PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office+64 3 **345 7100**
Web **www.pdp.co.nz**
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill

solutions *for your environment*

2 August 2023

Tom De Pelsemaeker
Team Leader - Freshwater and Land
Otago Regional Council
Level 2
144 Rattray Street
DUNEDIN 9016

Dear Tom

ONSITE WASTEWATER SYSTEMS ADVICE TO SUPPORT PLANNING FRAMEWORK

1.0 Introduction

Otago Regional Council (ORC) is currently in the process of preparing a new regional plan, the Land and Water Regional Plan (pLWRP). As part of this process, ORC is considering objectives, policies and rules governing management of onsite wastewater systems within the Otago Region.

Pattle Delamore Partners Ltd (PDP) designs and assesses environmental effects from wastewater management systems. PDP has provided technical advice on onsite management of wastewater for many consent applications both within Otago and other regions. ORC has engaged PDP to provide technical advice on matters which should be considered in developing rules permitting or requiring a consent for onsite wastewater management within Otago. In particular, in this letter report PDP has provided the requested advice on the following:

1. Identifying thresholds where a closer look at location and design of on-site wastewater systems on a case-by case basis might be more appropriate (i.e. through a consent pathway).
2. Identification of high-risk areas where on-site wastewater systems should not be permitted and where it may be more appropriate to require a consent (or where they should not be allowed).
3. Review of the adequacy/appropriateness of the relevant standard *AS/NZS 1547:2012 On-site domestic wastewater management* within an Otago context.
4. Review of the technical information provided by Community and Public Health at the hearing on Environment Canterbury's Proposed Land and Water Regional Plan.

2.0 Onsite Wastewater Management Policy Direction

ORC has completed two rounds of community consultation on the new regional plan. A summary of the consultation and previous direction from councillors, Mana Whenua, key stakeholders and the community was prepared for ORC's Environmental Science and Policy Committee in May 2023 (Otago Regional Council, 2023). PDP has considered this guidance and direction when presenting options and advice to ORC on managing onsite wastewater in the new regional plan. In particular, the following direction has been considered:

1. Council:
    a. Where needed require upgrades for existing wastewater systems but enable stepped change (over time).
    b. Ensure that consents do not prevent achieving outcomes.
    c. Set controls and thresholds for onsite wastewater systems.

2. Mana Whenua:
    a. Consent durations that support achieving healthy waterways within a generation.
    b. A more proactive management for existing septic tanks and requirement for new septic tanks to avoid contaminants entering soil or water.

3. Key stakeholders and community:
    a. Control for existing and new on-site wastewater systems.

4. ORC have indicated the policy framework for managing discharges from on-site wastewater systems will be focused on:
    a. Requiring secondary or advanced treatment;
    b. Requiring re-assessment of the serviceability and effectiveness of on-site systems at regular intervals; and,
    c. Providing for the ability to decline applications where discharges from proposed onsite wastewater treatment systems pose a high risk to the environment.

3.0 Risk Factors

All onsite wastewater systems and their effects on the environment are unique due a wide range of inputs, treatment levels and environmental factors. As such, regulating onsite wastewater discharges in a consistent and straightforward manner is a challenge. The following sections of this report provide a description of various factors which impact the risk of adverse environmental effects from onsite wastewater management, a discussion of how these factors can be managed and, where possible, recommendations for implementing rules or thresholds to manage these risks.

3.1 Depth to Groundwater

Separation of the discharge point from groundwater is important as the rate of removal of pathogens is typically orders of magnitude higher in the surface soils and unsaturated vadose zone compared to removal rates when effluent enters groundwater (Schijven, Pang, & Ying, 2017).

AS/NZS 1547:2012 recommends all discharges have a minimum of 600 mm separation to the highest seasonal water table level. Other regional plans adopt minimum distances typically between 600 mm and 1000 mm. Notably, Auckland Regional Council's Onsite Wastewater Guidelines (TP58/GD06[1]) set out variable offsets based on the soil category and treatment level with larger separation required for highly permeable sands and gravels and reduced separation required for higher levels of treatment prior to discharge (Auckland Regional Council, 2004) (Auckland Council, 2021).

PDP has completed indicative modelling using log removal rates for different soil types (Schijven, Pang, & Ying, 2017). For systems above a highly permeable gravel/sand aquifer, minimum separation distances of up to 1.5 m are not sufficient to prevent pathogens from primary, secondary, and tertiary treated discharges reaching a bore 50 m downgradient at concentrations above the thresholds in the Water Services (Drinking Water Standards for New Zealand) Regulations 2022. The risk to bores reduces in less permeable aquifers.

[1] As GD06 is currently a draft document we have referred primarily to TP58 in this report. The information/guidance referenced in this report is generally consistent across TP58 and GD06.

PDP recommend that, in all circumstances, a minimum separation to the highest seasonal groundwater level of 600 mm is required as per AS/NZS 1547. Where ORC has mapped alluvial aquifers which are known to be used as sources of drinking water and are formed of permeable sands and gravels (or other aquifers with potential for rapid flow paths) and the discharge is to rapidly draining Category 1 soils, PDP recommends a minimum of 2 m separation to groundwater. Gravel and sand aquifers are predominantly comprised of material where the particle size is greater than 0.06 mm (based on the definition of coarse grain size in New Zealand Geotechnical Society (2004). On its own, this is unlikely to provide sufficient protection to groundwater sourced drinking water supplies and should be combined with appropriate treatment levels and setback distances to ensure the risk to private drinking water supplies is managed.

The basis for the 2 m suggestion is on the practicality of investigation rather than a target level of treatment. For instance, to ensure that minimal pathogens enter groundwater from a primary discharge could require a separation on the order of 15 m. However, proving this would likely require drilling a monitoring bore (dependent on other sources of information) which is a significant burden to place on homeowners planning to install an onsite wastewater treatment system. Considering that most disposal bed and trench systems discharge wastewater at a depth of 0.2 – 0.6 m based on AS/NZS 1547 designs, assessing this separation would therefore require excavation of an auger hole or test pit to a depth of approximately 2.5 m. Soil investigations are required under AS/NZS 1547 to determine loading rates regardless of groundwater. Requiring 2 m of separation increases the opportunity for pathogen removal, while minimising additional costs to homeowners.

One issue with test pits is that the depth to groundwater varies throughout the year and test pits are used to make a single measurement. It can be difficult to assess seasonal variation in the groundwater table, unless there is information from nearby bores or signature changes on the soil (e.g. orange mottling/grey colour). As above, we recommend that ORC consider a separation of at least 2 m for rapidly draining Category 1 soils above permeable aquifers used for drinking water supply to add in the management of contamination risk, but a separation distance of 1 m may be more practical to prove given measurement difficulties.

Near the coast, sea level rise should also be accounted for. Predictions for combined sea level rise and vertical land movement along the Otago coastline estimate a net sea level rise more than 1 m by 2100 under SSP5-8.5 (Naish, et al., 2022). Rising sea levels will cause proportional increases in coastal groundwater levels with coastal groundwater levels likely to rise (Pattle Delamore Partners, 2011).

Mapping of specific areas at risk of saltwater intrusion and rising groundwater levels due to sea level rise would be the preferred approach from a technical perspective. Alternatively, a conservative approach could require systems which are within a specific distance of mean high-water springs and elevation above mean sea level to assess the risk in a consenting process. Specific conservative distances could be added for different locations, for example 2 km inland and less than 20 m land elevation, with calculations to support these based on local geology.

3.2 Slope

Slope is a risk factor as it increases the likelihood of surface breakout and subsequent overland flow of wastewater discharged through a disposal system, particularly in lower permeability soils. Slope can also make the even distribution of wastewater through a disposal system more difficult and can influence the difficulty of installation of an onsite wastewater disposal system.

PDP recommends that ORC implement the slope limitations set out in AS/NZS 1547:2012 which are intended to limit the installation of standard systems. The standard does not prevent the installation of systems on greater slopes but does require that specialist and specific design is carried out considering other factors including treatment level, discharge rate and environmental risk. This approach is therefore considered consistent with a permitted activity threshold.

The slope guidelines in AS/NZS 1547 (Table K2) are:

- ETA/ETS beds and trenches – up to 10% grade
- Conventional mounds, beds and trenches including LPED systems – up to 15% grade
- Sub surface drip irrigation – up to 30% grade

Beyond these limits PDP recommends a resource consent should be required.

