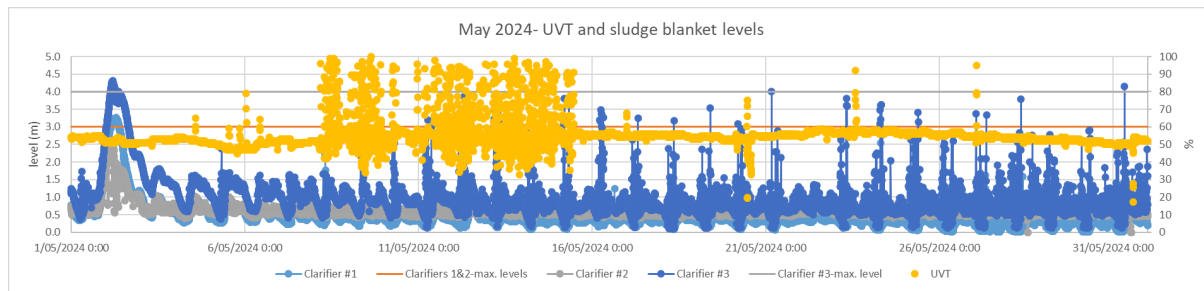


Figure 6- Sludge blanket levels in secondary clarifiers and UVT values trends-May 2024

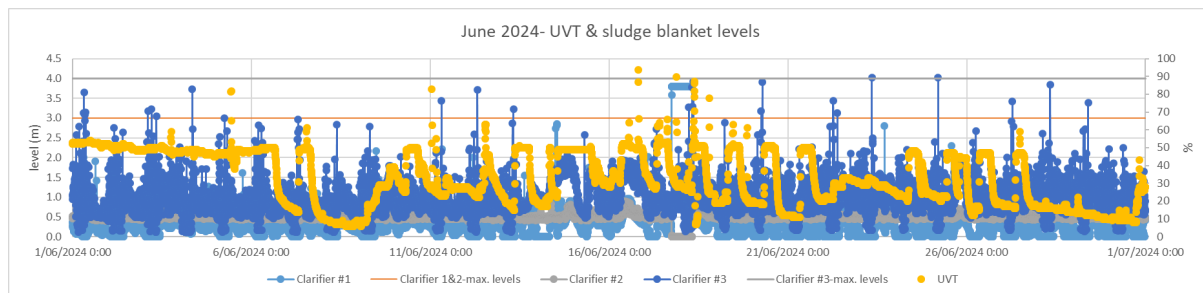


Figure 7- Sludge blanket levels in secondary clarifiers and UVT values trends-June 2024

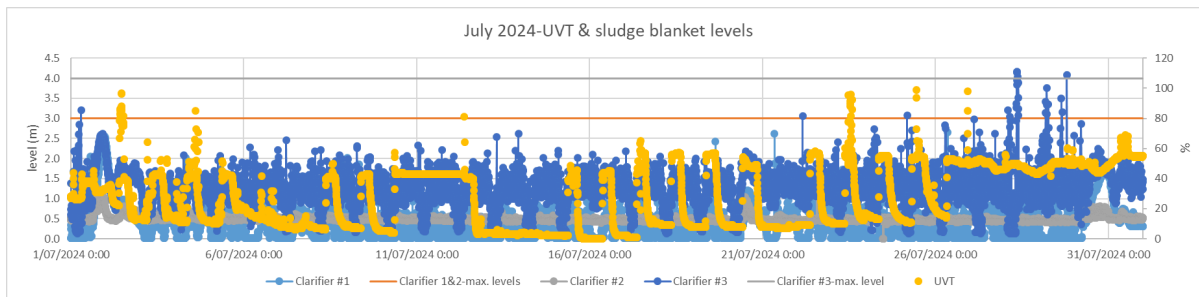


Figure 8- Sludge blanket levels in secondary clarifiers and UVT values trends-July 2024

