PHF Science

Memorandum

TO:	Hannah Goslin, Otago Regional Council
FROM:	Peter Cressey, PHF Science
DATE:	28 August 2026
SUBJECT:	**Public health aspects of *Resource Consent Application to Otago Regional Council for Discharge of Treated Wastewater & Associated Activities – Shotover Wastewater Treatment Plant***
PEER REVIEWED BY:	Beverley Horn, Senior Scientist, PHF Science Daniel Bohnen, Group Manager, PHF Science

Background

The Shotover wastewater treatment plant (WWTP) is operated by the Queenstown Lakes Regional Council (QLRC). The Shotover WWTP currently services the Whakatipu Basin communities of Queenstown, Arthurs Point, Frankton, Kelvin Heights, Quail Rise, Shotover Country, Lake Hayes Estate, Lake Hayes and Arrowtown (an average population of 50,000 people in 2024). Recent upgrades to the WWTP mean it can now receive additional wastewater from Jacks Point Village, Hanley's Farm, Ladies Mile and an extension of the Quail Rise residential development area (servicing a total projected average population of 70,000 people by 2040).

QLDC have lodged an application, seeking resource consents for long-term disposal of treated wastewater from the WWTP to the Kawarau River. These consents will enable the eventual transition of the WWTP disposal infrastructure from the consented but failed dose and drain (DAD) disposal system, and the short-term Kimiākau/Shotover River emergency discharge, to a permanent, fit-for-purpose discharge system.

The application, *Resource Consent Application to Otago Regional Council for Discharge of Treated Wastewater & Associated Activities – Shotover Wastewater Treatment Plant* includes, as Appendix A, a report by GHD entitled *Shotover WWTP Surface Water and Groundwater Assessment*. This report (**the Report)** includes a section 7, *Public health risk assessment.* The Otago Regional Council (ORC) has asked PHF Science to provide comments on this risk assessment, including on the appropriateness of the methods used and the conclusions drawn.

Public Health Risk Assessment

Although section 7.2 of the Report is titled *Hazard identification*, it includes a description of the process for performing a quantitative microbial risk assessment (QMRA). However, the description (points 1 to 7) fails to acknowledge the impact of dilution in the receiving environment, which should be considered as part of point 3. Dilution is discussed in some detail in section 6 of the Report, in relation to the reasonable mixing zone.

PHF Science

Pathogens considered

In section 7.2 of the Report, the pathogens *Campylobacter*, norovirus and adenovirus are identified as suitable targets for human risk assessment. While QMRA conducted in New Zealand usually consider norovirus and often consider adenovirus, *Campylobacter* is not usually considered due to:

- The ability of normal WWTP processes to substantially remove or inactivate this organism, and
- The non-specificity of the organism to human waste. That is, the concentration of *Campylobacter* in the receiving environment can be markedly affected by non-human faecal sources, including ruminants and birds.

Indicator organisms

Section 7.3 of the Report discusses the measurement of indicator organisms, such as *Escherichia coli*, as surrogates for the presence of enteric pathogens and, in particular, the findings of the recent Ministry for the Environment (MfE) freshwater study. Section 7.3 of the Report notes that "While the findings of this programme of work are yet to be incorporated into national policy or guidance, the updated understanding of pathogen risk and use of faecal indicators for assessing risks from norovirus, is considered to be relevant in assessing risks to the recreational water users of the Kawarau River".

However, the MfE study sites were carefully selected to **not** be influenced by **treated** wastewater and human faecal contamination was assumed to come from leaking sewer pipes and other sources of untreated wastewater. Wastewater treatment processes, such as those carried out at the Shotover WWTP, will not affect all microbial organisms equally and correlations established for environments impacted by untreated wastewater are unlikely to be transferable to environments impact by treated wastewater.

This point was also highlighted in the *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* (MfE, 2003). The Guidelines state that "These guidelines should not be directly applied to assess the microbiological quality of water that is impacted by a nearby point source discharge of treated effluent without first confirming that they are appropriate".

Exposure pathways

Section 7.5 of the Report identifies ingestion of water and inhalation of water during primary or secondary contact recreation as the most relevant exposure pathways. While consumption of edible biota may sometimes be included in a QMRA, this is less relevant for a freshwater environment as:

- Edible freshwater species (fish and kōura) are not known to bioaccumulate microbial pathogens. In contrast, shellfish are able to bioaccumulate norovirus to concentrations above those in the surrounding water.
- Pathogens will be present in the gut (fish) or hepatopancreas (koura), which are not usually consumed by humans.
- These biota are not commonly consumed without cooking. Cooking inactivates common pathogens.

The identified exposure pathways appear to be the most appropriate for the environment under consideration.