3.3 Soil Type

Soil type is a site-specific factor which has significant influence on the design of and resulting environmental impact from onsite wastewater systems. Soil type can influence:

- The method of disposal.
- The size of disposal systems.
- The rate of removal of pathogens and nutrients in the disposal system.
- The likelihood of failure of onsite systems.
- The risk to downgradient bores and surface waterways.

The highly variable soils in Otago pose a significant challenge when attempting to regulate onsite wastewater discharges. AS/NZS 1547 sets out a system of categorising soils and setting applicable onsite wastewater design parameters, including design application rates, to mitigate against failure or gross adverse environmental effects. PDP recommend that ORC require onsite systems to be designed in accordance with AS/NZS 1547 including following the procedures for soil identification and disposal system design in accordance with AS/NZS 1547.

3.4 Volume

Based on a review of other regional plans, 2,000 L/day averaged across a week or a month appears to be the most common limit for permitted onsite wastewater discharges. However, some regional councils have provided different limits based on treatment type. For instance, the Waikato Regional Plan permits a discharge of 1,300 L/day (averaged over one month) for primary treatment discharges (septic tanks) and up to 3,000 L/day for secondary treatment systems (aerated wastewater treatment).

For reference, AS/NZS 1547:2012 recommends daily flow allowances of 200 L/p/day where a dwelling is supplied by a bore or reticulated system. Therefore, the population equivalents (PEs) of the flow limits listed above are:

- 1,300 L/day = 6.5 people
- 2,000 L/day = 10 people
- 3,000 L/day = 15 people

In general, a limit of 2000 L/day would be expected to permit discharge from a 6-bedroom house with 9-10 occupants. PDP does not recommend that the permitted limit exceeds 2,000 L/day for a primary treatment system/septic tank as this will exceed the design limits of AS/NZS 1547, which covers systems normally designed for domestic wastewater flows up to 14,000 L/week. Beyond 2,000 L/day, system specific design is considered to be required and “off the shelf” products may not be suitable.

PDP notes that ORC’s current water plan has a limit of 2,000 L/day (calculated as a weekly average) in Rule 12.A.1.4. PDP considers wording based on a weekly average of 2,000 L/day would also be acceptable, however, this limit should only apply to domestic wastewater from dwellings occupied for primarily residential purposes. We note that wastewater from other activities such as cafes/restaurants and public toilets can have a higher contaminant load and therefore may not fall within the range of potential environmental effects which have been covered in this report or the treatment and disposal design requirements set out in AS/NZS 1547.

ORC may wish to consider implementing an additional permitted activity rule where secondary treatment systems are required due to flowrate, density, or the sensitivity of the receiving environment. This may improve environmental outcomes due to tighter discharge quality requirements, while also reducing the burden of applying for and processing consents on both residents and ORC. Further discussion on these aspects is provided in the sections below.

3.5 Treatment Type/Performance

3.5.1 Primary vs Secondary Treatment

Before considering the type of treatment required within Otago, it is important to consider the definitions of primary and secondary treatment. The two terms describe the method of treatment rather than the quality of the effluent produced. The definitions of the two treatment types are (from AS/NZS 1547, Section 1.9):

- Primary Treatment – the separation of suspended material from wastewater in septic tanks, primary settling chambers, or other structures, before effluent discharge to a land application system.
- Secondary Treatment – Aerobic biological processing and settling or filtering of effluent received from a primary treatment unit. Secondary treatment systems are also called aerated wastewater treatment systems (AWTS).

It is important to recognise that, while secondary treatment systems or AWTS generally produce effluent with lower concentrations of key contaminants including BOD, TSS, nitrogen and phosphorus, the method of treatment does not guarantee the effluent quality. Particularly for nutrients, AWTS have widely varied performance with some achieving high levels of nutrient removal and others minimal removal.

As new permitted activity rules for onsite systems are expected to require discharge to ground rather than surface water, BOD and TSS are generally less of an issue when considering water quality. This is provided the treatment is sufficient to prevent clogging or blinding of the disposal field with TSS or biological growth.

It is noted that AS/NZS 1547 requires secondary treatment systems where the discharge is to drip or spray irrigation (the latter not commonly installed in New Zealand for onsite wastewater but widely used in Australia) to achieve an effluent quality where, 90% of the time, BOD is less than 20 g/m³ and TSS is less than 30 g/m³ (Section M2.1).

While using both primary and secondary treatment definitions in any new onsite wastewater rules may generally promote reduced nutrient losses, ORC should consider using more specific effluent quality based definitions to ensure compliance with any nutrient loss targets or pathogen reduction requirements.

3.5.2 Effluent Quality Categories

PDP recommend that ORC consider implementing stricter standards in specific areas or catchments where there is an elevated risk of contamination of surface water or cumulative adverse environmental effects from onsite wastewater systems. One parameter to consider is the level of treatment provided, in particular for pathogens and nutrients. AS/NZS 1547 does not set out any particular limits for either pathogens or nutrients in treated effluent and therefore the responsibility falls to the regulator to set these limits both globally and within specific areas.

For comparison, Environment Bay of Plenty (EBOP) has implemented specific effluent quality requirements for treatment systems installed within the Rotorua Lakes catchments. This policy was specifically targeted to limit further water quality decreases with the lakes, which suffer from poor water quality from both land use and large numbers of onsite wastewater systems. The rules require systems to achieve treatment providing less than 15 g/m³ Total Nitrogen in the system effluent.

Notably, EBOP also required existing systems to be upgraded and, in specific areas of extreme risk, mandated maintenance of septic systems.

PDP understand that ORC is interested in ensuring environmental outcomes are met by requiring improved levels of treatment where appropriate. An example of where this could be considered is the Lake Hayes catchment, which suffers from nutrient enrichment and is already identified in current ORC wastewater rules (e.g. condition B of Rule 12.A.1.4 means a consent is required in this zone).

Beyond defaulting to a consent being required or requiring primary or secondary treatment (septic tanks vs aerated treatment systems), PDP recommend that ORC consider drafting permitted activity conditions with a third category of AWTS which have been proven to achieve a high level of nitrogen removal. In the Bay of Plenty, this limit has been set at a median performance of <15 g/m³ nitrogen in the effluent based on testing in the Onsite Effluent Treatment System National Testing Programme (OSET NTP). Under the NTP guidelines, less than 15 g/m³ was an A rating. ORC should note that this testing programme has not been operational since 2021 and therefore proving this treatment performance may be challenging for suppliers.

The OSET NTP was originally setup as a partnership between the Bay of Plenty Regional Council, Rotorua Lakes District Council, and Water New Zealand as a response to the onsite wastewater management issues identified by Bay of Plenty Regional Council. ORC could consider working together with other regional councils to re-establish the OSET testing programme. Alternatively, ORC could develop a strategy for approving nutrient removal systems in sensitive areas. This could be achieved by requiring suppliers to regularly sample the effluent from their existing onsite systems for a set duration and frequency to demonstrate to ORC their ability to regularly meet the stipulated effluent quality.

Ultimately, these AWTS with high nutrient removal would likely only be required in limited specific locations where onsite systems are having an adverse effect or contribute to cumulative water quality issues. Systems with high levels of nutrient removal may be appropriate for higher density rural subdivisions.

PDP recommend that ORC considers adopting the following treatment levels (as necessary for different locations):

a. Primary Treatment (Septic Tanks) – design and installed in accordance with AS/NZS 1547 & AS/NZS 1546.1

b. Secondary Treatment (AWTS) – capable of treatment performance to meet 90th percentile limits of 20 g/m³ for BOD and 30 g/m³ for TSS, designed and installed in accordance with AS/NZS 1547 and AS/NZS 1546.3

c. Secondary Treatment with Nitrogen Reduction (AWTS + NR) – meets the requirements of (b) and achieves median effluent nitrogen concentrations less than 15 g/m³.

d. Tertiary Treatment (UV disinfection) – systems capable of achieving average Faecal Coliform counts below 200 cfu/100 mL[2].

[2] A limit for tertiary treatment (disinfection) of 200 cfu/100 mL is adopted from TP58/GD06.