UVT readings provide a good real-time indication of changes in the final effluent quality, specifically changes in the suspended solids concentrations. Increased sludge blankets can result in increased suspended solids in the final effluent and therefore, the blanket level trends were evaluated for the purpose of this investigation. Figure 6 shows blanket levels in individual clarifiers. At the same time, maximum acceptable levels are depicted. For clarifier 1 & 2, level of 3 metres is considered to be maximum, which once reached, increased solids in the effluent may occur. For clarifier #3 the maximum level is 4 metres. Figure 6-8 shows that the sludge blanket levels were below the maximum levels for the majority of the investigating period therefore no negative effect is assumed. The only exception is an event which occurred on 2 May 2024. From 2:40 am until 9:10 am the blanket levels in clarifier #1 oscillated above 3 meters with a maximum of 3.3 m. Blankets in clarifier #3 were above 4 meters between 3:15 and 6:20 am with a maximum of 4.3 m. It is important to note, that given instrument inaccuracy should be considered and the exceedance of the empirical maximum limits does not necessarily mean sludge carry-over. Considering low BOD₅ and TSS results in the final effluent and stable UVT values for these days, the blanket level increase did not result in significant solids increase.

ABSENT/FAILED DEFENCES

Following section provides details on key parts of the treatment system, which contributed to the UVT values non-compliance.

Duron UV system operation issues

A number of issues have been experienced with a Duron UV system effluent penstock since its commissioning. There is ongoing cooperation with the system supplier to resolve this issue.

The last significant failure of the Duron UV penstock occurred on 5th June 2024. To minimise the risk of non-compliant effluent due to the disinfection system failing, the Duron UV system is in operation only when the plant is supervised (during day hours approx. from 8am until 3pm). During the night hours and weekends, the TAK UV system which is normally an assist system is used as the duty.

For UVT online monitoring, a UVT probe is located in the Duron UV system, as this one is considered as the duty system. It is important to note, that installation of a TAK system dedicated UVT probe is underway.

When the Duron UV system is not in operation, there is no flow through the channel and the water column is stagnant. These conditions are not representative and explain the low UVT values during these time periods (when there is a constant flow through the channel, UVT readings increase). Periodical increases and decreases of the UVT values can be observed from the trend given in figures 2 and 3.

As an example, please see Figure 9 for a detailed snapshot. This figure captures the trend for the UVT readings and flow through the Duron channel, supporting the explanation given above.