PHF Science

Pathogen removal by the Shotover WWTP

Section 7.6 of the Report discusses *E. coli* concentrations in treated Shotover WWTP effluent and in the Shotover and Kawarau Rivers. While this analysis is interesting and clearly identifies substantial *E. coli* contamination in both rivers upstream of the effluent discharge, the non-specific nature of *E. coli* contamination makes this analysis of limited use for assessment of risks due to the Shotover WWTP discharge. Results of virus testing are also presented and confirm that treated wastewater from the Shotover WWTP may still contain substantial concentrations of viruses. It appears that the results presented relate to testing of a single wastewater sample and considerable variability in virus concentrations over time would be expected.

Section 7.6.1.3 discusses potential viral removal by the Shotover WWTP. Data are presented for viral attenuation during secondary treatment (Table 7.3) and UV disinfection (Table 7.4). Interpretation of the information in Table 7.3 would be enhanced by commentary on the processes in place at the WWTPs mentioned, compared to the Shotover WWTP. I concur with the conclusion that the processes currently in place at the Shotover WWTP are likely achieving an approximate 4 $\log_{10}$ viral attenuation, although the low UV susceptibility of adenoviruses means that attenuation may be lower for these viruses. The viral reductions discussed in section 7.6.2 of the report are plausible but speculative.

Health risk assessment

Section 7.7 of the report considers risks associated with *Campylobacter* and norovirus in discharge effluent from the Shotover WWTP.

Campylobacter

Risks associated with exposure to *Campylobacter* were assessed through reference to the *National Policy Statement for Freshwater Management 2020, Amended December 2025* (NPS FM). The NPS FM classifies waterways in terms of utility for contact recreation. The categories are defined by *E. coli* concentrations and equate to levels of risk of *Campylobacter* infection. The NPS FM was derived from the *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* (MfE, 2003). The Guidelines state that “These guidelines should not be directly applied to assess the microbiological quality of water that is impacted by a nearby point source discharge of treated effluent without first confirming that they are appropriate”. There is no evidence in the Report that the Guidelines or NPS FM have been confirmed as appropriate for the current situation.

Norovirus

The Report references a PHF Science study considering risks from norovirus exposure, based on concentrations of the indicator virus CrAssphage. The Report then considers the relationship between concentrations of CrAssphage and concentrations of *E. coli*. As previously mentioned, the PHF Science study specifically selected freshwater sites **not** impacted by treated human wastewater. Based on current knowledge, the approach adopted in the Report is inappropriate for assessing risks associated with receiving environments impacted by treated human wastewater, specifically:

- While there is evidence for a correlation between concentrations of CrAssphage and norovirus in untreated wastewater, data for treated wastewater are unavailable. Any correlation between the concentrations of these viruses in treated wastewater is likely to be dependent on the characteristics of the treatment process, and

- Correlations between concentrations of CrAssphage and *E. coli* will similarly be affected by wastewater treatment.

As noted in the PHF Science study “CrAssphage is a promising indicator for identifying differences in norovirus infection rates. Further analysis is required to improve understanding of the uncertainty associated with these estimates and the effect of decay rates” (Leonard *et al.*, 2025).

Refined health risk assessment

Section 7.8 of the Report notes that “To provide further surety of the public health risk assessment, microbial monitoring of wastewater and river water is being broadened for a period of time to provide a dataset specific to the Kawarau and Kimiākau/Shotover Rivers. Based on the results of monitoring a location and discharge specific QMRA will be carried out to refine the estimates of risk to recreational users of the water. This will also take into consideration any refinements to the discharge structure design during detailed design, to enhance dilution”.

It should be clarified with the applicant whether the proposed further microbial monitoring will include monitoring of microbial pathogens, particularly enteric viruses. If the monitoring is intended to focus on indicator organisms, it is unlikely that the monitoring will put the applicant in a better position to complete a refined health risk assessment, as they will continue to be dependent on correlations that have not been substantiated for this discharge.

Conclusions

The approach adopted in the Report to assessing risks to public health during contact recreation in the Kawarau River due to treated wastewater discharges from the Shotover WWTP is inappropriate, as it uses correlations between indicator organisms and pathogens that were established in environments impacted by untreated wastewater and specifically selected to not be impacted by treated wastewater. While norovirus is an appropriate pathogen for such a risk assessment, *Campylobacter* is not, as it will be effectively removed by wastewater treatment processes and may be present in the environment from sources other than human waste.

While further refined health risk assessment is proposed, based on further monitoring, it should be clarified whether this monitoring will include analyses of relevant pathogens.

PHF Science

References

Leonard M, Eaton C, Gilpin B, Horn B, Wood D. (2025) Freshwater microbiological research programme 2020-2025. Christchurch: PHF Science.

MfE. (2003) Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. ME Number: 474. Wellington: Ministry for the Environment.