Many onsite systems have limited ability to remove phosphorus. To maximise the removal of phosphorus in wastewater, the most effective method is often discharge using subsurface drip line irrigation. Drip irrigation has a lower hydraulic loading rate compared to a conventional disposal trench or bed. This means that there is increased area and capacity for phosphorus adsorption in the natural soils and potential phosphorus uptake in any vegetation planted on the irrigation field. It should be noted that AS/NZS 1547 recommends that drip irrigation should only be used in combination with a secondary treatment system as described above. A primary treatment system does not provide adequate solids removal and is likely to result in blocked emitters and failure of the irrigation system.

If ORC has identified catchments where reductions in phosphorus losses are required or specific areas where onsite systems are resulting in or could result in adverse effects due to phosphorus then ORC could consider promoting or requiring the use of secondary treatment systems with drip irrigation disposal systems to maximise phosphorus removal in the treatment/disposal system.

3.6 Setback Distances for Bores

Setback distance requirements for onsite wastewater discharges from bores are important to manage the risk of drinking water supply contamination. Current requirements from various regional councils are illustrated in Table 1. Many regional councils have adopted a standard 50 m setback distance, although it is not clear what the basis for this setback is. Appendix AS/NZS 1547:2012 includes recommendations for setback distances from bores of 15 to 50 m, noting that highly permeable aquifers can allow microorganisms to be readily transported hundreds of metres downgradient (Pang, Close, Goltz, Noonan, & Sinton, 2005).

Table 1: Other Regions' Onsite Wastewater Setback Distances from Bores

Council	Plan Name & Date	Offset from Existing Bores
Otago Regional Council	Regional Plan Water 2004	50 m from a bore used to supply water for domestic needs or drinking water for livestock
Environment Southland	Southland Water and Land Plan 2018	50 m from any bore; and, not within the microbial health protection zone of a drinking water supply site; or, if no zone is identified then not within 250 m of a drinking water supply site.
Environment Canterbury	Land and Water Regional Plan 2015	50 m of a bore used for water abstraction; and, Not within a Community Drinking Water Source Protection Zone.
Marlborough Council	Proposed Marlborough Environment Plan 2020	50 m of any bore (unless in a confined aquifer) Not within a Groundwater Protection Area.
Greater Wellington Regional Council	Proposed Natural Resources Plan 2019	50 m from a bore used for water abstraction for potable supply; and, Not within a community drinking water supply protection area

From a technical perspective, a sufficient distance for a discharge from a bore used to supply potable water is highly variable and depends on:

- The contaminants of concern (most commonly microbial pathogens).
- The level of treatment provided by the onsite system.
- The soils present and strata in the underlying unsaturated (vadose) zone.
- The depth to groundwater.
- The aquifer conditions including hydraulic conductivity, flow direction and water chemistry.

Providing a single appropriate setback distance is difficult considering the wide variety of soils and aquifers present across Otago. The risk can be particularly elevated in alluvial gravel and sand aquifers where higher hydraulic conductivity may allow rapid transport of contaminants from onsite wastewater discharges to bores. In less permeable aquifers, such as those with a greater percentage of fine grained sediments (silt and clay), slower groundwater movement may reduce or eliminate the risks from pathogens to nearby bores. Additionally, less permeable aquifers may have fewer bores due to lower yields.

A 50 m setback may be appropriate for discharges where the subsoils, vadose zone and aquifers have a sufficiently long time of travel due to low hydraulic conductivity, however, ORC may wish to consider applying more stringent requirements to more permeable aquifers including those gravel aquifers identified in the C series maps under the Otago Regional Plan: Water or other more extensive mapping. PDP may be able to further recommend aquifer specific setback distances, based on data ORC has available for individual aquifers.

As an example of the risks to bores, several scenarios are presented below in Table 2 based on the approach set out in Schijven, Pang, & Ying (2017). These scenarios are presented to demonstrate the impact treatment level and hydrogeological setting can have on the risk to downgradient bores. Setback distances have been calculated to a faecal coliform concentration of 1 cfu/100 ml, based on the maximum acceptable value set in the *Water Services (Drinking Water Standards for New Zealand) Regulations 2022* for *E. coli*, which is a sub-set of faecal coliforms. This assessment is not a complete quantitative microbial risk assessment. The scenarios and predicted setback distances should not be considered appropriate in instances where the circumstances differ from those described in the scenarios. Alternative more complex modelling approaches based on specific microbial risk and that allow for dilution and dispersion may result in different distances.

As summarised in Appendix C of PDP (2018), Blaschke et al. (2016) determined setback distances between on-site wastewater treatment systems and drinking water wells in alluvial aquifers based on virus contamination. This was based on a set level of risk, with a resulting 12 log reduction of enteric virus particles determined to be necessary. Modelled results found setback distances ranging 39 – 144 m in sand aquifers, 66 – 289 m in gravel aquifers, and 1 – 2.5 km in coarse gravel aquifers. This was further than distances calculated by Schijven et al. (2006) of 206 – 418 m to achieve the same risk of infection. A range of setback distances are presented in Table C-1 in Appendix C of PDP (2018).

Based on Table 2 below and literature values, the larger risks in alluvial gravel and sand aquifers is clear. In these locations, ORC may wish to require a larger setback distance, and or a higher level of treatment in order to mitigate against the risk of downgradient bore contamination. Fractured rock aquifers or limestone aquifers also have the potential for greater risk, which varies greatly depending on the aquifer. Consents could be required for all discharges over shallow fractured rock or limestone aquifers to account for this risk variability. Additional aquifer mapping could help refine the areas where this is necessary.

Table 2: Potential Pathogen Transport Scenarios

Scenario	Predicted FC Concentration at Discharge (cfu/100 mL)	Predicted FC Concentration in Drainage to Aquifer (cfu/100 mL)	Predicted Distance to <1 cfu/100 mL (metres)
Primary Effluent, discharged to loam[1] soils, gravel and sand vadose zone[2,] and gravel and sand aquifer[3]	1,000,000	6,750	~1000
Primary Effluent, discharged to loam[1] soils, silt/clay vadose zone[2,] and silt/clay aquifer	1,000,000	1,350	~40
Secondary Effluent, discharged to loam[1] soils, gravel and sand vadose zone[2,] and gravel and sand aquifer	10,000	67	~500
Tertiary Effluent, discharged to loam[1] soils, gravel and sand vadose zone[2,] and gravel and sand aquifer	200	1	~40

Notes:

1. *Assumed 0.3 m soil thickness beneath discharge at 0.1 m.*
2. *Assumed 2 m thick unsaturated vadose zone.*
3. *Log removal values sourced from Schijven et al* (2017).
4. *Initial Faecal Coliform concentration obtained from TP58* (Auckland Regional Council, 2004). *Primary treatment effluent concentrations based on a well-functioning septic tank.*

3.7 Setback Distances for Surface Water Bodies

Onsite wastewater discharges can affect surface water quality through a variety of mechanisms:

1. Failed disposal systems can lead to overland flow and direct discharge to surface water bodies such as drains or streams.
2. Inappropriately designed disposal systems in low permeability soils can lead to lateral subsurface flows into drains/streams. This can also include tile drains which are too close to a disposal system.
3. All onsite wastewater systems can contribute to cumulative effects on catchment wide water quality, including nutrients.

Rules requiring a setback from surface water should be designed to prevent issues 1 and 2 listed above. Separation distance is also a factor for microbial pathogen effects, but in general, management of wider cumulative effects on water quality is highly dependent on the location and environmental conditions of the specific catchment. This aspect is discussed further below.

The most common setback distance from surface water in other regional plans is 20 m. Comparatively, the current Regional Plan: Water for Otago requires a setback of 50 m from all surface water bodies (in Rule 12.A.1.4).

The key factors affecting surface water contamination risk include:

- Slope
- Sensitivity of the receiving environment and effluent quality
- Soil type, vadose zone and aquifer properties

A 20 m separation may be appropriate for situations where the soils are of moderate permeability and there are not significant slopes. PDP recommends that, as a minimum, all onsite wastewater treatment and disposal systems are 20 m from surface water bodies including stormwater drains, roadside drains, and tile drains.