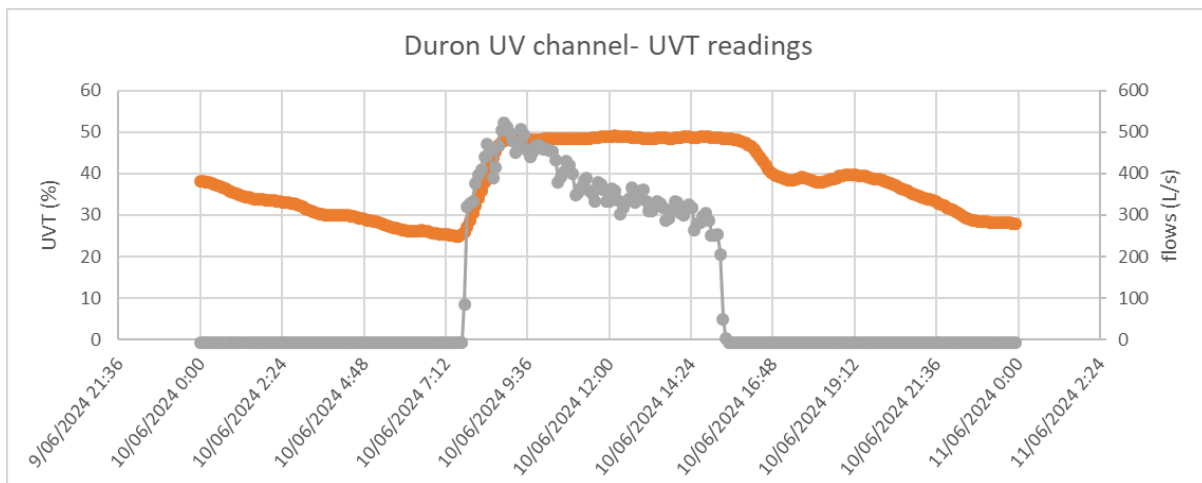


Figure 9- Flows and UVT readings in the Duron UV channel (10 June 2024)

UVT probe operation

As mentioned above, differences between the laboratory results from the grab sample and the online readings have been observed.

The last calibration of the probe was conducted on 17th July 2024. The calibration showed inaccurate scaling of the instrument. As a result of this, the values were consistently lower than real values negatively affecting the average values.

Two corrective actions were suggested. Firstly, it was identified that the cleaning solution used for the standard cleaning may not be strong enough. Currently, a solution consisting of citric and phosphoric acid is used and it has historically provided good results. However, a stronger solution of phosphoric acid (60%) was recommended to achieve better results.

The second recommendation from the instrumentation technician was to set an offset value for the UVT value, aligning the probe measurements with the benchtop instrument and results from the external laboratory. This was implemented, and the verification process is ongoing.

INDIVIDUAL - HUMAN FACTORS/TEAM ACTIONS

Plant's operators have been conducting the maintenance required as per the preventative maintenance task schedule. Monitoring of the treatment process has been done according to the standard instructions

ORGANISATIONAL FACTORS

It is important to note that individual decreases in the UVT readings are supposed to be notified and investigated. Due to the extensive period of the low-readings, it was decided to collate all observations into one report rather than into separate reports.

CORRECTIVE ACTIONS

| Corrective Actions | Reference of issue on captured system or Defect raised | Responsibility | Measurement |
|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------|
| Cooperation with the Duron UV system penstock supplier to address mechanical issue with the penstock is ongoing | Due to the unreliability of the Duron UV system, the flow through the Duron channel is intermittent negatively affecting the UVT readings | Team Leader/ Coordinator | Rivo action. |
| Installation of new UVT probe dedicated to the TAK channel | UVT readings will be independent from the UV system on duty | Process engineer/ Team Leader | Rivo action |
| Optimisation of the UVT probe maintenance (cleaning). | It was identified that historically proven cleaning chemicals are not sufficient to maintain required UVT readings. | Process engineer/ Team Leader | Rivo action |

CONCLUSION

- UVT readings have decreased below the 45% limit given by the Condition 12D of the Resource consent WGN200229[36816] a number of times during the May- July 2024 period.
- Contributing factors such as effluent quality and equipment condition/operation were investigated and are summarised below.
- Concentrations of suspended solids in the final effluent, possibly negatively affecting the UVT values, have increased on three days during the investigated period. It was 22nd May, 1st July and 7th July 2024 and the values were 86, 75 and 37 g/m³ respectively. Considering the duration of the period when the UVT values were below the 45% limit, the contribution of the effluent quality is minor.
- The UVT probe used for recording is positioned in the Duron UV channel. During the investigated period, this channel was used only during site working hours due to mechanical issues with its effluent penstock. As a result, the flow through this channel was intermittent, causing unrepresentative readings i.e. low values. Trends analysing the UVT values and flows through the channel support this explanation. UVT grab samples collected during this period indicate good effluent quality not responding to the UVT values below 45%. It is believed that this is a main reason for the low UVT readings.
- In addition to reasons above, verification of the probe readings showed that the values provided by the probe are lower than results from the laboratory or benchtop instrument. This contributed to the overall lower values of the UVT. It was identified that the scaling of the instrument was inaccurate resulting in lower UVT values. Corrective actions recommended by the Instrumentation technician have been performed or are ongoing.