When other risk factors are present, PDP recommend that ORC require a setback of the existing 50 m for:

a. Sites where the average slope between the treatment system and/or disposal system and the surface water body exceeds 10% slope.

b. For sites with Category 1 or Category 5/6 soils which may elevate risk of rapid transmission of contaminants into the waterbody via subsurface or overland flow (Tables R1 & R2 of AS/NZS 1547).

c. Sites where the surface water body has higher water quality targets, or increased significance. For example, Regional Plan – Receiving Water Groups 5 - Lakes Wakatipu, Wanaka and Hawea.

d. From mean high water springs (additional distance may be required due to sea level rise/coastal inundation risk)

In addition, ORC could also consider requiring additional setbacks from waterbodies (and tributaries) which are not meeting water quality targets. This is discussed further below in Section 3.9.

3.8 Flooding and Coastal Inundation

Flooding should be considered in detail during the consenting of the dwelling. However, there should still be some consideration given to the location of both the disposal field and the treatment system (septic tank or AWTS), as these may be located at a lower elevation than, or some distance from, the dwelling.

Flooding of onsite systems could cause damage to disposal systems, e.g., if a large volume of sediment laden water entered a disposal trench it could blind the infiltration media and lead to failure of the disposal trench. Likewise, silt from floodwaters could enter the treatment system and require removal to ensure the treatment system functions correctly. For septic tanks particularly, if floodwaters enter the tank, they are likely to displace wastewater. Floodwaters heavily contaminated with human effluent may create a significant public health hazard. Erosion of material from the disposal areas could also occur requiring remediation.

AS/NZS 1547 recommends considering flood potential in the risk assessment with the threshold set at the 1 in 20-year flood level. GD06 (Auckland Council, 2021) and TP58 (Auckland Regional Council, 2004) also adopt the 1 in 20-year scenario with the exception that septic tanks should be sited above the 1 in 100-year flood level. Systems should also be sited outside of the 1 in 20-year coastal inundation zone (Auckland Council, 2021).

Generally, PDP recommends that ORC adopt the requirements set out in AS/NZS 1547 either as a standalone or with the 1 in 100-year limit for septic tanks.

However, we note that climate change is expected to contribute to increased frequencies and higher intensities of extreme rainfall (Ministry for the Environment, 2018). Dependent on catchment specific parameters, this is generally expected to increase the recurrence and severity of flooding and coastal inundation. This means what was once a 1 in 20-year flood is likely to occur more frequently as climate changes continues to occur. It is important that any flood modelling utilised to inform this threshold is up to date and considers the effects of climate change out to the design horizon of the onsite system (up to 40 years for an onsite system, refer to Section 8.1).

3.9 Cumulative Effects and Catchment Water Quality Management

While setback distances and good disposal system design may help to prevent against contamination of waterbodies at an individual level, rules for individual systems are generally ineffective against preventing adverse effects from cumulative discharges from a large number of systems. A more targeted approach is necessary where onsite systems are known or expected to be contributing significantly to localised or catchment wide adverse effects.

The contribution of onsite wastewater systems to catchment nutrient loads can vary significantly based on the size of the catchment and the dominant land uses within the catchment. For instance, in the Rotorua Lakes catchments, onsite wastewater discharges were identified as a major contributor to nutrient loads (Bay of Plenty Regional Council, 2006). Conversely, an investigation commissioned by Environment Southland on nutrient loads within the Oreti, Mataura, Waiau, and Aparima catchments found that onsite systems contributed between 0.2% and 2.8% of total nitrogen loads. In these instances, nitrogen from agricultural leaching and run-off dominated the catchment nitrogen load (Liquid Earth Limited, 2014).

PDP recommends that ORC take a targeted approach to managing nutrient loads from onsite wastewater systems focusing on improving outcomes in areas where:

- Waterbodies are at a high risk of contamination from onsite systems. Risk indicators could include density of systems or sensitivity of the receiving environment.
- There are known adverse effects on the receiving environment due to cumulative onsite wastewater discharges.
- Water quality targets are not being met or water quality indicators show a declining trend as identified in ORC's State of the Environment monitoring programme (or other water quality data).

The responses to the above scenarios could be adaptive, with measures and restrictions changing based on improvement or continued decline of water quality, although homeowners do require long term certainty for their investment in onsite wastewater systems. Options ORC could consider to reduce the nutrient loads from onsite wastewater systems include the following, which could be applied globally or targeted at sensitive areas as identified by the criteria above:

- For new systems:
  - Restricting density
  - Requiring advanced systems with higher nutrient/pathogen removal
  - Requiring evidence of regular maintenance on the treatment system and disposal area (dependent on type)
- For existing systems:
  - Mandating maintenance frequencies and reporting
  - Mandatory upgrades/replacement of systems which have exceeded their design life (max 40 years)
  - Requiring staged upgrade to advanced treatment systems
  - Promoting establishment of reticulated systems and centralised treatment for higher density areas

3.10 Community Drinking Water Supplies and Source Protection Zones

An updated NES for sources of human drinking water is due to be released shortly. PDP understand that the NES will require councils to map source protection zones to help protect community drinking water supplies from contamination. PDP is currently preparing guidance for MfE on this mapping process.

It is important that onsite wastewater discharges within the source protection zones that could impact the supplies are well controlled. Typically, this would include requiring a consent for an onsite wastewater discharge within any defined source protection zones or within a set distance of a community supply bore. For comparison, Environment Southland (ES) has specified that discharges within 250 m of a community supply bore require a consent.

For Otago, particularly within the high permeability aquifers, PDP advise that 250 m would not be sufficiently conservative for community supply bores. Specific mapping of the protection zones is preferable, however, at a minimum PDP would recommend requiring consent within 2.5 km of a community water take where a source protection zone has not yet been mapped. This is a conservative distance based on PDP (2018).

Some consideration could be given to upgradient vs downgradient setback distances. However, unless this information is already mapped or available for a given community supply, it may be difficult to implement a rule. Groundwater flow direction is one of the primary considerations in developing source water protection zones. Without these zones being established, it may be that the most straightforward option is to require a resource consent and to consider the actual risk to the supply (based on groundwater flow or otherwise) and potential mitigating actions on a case-by-case basis.

ORC have mapped Groundwater Protection Zones for the current Regional Plan: Water for Otago (as part of the C-Series maps), which form part of the current onsite wastewater discharge rules (e.g. Rule 12.a.1.4). These zones could be included in future rules, although PDP would recommend further review on whether they provide sufficient protection to drinking water supplies, prior to inclusion.

3.11 Preventing Failure – Design, installation, operation and maintenance

Poor maintenance and aging septic tanks are often a significant source of environmental issues stemming from onsite wastewater management. The Ministry for the Environment (MfE) prepared a discussion document on an NES for Onsite Wastewater Systems (Ministry for the Environment, 2008). Based on Waste and Sanitary Services Assessments completed in the mid-2000s by Territorial Authorities, MfE estimated that 250 communities (42,000 dwellings) were serviced by septic tanks at a high risk of failure (Ministry for the Environment, 2008). Furthermore, it was estimated that nationally 15 to 50 percent of onsite systems (rural and townships) are failing. Most onsite wastewater contractors who responded to MfE's consultation thought the failure rate was underestimated (Johnson & Freise-Preston, 2009).

Onsite wastewater system failures can generally be attributed to the following categories:

- Inadequate management of the system (e.g., disposing of unsuitable items or chemicals)
- Inadequate maintenance of the system (e.g., not pumping out the tank when required)
- Failure of the tank (e.g., leaking directly into the ground through cracks in the tank walls and joints)
- Failure of the disposal field (e.g., blocked pipes concentrating the discharge to ground or causing emergence at the surface of the disposal field, ponding and potentially runoff). In some instances this may result in the discharge being piped to a stormwater pipe or open drain as an alternative to the failed disposal field.

- Poor investigation, design and/or installation (e.g., inadequate permeability causes ponding/runoff, highly permeable soils prevent adequate treatment prior to drainage to groundwater, inadequate separation where groundwater levels are high, inadequate sizing of the treatment system).

These failures can lead to exposure to wastewater and adverse environmental effects resulting from poor treatment or wastewater directly entering surface water. Currently, ORC's onsite wastewater rules have limited requirements for the design, installation, operation, and maintenance of onsite wastewater systems. PDP recommends that ORC considers implementing conditions on the permitted activity status of onsite wastewater to require both new and existing systems to be well maintained. Particularly for ageing existing systems, this may provide an enforcement pathway where either ORC or the relevant territorial authority is aware of failing onsite systems. Conditions could include:

- Compulsory pump out frequencies for areas where more than minor adverse effects have been identified due to onsite wastewater systems and in particular failing onsite systems (e.g., Glenorchy, Clyde). For context, Environment BOP enforces maintenance of onsite systems for select areas around vulnerable lakes such as Rotoma and Tarawera.
- For all other areas, systems are maintained in accordance with the manufacturer's instructions or general good practice. For instance, the manufacturer maintenance requirements for a Hynds concrete septic tank are:
  - Inspection and cleaning (when required) of the outlet filter every 6 months.
  - Routine pump out of the accumulated sludge and scum; recommended every 3-5 years.
  - Disposal field does not have any wet or saturated areas.

  These requirements could be considered the minimum maintenance of onsite systems.
- Discharge of wastewater to a disposal field shall not result in saturation of the soils above the disposal field, wet areas in the disposal field, ponding of wastewater or overland flow of wastewater (notably, under the current ORC rules, unintentional overland flow of wastewater is permitted provided it does not leave the property boundary or enter surface water).

Other conditions regarding the design and installation of an onsite wastewater system would also offer improved environmental protection. These conditions may be limited to new systems as it is likely to be difficult to determine or enforce compliance for existing systems:

- A minimum vertical separation for the discharge to the highest annual groundwater level (discussed in Section 3.1 of this letter).
- Design and installation of onsite wastewater treatment and disposal systems is completed in accordance with industry best practice guidelines (AS/NZS 1547:2012, AS/NZS1546.1, and AS/NZS 1546.3 and or Auckland Council TP58/GD06,). This would cover aspects including:
  - Sizing of onsite systems based on dwelling size, typical flowrates, and septic tank capacity requirements.
  - Sizing and determining appropriate design loading/irrigation rates for disposal fields.
- Retaining appropriate offsets to surface water, bores, and other potential receptors (discussed elsewhere in this report).

3.12 Density

Density of dwellings is one of the most influential factors on the risks from onsite wastewater discharges. Not only does density impact on the cumulative contributions to aquifer and catchment nutrient loads, but density may also provide some indication of the likelihood of nearby downgradient bores.

Table 3 provides a summary of nitrogen loadings considering lot size and treatment level. The lot sizes assessed have been based on minimum sizes specified in various district plans within Otago. To provide context, it is possible to compare the nitrogen loading rates to Rule 12.C.1.3 of the Regional Plan: Water for Otago. Table 4 provides minimum lot sizes for various treatment levels in the Nitrogen Sensitive Zones set out the Regional Plan: Water.

To prevent increasing nutrient loads, ORC may wish to consider limiting permitted activity status to the lot sizes set out below. This may be particularly important for catchments where water quality targets are not being met.

Table 3: Areal nitrogen loads based on lot size and treatment type

Lot Size		Lot Dimensions[1]	Nitrogen Loading – Septic Tank[2,3] (kg N/ha/y)	Nitrogen Loading – Aerated Treatment System[2,4] (kg N/ha/y)	Nitrogen Loading – Aerated Treatment System + Nutrient Removal[2,5] (kg N/ha/y)
1,000 m^2	0.1 ha	32 m x 32 m	274	164	55
1,500 m^2	0.2 ha	39 m x 39 m	183	110	37
2,000 m^2	0.2 ha	45 m x 45 m	137	82	27
4,000 m^2	0.4 ha	63 m x 63 m	68	41	14
6,000 m^2	0.6 ha	77 m x 77 m	46	27	9
10,000 m^2	1 ha	100 m x 100 m	27	16	5
15,000 m^2	1.5 ha	122 m x 122 m	18	11	4
20,000 m^2	2 ha	141 m x 141 m	14	8	3
40,000 m^2	4 ha	200 m x 200 m	7	4	1

Notes:

1. *Assuming a square section. Provided to assess potential distance of downgradient domestic supply bores.*
2. *Assuming each dwelling has 5 population equivalents (PE) and 15 g N/PE/day. Conservative assessment of nitrogen load based on the range of nitrogen loads reported in GD06* (Auckland Council, 2021).
3. *Assessment based on no removal of nitrogen in the septic tank.*
4. *Assessment based on 40% removal of nitrogen in an aerated wastewater treatment system* (Auckland Regional Council, 2004).
5. *Assessment based on 80% removal of nitrogen in an advanced aerated wastewater treatment system Bay of Plenty Regional Council* (2006) .

Table 4: Lot Sizes to Achieve Nitrogen Loss Targets

Treatment Type[1]	Minimum Lot Size for 15 kg N/ha/y Losses (H5 & H6)	Minimum Lot Size for 20 kg N/ha/y Losses (H1 - H4)	Minimum Lot Size for 30 kg N/ha/y Losses (Elsewhere)
Septic Tank – No N removal	2 ha	1.5 ha	1 ha
Aerated Treatment – 40% N Removal	1 ha	8,000 m²	6,000 m²
Aerated Treatment and Nutrient Removal – 80% N Removal	4,000 m²	3,000 m²	2,000 m²

Notes:

1. *Assuming each dwelling has 5 population equivalents (PE) and 15 g N/PE/day.*

3.13 Connection to Reticulation

Where available, connection to a reticulated wastewater network with a centralised treatment system is preferable. From a regulatory perspective, a centralised treatment plant and discharge 'point' makes managing environmental effects and providing improved water quality outcomes more straightforward. Generally, centralised treatment systems are more cost effective at scale, provide easier pathways for improving environmental performance, and can be upgraded to keep up with growth or changing requirements (Pasciucco, Pecorini, & Iannelli, 2022).

PDP, in its role as a technical adviser to ORC, has had recent experience of reticulation implementation and onsite wastewater systems. In some instances, despite reduced surface water quality due to onsite wastewater discharges being identified, there was not a regulatory tool or mechanism to require connection to the new reticulated system. The current rules allow a situation where, even if reticulation was installed to the property boundary, a house owner could legally continue to use the existing septic tank.

PDP recommend that ORC consider including a condition for both new and existing wastewater systems that requires connection to a council/TA operated wastewater network within a certain vicinity. For existing systems, requiring immediate connection, depending on the approach taken by TA's may not be practicable. ORC could consider requiring connections within 3 years (or another appropriate timeframe) of commissioning of such a wastewater system. For comparison, the LWRP (Environment Canterbury) requires connection if a sewerage network "is available". The definition of available is somewhat ambiguous. As such, PDP recommend that ORC consider adopting the approach set out in the Proposed Marlborough Environment Plan (2020) which does not permit onsite wastewater systems if there is either:

- A council operated sewage system within 30 m of the property boundary; or,
- A council operated sewage system within 60 m of the closest building on a property.

These distances are consistent with Section 459 of the Local Government Act 1974 where councils may require installation of private drainage networks (i.e., a sewer/wastewater system) to connect to public networks.

In addition, we recommend that if ORC is granting a consent for an onsite wastewater system, due to flows exceeding the permitted activity threshold or any other reason, the consent conditions should require the consent holder to connect to a reticulated network, under the same conditions as above, if or when one becomes available.

4.0 Risk Assessment Framework

As described above, there are a large range of factors which can influence the acceptability of onsite wastewater discharges. In many instances, the factors are interdependent, that is, if one factor provides greater risk mitigation, a lower level of risk mitigation may be required from another factor. For example, where groundwater is deep, a high level of pathogen removal in the vadose zone may require a smaller offset from downgradient supply bores compared to a scenario where the groundwater is very shallow. As an alternative to individual conditions, ORC could consider implementing a risk assessment framework to assess the effects of various factors on the risk of the discharge and ultimately determine its status as a permitted activity or otherwise. If implemented correctly, this could improve environmental outcomes while also reducing regulatory demands.

An example of a risk management framework is currently being developed by the Ministry for the Environment for assessing the risk of nutrient losses from farmland. PDP understands that MfE's risk index tool will consider a variety of environmental, climate, and land use factors to provide a high-level assessment of the risks of nitrogen leaching.

ORC could consider developing a risk assessment framework/risk index tool to assess either solely the risk of pathogens from onsite wastewater discharges or to assess the risk of pathogens and nutrients. In either instance, the output of the risk assessment could be used to assess the permitted activity status of the individual system. Any risk assessment/index tool would provide a framework for applicants and planners to assess the risk and may consider the following factors:

a. Depth to groundwater

b. Soil type

c. Vadose zone and aquifer material

d. Treatment level (pathogens)

e. Aquifer type/use (the need to protect high value aquifers) and catchment surface water quality trends (where relevant)

f. Presence and location of private/public water supply bores

And, if considering nutrient risk, could also consider:

g. Treatment level (nutrient removal)

h. Onsite systems density

i. Aquifer water chemistry

j. Catchment water quality trends

Each of the above factors could have a weighting applied and a score based on defined brackets for each parameter. A final risk score would be found by summing the score of each category multiplied by the importance weighting. Risk scores below a certain value could be deemed a permitted activity while those exceeding the cutoff would require a resource consent. Individual limits/rules would still be required to manage critical risks, such as setbacks from surface water or exclusions from source protection zones.

The alternative option is to manage each parameter individually. Recommendations for limits or thresholds for each individual risk factor are compiled in Section 7.0 of this letter based on the factors set out in Section 3.0.

The factors set out above also need to be considered in assessments of risk to drinking water supplies and surface waterways for systems that do require resource consent. There are a number of different methodologies that can be applied for these assessments, ranging from simple mass balance approaches for nutrients and using spatial removal rates for pathogens through to more complex numerical groundwater-surface water models. Simple approaches are generally all that is required for onsite wastewater systems, provided they are sufficiently conservative to allow for uncertainty.

5.0 Appropriate Standards and Guidelines

5.1 AS/NZS 1547:2012 On-site Domestic Wastewater Management

5.1.1 Purpose

AS/NZS 1547:2012 sets out the requirements for treatment units and their land application (disposal) systems to achieve sustainable and effective on-site wastewater management to protect public health and the environment.

Generally, AS/NZS 1547 sets out a process for site investigation, design, installation, and maintenance of onsite systems. The process and design parameters/limits included in the standard are intended to prevent premature failure of onsite disposal systems and prevent against gross environmental effects such as discharges to surface water due to overland flow from a failed disposal trench.

As the standard sets out criteria for onsite systems across two countries with widely varying site specific and environmental factors, AS/NZS 1547 does not provide specific guidance on the effluent quality, disposal method, density, or any other factors to prevent against degradation of water quality within a specific area or catchment. Instead, these factors are listed within the risk assessment procedure set out in Appendix A of AS/NZS 1547. These risks are intended to be assessed and managed by the 'implementors' of the standard, i.e., designers, installers, and regulators.

5.1.2 Risk Assessment

Ultimately, requiring designers and installers of wastewater systems to assess and appropriately mitigate the potential for cumulative effects from onsite wastewater on an individual basis is unlikely to be successful or cost effective. This approach would generally match the requirements of the current regional plan which have not been adequate in places to prevent adverse effects from onsite wastewater systems, e.g., Kingston (Otago Regional Council, 2006).

Management and regulation of onsite wastewater discharges based on risk in specific areas or catchments is likely to be significantly more effective without imposing additional construction, maintenance or regulatory costs on those homeowners who do not live in high-risk areas.

5.1.3 Recommendation

PDP recommend that AS/NZS 1547 is generally applicable to Otago. The design process, design limits and recommendations are generally appropriate for managing the design and installation of individual onsite systems, including assessment of soil types and application rates. However, AS/NZS 1547 does not provide for the management of adverse environmental effects such as those arising from cumulative onsite wastewater discharges. AS/NZS 1547 should be utilised as a design guide for onsite wastewater systems, however, it should be supplemented by robust rules set out in a regional plan to help prevent individual and cumulative adverse effects.

6.0 Review of LWRP Evidence

As part of the scope of this work, at ORC's request PDP has considered two statements of evidence prepared in 2013 for a submission from the Community and Public Health Division of the Canterbury District Health Board (CDHB) on the Canterbury Land and Water Regional Plan. The first piece of evidence is from Wendy Williamson of the Institute of Environmental Science and Research (ESR) and covers technical matters on cyanobacteria/cyanotoxins and public health issues from onsite wastewater systems. The second statement of evidence is from Stewart Fletcher, a planning consultant. PDP's review has focused specifically on the onsite wastewater portions of the evidence statements.

With regard to onsite wastewater management, the two evidence statements largely identify the same issues and draw similar conclusions to this report. That is, the suitability of onsite systems and potential for environmental and/or public health risk from onsite discharges is highly variable and dependent on the specific environmental setting. Specifying rules to adequately manage or prevent public health or adverse environmental effects in all circumstances is very difficult. For instance, in paragraph 4.3.11, Dr Williamson highlights the need to have a minimum of a 300 m setback to a 60 m deep bore to prevent against possible contamination for a gravel vadose zone and gravel aquifer setting. However, the LWRP includes a minimum setback of only 50 m which may be appropriate in some scenarios, but not in the example case. In an attempt to improve on this risk management, PDP has suggested ORC consider a risk assessment tool for onsite wastewater as part of the permitted activity rule. This may allow ORC to take a more effective approach to managing the risk of groundwater contamination.

We also note that the evidence statements suggest a threshold where reticulation should be considered; a density exceeding 1.5 dwellings per hectare and a population exceeding 1000. This was incorporated into the LWRP permitted activity rule where new discharges in such an area were classed as a restricted discretionary activity. Notably, it is admitted in the evidence that this population threshold is a "line in the sand" based on experience but lacking "data to support or refute" the threshold.

PDP cautions against implementing this threshold based on density and population in Otago without first considering the differences in environmental setting between Otago and Canterbury. The test case for the threshold is Darfield, one of New Zealand's largest unsewered communities. Darfield is a rural town on the Canterbury Plains, the predominant use of the land surrounding Darfield is intensive agriculture, primarily dairy farming. Groundwater in the vicinity of Darfield is also deep and the town is located far from major waterbodies such as the Waimakariri and Selwyn Rivers. These factors may limit the risks from onsite systems compared to risks from smaller communities such as Kingston or Glenorchy where groundwater is relatively shallow and the path to high value water bodies (Lake Wakatipu) is short. Notably, neither Kingston nor Glenorchy would meet this threshold for considering reticulation (Stats NZ, 2020).

Mr Fletcher refers to the *Guidelines for separation distances based on virus transport between on-site domestic wastewater systems and wells* (Moore, et al., 2010). Those guidelines provide tables with recommended setback distances based on strata type and depth to groundwater. Using these tables would be in line with the risk assessment framework discussed in Section 4.0 of this letter, although it is noted that those guidelines are considered to provide very conservative setback distances, as outlined in PDP (2018).

In general, the evidence statements are in line with the guidance provided by PDP in this letter regarding the identification of issues and risks associated with onsite systems. Caution is advised when interpreting the conclusions for Canterbury within an Otago context.

7.0 Recommendations for Permitted Activity Conditions

The limits or thresholds recommended by PDP for ORC's consideration for onsite wastewater permitted activity conditions are provided in Table 5 below. Please note that these limits/thresholds have been set out in a technical manner only and further consideration of the permitted activity wording is required.

Table 5: Recommendations for Permitted Activity Limits/Thresholds

Parameter	Proposed Limit/Threshold	Reason/Consideration of Alternatives
Separation from Groundwater	Minimum of 600 mm below point of discharge in all instances Minimum of 2000 mm below point of discharge in Category 1 Soils	600 mm is consistent with other regional plans and AS/NZS 1547. 600 mm can provide for a moderate level of pathogen removal and attenuation of contaminants. It is noted that even with 600 mm separation, drainage to the aquifer will still have high pathogen loads, particularly for primary treated effluent, but should avoid there being a direct discharge to groundwater. Category 1 soils are highly permeable and have reduced ability to assimilate contaminants/remove pathogens. 2000 mm will promote greater removal in these vulnerable soils. ORC could give some consideration to requiring this over aquifers that are or could be used for domestic/community supply or stock water drinking supply.
Slope	ETA/ETS systems shall not be installed on systems exceeding 10% grade Conventional mounds, beds and trenches including LPED systems shall not be installed on systems exceeding 15% grade Sub surface drip irrigation systems shall not be installed on systems exceeding 30% grade	Consistent with AS/NZS 1547. Intended to limit the potential for lateral flow and seepage downslope of the disposal system.
Soil Type and Application Rate	Soils must be assessed in accordance with AS/NZS 1547. Application rates shall not exceed the rates set out in Tables L1, M1 and N1 of AS/NZS 1547. Discharge of primary treated effluent shall only be to Category 1 – 4 soils. Discharge to Category 6 soils shall only be secondary treated wastewater via drip irrigation	The site soil assessment process set out in AS/NZS 1547 is considered robust. These permitted activity rules reflect the need for site specific design in unfavourable soils, particularly medium-heavy clays which may have very low drainage rates exacerbating the potential health risks if wastewater emerges at the surface.

Table 5: Recommendations for Permitted Activity Limits/Thresholds

Parameter	Proposed Limit/Threshold	Reason/Consideration of Alternatives
Volume	Domestic wastewater up to 2000 L/day from a residential dwelling.	A lower limit has been considered; however, this may be overly restrictive on large households. For instance, a limit of 1300 L/p would indicate that a family of 8 does not meet the permitted activity threshold. In order to avoid this regulatory burden, it is considered important to limit the permitted activity threshold to domestic wastewater from residential dwellings only. Discharges from commercial facilities such as cafes or restaurants, or other facilities such as public toilets are likely to have significantly different wastewater compositions, which have not been considered in this assessment.
Bores	The following setback distances apply from any bore used for water supply (private/domestic) based on treatment provided and location: Into an alluvial gravel and sand aquifer: Primary treatment – 1000 m Secondary treatment – 500 m Secondary Treatment + UV disinfection – 50 m Into fractured rock or limestone aquifers: All discharges – Not Permitted Into other aquifers: All discharges – 50 m	Highly permeable gravel aquifers, such as those found in some parts of Otago, present a high risk of contamination of groundwater/water supply bores. Contaminants are rapidly transported downgradient allowing minimal time for die off. Fractured rock aquifers or limestone aquifers also have the potential for greater risk, which varies greatly depending on the aquifer. Consents could be required for all discharges over shallow fractured rock or limestone aquifers to account for this risk variability. The recommended setback distances apply to well operated and maintained systems only.
Surface Water	A disposal system shall not be installed within 50 m of a surface water body including open drains/roadside drains where: a. The average slope between the treatment system and disposal system and the	Recommend applying a minimum setback of 20 m but increasing this to the existing 50 m setback where the risk of contamination is higher due to slope, soil type and the nature of the surface water body that could be impacted.

Table 5: Recommendations for Permitted Activity Limits/Thresholds		
Parameter	**Proposed Limit/Threshold**	**Reason/Consideration of Alternatives**
	surface water body exceeds 10% grade (5.7° slope) b. The disposal site soils are Category 1, 5 or 6 c. Water quality targets are not being met or the surface water bodies are Lake Dunstan, Lake Hawea, Lake Wakatipu or Lake Wanaka or their tributaries. Or within 50 m of mean high-water springs. Or within 50 m of any tile drains or other form of sub-surface drainage. For all other sites, the minimum setback from a surface water body including open/roadside drains shall be 20 m.	
Flooding/Inundation	All primary treatment systems (septic tanks) shall be sited outside/above the 1 in 100-year flood zone/level. All other treatment systems and disposal fields shall be sited outside/above the 1 in 20-year flood zone/level.	As per AS/NZS 1547 but with a stricter requirement for primary treatment systems.
Water Quality	Where catchment water quality targets for nitrogen are not being met, or catchment water quality trends are declining or there is a risk of degradation, onsite wastewater systems shall not discharge wastewater with an annual median total nitrogen concentration more than 15 g/m³.	Rule wording to be determined by ORC.
Source Protection Zones	As per the NES for human drinking water sources	
Maintenance and Operation	Secondary Treatment systems must be maintained and operated in accordance with the manufacturer instructions and AS/NZS 1547. System owners must maintain records of	Lack of maintenance is one of the primary causes of localised adverse effects. Mandating maintenance under the permitted activity status would provide a regulatory tool to prevent

Table 5: Recommendations for Permitted Activity Limits/Thresholds

Parameter	Proposed Limit/Threshold	Reason/Consideration of Alternatives
	inspections, cleaning and maintenance work completed which can be provided to ORC on request. Primary treatment systems must be maintained and operated in accordance with manufacturer instructions or, in the absence of any instructions due to age or otherwise, in accordance with industry accepted good practice and AS/NZS 1547 including: – Inspection and cleaning (when required) of the outlet filter every 6 months. – Routine pump out of the accumulated sludge and scum; recommended every 3-5 years. – Disposal field does not have any wet or saturated areas. System owners must maintain records of inspections, cleaning and maintenance work completed which can be provided to ORC on request.	discharges of untreated wastewater to the environment due to failed septic tanks.
Potential additional Maintenance and Operation rules.	Onsite systems within *designated maintenance zones* shall not operate unless ORC has granted an *Onsite Wastewater Warrant of Fitness* (*OWWoF*). An *OWWoF* will be granted by ORC on receipt of a satisfactory onsite wastewater inspection and maintenance (cleanout) report from a qualified drainlayer. The duration of an *OWWoF* shall be at the discretion of ORC but shall not be issued for more than 5 years.	ORC to develop rule wording if required. ORC could consider maintenance zones for areas which are known to have adverse effects from failed systems. ORC could consider requiring upgrade to secondary or secondary + nutrient removal systems in areas where primary treatment onsite systems are having an adverse environmental effect within a set timeframe (10 years for Rotorua Lakes). ORC could consider requiring replacement for aging systems (30-year

Table 5: Recommendations for Permitted Activity Limits/Thresholds

Parameter	Proposed Limit/Threshold	Reason/Consideration of Alternatives
	By DD/MM/YYYY, onsite wastewater systems within *designated upgrade zones* shall only be permitted if the level of treatment (secondary, secondary + nutrient removal, and/or tertiary)is as required by the specific *designated upgrade zone*. Discharge from septic tanks which have been installed for more than 30 years is not permitted unless a valid *OWWoF* for the discharge has been granted.	design life specified in AS/NZS 1546.1) unless they have been proven to be functioning well, i.e., have obtained a Warrant of Fitness.
Density	Onsite wastewater systems are permitted on the following sections sizes: H1-H4 Nitrogen Sensitive Zones: Primary treatment – 1.5 ha Secondary treatment – 8,000 m^2 Secondary treatment + nutrient removal – 3,000 m^2 H5/H6 Nitrogen Sensitive Zones: Primary treatment – 2 ha Secondary treatment – 10,000 m^2 Secondary treatment + nutrient removal – 4,000 m^2 Other Areas: Primary treatment – 1 ha Secondary treatment – 6,000 m^2 Secondary treatment + nutrient removal – 2,000 m^2 Treatment levels are defined as: Secondary – system achieves 90^{th} percentile quality of 20 g/m^3 for BOD and 30 g/m^3 for TSS.	Based on area required to meet existing nitrogen sensitive zone limits. Can be updated as required if changes to these zones or limits are anticipated.

Table 5: Recommendations for Permitted Activity Limits/Thresholds

Parameter	Proposed Limit/Threshold	Reason/Consideration of Alternatives
	Nutrient Removal – is a median effluent concentration less than 15 g/m^3 Total Nitrogen	
Reticulation	Discharge from an onsite system is not permitted if there is a publicly owned or operated reticulation system within: – 30 m of the property boundary; or, – 60 m of the closest building on a property. – And the system has existed in that location for more than 12 months.	Reticulation can reduce cumulative effects of onsite wastewater. A grace period of 12 months has been included to allow for time to plan, design and construct a connection. ORC may wish to consider a longer period.

8.0 Other Considerations

8.1 Effects from New vs. Existing Systems

AS/NZS 1546.1 is the New Zealand standard which covers design of septic tanks. The standard sets out a typical design life of 20-30 years, with a maximum of 40 years expected for well-maintained systems. Systems which exceed these design lifetimes are more likely to be in poor condition and as a result have reduced treatment capacity. In many instances, dwellings may have septic tanks which are approaching or already exceeding their intended lifetime. The contribution to environmental effects from these systems is likely to increase with time. ORC should consider the balance of standards/requirements applied to new systems compared to existing systems. In many instances, the effects from existing systems could far exceed systems designed and installed to modern standards.

ORC should consider the impacts of permitted older systems with minimal requirements in different locations and how these systems should be replaced/upgraded over time, together with funding options.

8.2 Upgrade Requirements

The best process for requiring, implementing, and particularly funding upgrade or replacement of onsite systems is difficult to determine. For ORC's reference, we have highlighted several approaches taken previously below.

The first example is the EBOP On-site Effluent Regional Plan (2006). For high-risk catchments, this plan gave homeowners 10 years to upgrade their systems (primarily septic tanks) to achieve a high level of treatment (secondary treatment + nutrient removal) or connect to a reticulated system. This gives homeowners certainty of the requirements but sufficient time to resource an upgrade.

Another approach to consider is requiring upgrades to treatment systems if the house is sold or changes ownership. In this instance, a discharge from an existing septic tank would cease to be a permitted activity under new ownership. PDP understand this approach has previously been used to manage individual upgrades of wood burners in polluted airsheds. The potential benefits of this approach are that upgrade burden is known and can be factored in by the purchasing party and that the burden is not placed on existing owners, who may not have the financial resources to fund an upgrade out of pocket.

ORC, likely in combination with the relevant territorial authority, could also consider financing upgrades and recouping the costs with a targeted rate applied to the properties over an extended period. PDP is aware that this method has been utilised to fund reticulated systems in small communities.

8.3 Maintenance Zones

While not included in the permitted activity limits/thresholds described above, PDP recommend that ORC make some consideration for specific maintenance zones where owners are required to provide ORC with evidence they are maintaining and operating their septic tank in accordance with industry good practice. This could provide a more immediate and lower cost improvement in high-risk areas compared to replacement/upgrade of onsite systems. The requirement would likely include submission to ORC of a 'cleanout' report prepared by a licensed drainlayer after servicing of a septic tank. These maintenance zones would be targeted at areas of high septic tank density where the environmental risks of widespread septic tank failure are elevated.

Under the proposed PA rules, maintenance of a septic tank is required, however, one of the key benefits of a maintenance zone approach is targeting ORC's time and financial resources at areas of particular concern. In an ideal world, ORC could monitor all septic tanks for correct maintenance. However, financial and time constraints may limit this approach. Setting out specific areas of concern would allow for more efficient use of compliance resources.

8.4 Global Consent Approach to New Discharges

While not specifically related to permitted activity rules, we wish to highlight to ORC issues which have been identified by the onsite wastewater industry. The most important of these is the ability to consent new systems in new subdivisions. Issues have arisen in parts of Canterbury where existing groundwater quality exceeds targets, particularly for nitrogen. Increases in nitrogen losses as a result of new developments with onsite systems are therefore not considered acceptable. In many instances, the cost of applying for a consent has been placed on the individual owner of each section who is forced to apply individually for each consent. This causes several issues, firstly the maximum effect of each individual consent must be assessed and secondly, management of cumulative issues is difficult to implement on an individual basis.

ORC may wish to consider a strategy where, for subdivisions which will not meet the permitted activity rules, encouraging developers to apply for a "global consent" for onsite discharges in the subdivision. This would remove the burden on individual landowners, could provide better value for money technical assessment, allow for assessment of discharges 'averaged' over the whole community, allow for easier consideration of cumulative effects, and raise any issues which may prevent onsite wastewater discharges prior to individual landowners purchasing properties and subsequently seeking a consent.

9.0 Summary

In this report, PDP has identified and summarised a range of environmental factors which ORC should consider when preparing new onsite wastewater permitted activity rules and when assessing onsite wastewater consent applications. For each of these factors, thresholds or limits, where a more detailed review of location and design of on-site wastewater systems on a case-by case basis might be more appropriate (i.e. through a consent pathway), have been identified and justified based on local, national, and international literature and guidelines. The recommended thresholds and limits have been presented above in Table 5.

In addition to the individual thresholds, PDP have suggested ORC consider developing a risk assessment framework which considers the interdependencies of many of the risk factors. The framework could solely consider the risk of pathogens to drinking water or could additionally consider contributions to catchment nutrient loads and surface water quality outcomes. Considering multiple risk factors together may promote better environmental outcomes while reducing the need for consents for discharges which, when considering all factors, have a low risk of adverse environmental effects.

PDP have provided guidance on the suitability of *AS/NZS 1547:2012 On-site domestic wastewater management* within an Otago context. Generally, AS/NZS 1547 is suitable to use as a design and installation guide for onsite wastewater management. However, it should be supplemented by robust rules set out in a regional plan to help prevent individual and cumulative adverse effects.

A review of the technical information provided by Community and Public Health at the hearing on Environment Canterbury's Proposed Land and Water Regional Plan found that the evidence statements are in line with the guidance provided by PDP in this letter. However, caution is advised when interpreting the conclusions for Canterbury within an Otago context.

10.0 References

Auckland Council. (2021). *On-site Wastewater Management in the Auckland Region.* Auckland.

Auckland Regional Council. (2004). *Technical Publication No. 58 On-site Wastewater Systems:Design and Management Manual.* Auckland.

Bay of Plenty Regional Council. (2006). *Bay of Plenty On-Site Effluent Treatment Regional Plan.* Whakatane.

Blaschke, A. P., Derx, J., Zessner, M., Kirnbauer, R., Kavka, G., Strelec, H., . . . Pang, L. (2016). Setback distances between small biological wastewater treatment systems and drinking water wells against virus contamination in alluvial aquifers. *Science of the Total Environment, 573*, 278-289.

Johnson, B., & Freise-Preston, A. (2009). *Proposed National Environmental Standard for On-site Wastewater Systems. Report on submissions.*

Liquid Earth Limited. (2014). *Contribution of On-site Wastewater Disposal to Cumulative Nutrient Loadings in the Southland Region.* Invercargill: Environment Southland.

Ministry for the Environment. (2008). *Proposed National Environmental Standard for Onsite Wastewater Systems Discussion Document.*

Ministry for the Environment. (2018). *Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition. Wellington: Ministry for the Environment.*

Moore, C., Nokes, C., Loe, B., Close, M., Pang, L., Smith, V., & Osbaldiston, S. (2010). *Guidelines for separation distances based on virus transport between on-site domestic wastewater systems and wells.* Porirua: Environmental Science and Research Limited.

Naish, T., Levy, R., Hamling, I., Garner, G., Hreinsdottir, S., Kopp, R., . . . Wallace, L. (2022, July 07). The significance of vertical land movements at convergent plate boundaries in probabilistic sea-level projections for AR6 scenarios: The New Zealand case.

New Zealand Geotechnical Society. (2004). *Field Description of Soil and Rock.*

Otago Regional Council. (2006). *Groundwater quality in Kingston and Glenorchy.* Dunedin.

Otago Regional Council. (2023, 05 23). *How we develop a new land and water plan.* Retrieved from Otago Regional Council Website: https://www.orc.govt.nz/media/14462/managing-discharges-wastewater-and-stormwater-systems-industrial-and-trade-waste-and-earthworks.pdf

Pang, L., Close, M., Goltz, M., Noonan, M., & Sinton, L. (2005). Filtration and transport of Bacillus subtilis spores and the F-RNA phage MS2 in a coarse alluvial gravel aquifer: Implications in the estimation of setback distances. *Journal of Contaminant Hydrology*, 165-94.

Pasciucco, F., Pecorini, I., & Iannelli, R. (2022). Planning the centralization level in wastewater collection and treatment: A review of assessment methods. *Journal of Cleaner Production*.

Pattle Delamore Partners. (2011). *New Zealand Guidelines for the Monitoring and Management of Sea Water Intrusion Risk on Groundwater.* Envirolink.

Pattle Delamore Partners. (2018). *Technical Guidelines for Drinking Water Source Protection Zones.* Christchurch: Ministry for the Environment.

Schijven, J. F., Mulschlegel, J. H., Hassanizadeh, S. M., Teunis, P. F., & de Roda Husman, A. M. (2006). Determination of protection zones for Dutch groundwater wells against virus contamination - uncertainty and sensitivity analysis. *Journal of Water and Health*, 297-312.

Schijven, J., Pang, L., & Ying, G.-G. (2017). *Evaluation of subsurface microbial transport using microbial indicators, surrogates and tracers.* Institute of Environmental Science and Research. doi:https://doi.org/10.26091/ESRNZ.7967336.v1

Stats NZ. (2020, November 13). *2018 Census*. Retrieved from Stats NZ: https://www.stats.govt.nz/2018-census/

11.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Otago Regional Council and others (not directly contracted by PDP for the work). PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Otago Regional Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by

Oliver Hunt

Senior Environmental Engineer

Prepared by

Neil Thomas

Technical Director – Water Resources

Reviewed and Approved by

Hilary Lough

Technical Director – Water Resources