Low depth irrigation

Two low depth effluent irrigation methods are utilised; a travelling irrigator for dairy shed effluent (just WW1&2) and the slurry tanker with the trailing shoe for slurry (both WW1&2 and the Horner Block). Both systems will apply effluent at low depths; less or equal to 10 mm per application for the travelling irrigators and a maximum of 2.5 mm per application for the trailing shoe slurry tanker.

By discharging 15.2 m^3/hectare, the slurry tanker system applies effluent at a depth of 1.5 mm and can apply effluent at lower depths (e.g. 1 mm) by speeding up the tractor travel speed. The use of very low depth irrigation using the slurry tanker with a trailing shoe increases the frequency by which it is safe to apply effluent because a lower soil moisture deficit is required prior to irrigation. A slurry tanker with a trailing shoe is available for use as and when required.

The travelling irrigators have been tested and found to apply effluent to a depth of less than 10 millimetres each (see Appendix for reports). The travelling irrigators are only used when there is sufficient soil moisture deficit and no rain is forecasted for the following 24 hours. Where insufficient soil moisture deficit exists, dairy shed effluent irrigation is deferred by diverting to the ponds for storage.

The application of effluent (both dairy shed and slurry) in this manner should reduce the risk of exceeding a soil's infiltration rate, thus preventing ponding and surface runoff of freshly applied effluent. A low application depth also increases the likelihood of retaining the applied nutrients in the root zone. This decreases the likelihood of preferential flow and allows a greater volume of applied effluent to move through smaller soil pores via matrix flow, thus allowing for greater attenuation of effluent contaminants[22] [23]. This is of importance where subsurface drainage has been installed.

Best practice irrigation minimises the risk of contaminant loss via pathways relevant to the Central Plains and Oxidising physiographic zones; subsurface drainage (tiles) when wet in winter/spring and deep drainage when cracks are present or when soils are saturated. Effluent is not applied over low points, where tile drains have been installed, when soils are near or at field capacity. In addition to this, buffer distances from discharge area to surface waterways are maintained minimising the risk of effluent reaching surface waters directly via overland flow or spray.

Future proof – WW1&2

In order to future proof the discharge activity at WW1&2, low rate irrigation (pods or a cannon/rain-gun) is included in this application and AEE. The applicants have already demonstrated a willingness to invest, upgrade and innovate, which is evident in their recent investment in wintering barns. They will consider upgrading the dairy shed irrigation system as part of future developments once the current round of investment and expansion at WW1&2 has been completed. The proposed system is described in section 6. Low rate irrigation is considered as best practice by Environment Southland, as such it will have effects that are the same or less than the existing low depth irrigation system.

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[22] Houlbrooke DJ, Monaghan RM, Smith LC and Nicolson C (2006) Reducing contaminant losses from land applied farm dairy effluent using K-line irrigation systems. In: Currie, L.D. and Hanly, J.A. (ed.) Implementing sustainable nutrient management strategies in agriculture. Fertiliser and Lime Research Centre, Massey University, Palmerston North, pp. pp. 290-300.

[23] McLeod M, Schipper LA, Taylor MD (1998) Preferential flow in a well drained and a poorly drained soil under different overhead irrigation regimes. Soil Use and Management, 14, 96-100.

Effluent receiving areas and nutrient loading

The effluent receiving area is large and comprises a combination of low and high-risk soils at both WW1&2 and Horner Block. When the application depth is limited as already described, the presence of low risk soils reduces the risk of contaminant loss to ground and surfacewaters due to its drainage properties (matrix flow). This allows higher risk areas to be avoided when soils are at or above field capacity and there is risk of bypass drainage to ground and surfacewaters.

It has been demonstrated in section 6 and in the nutrient budget analysis report that the effluent receiving area is sufficiently large to receive both the N loading from slurry and the volume of slurry from the storage ponds. The higher strength nature of slurry effluent has been accounted for in calculating the N loading per hectare from slurry.

A maximum of 150 kg N/hectare from effluent (including both liquid and slurry) will be applied at the WW1&2. The 150 kg N/hectare limit will be adhered to, which is the standard limit placed on farm dairy effluent discharge activities on milking platforms by Environment Southland.

The scale of the discharge activity allows for the sustainable use of land to receive effluent. The consented discharge area is large and has a ratio of over 30 hectares per 100 cows, which is well above the Council recommended ratio of 8 hectares per 100 cows. As is modelled in Overseer, where effluent or slurry is applied to land, fertiliser is reduced accordingly, which mitigates the risk of overloading soils with nutrients such as N and P causing loss to water.

Horner Block – slurry receiving area

A maximum of 250 kg N/hectare will be applied from slurry at the cut and carry Horner Block (97 ha). The block is used to grow grass to feed cows at various farms and is not used to graze cows directly. Typically, there will be 4 cuts per season. Cows were IWG at the Horner Block in the past but are no longer grazed there. Urine patches are a major source of N leached to groundwater from pastoral farming. Since no stock is grazed at the Horner Block there are no recent/new urine patches, which greatly reduces N loss.

Cut and carry blocks are efficient at utilising N and generally have low N loss to water[24] despite high N inputs; this is supported by Overseer analysis for existing and proposed activities at the Horner Block. Under the proposal, Overseer modelled the application of 243 kg N from slurry and predicts low average annual N loss (i.e. 19 kg N/hectare). This supports the conclusion that the risk of nitrate loss to groundwater is very low from the use of the Horner Block as a cut and carry block. The potential issue of cracking in Braxton soils (arguably not covered by Overseer) is mitigated by always maintaining good pasture cover and plant root structure, and by monitoring and avoiding areas if and where this occurs.

As is modelled in the proposed nutrient budget, less N fertiliser will be applied to off-set the N input from slurry to ensure that N inputs at the Horner Block are not excessive. Overall (from both slurry and fertiliser), no additional N will be applied compared to what has been applied previously and pasture production will be maintained at its existing levels.

[24] McLeod (2015). NITROGEN LEACHING FROM CUT-AND-CARRY LUCERNE. Landcare Research. https://www.massey.ac.nz/~flrc/workshops/15/Manuscripts/Paper_McLeod_2015.pdf

It is unlikely that the discharge of slurry at the Horner Block will result in elevated groundwater nitrate levels. Due to soil types (Drummond and Waiau) and their drainage properties (matrix flow), much of the HB classed as low risk for effluent discharge. So long as slurry is applied at a depth lower than the soil moisture deficit and at less than 50% of PAW, there is minimal risk of nitrate loss to groundwater from low risk soils, as supported by Houlbrooke et al. (2006).

Where high risk soils are found (Braxton), there is a potential pathway for nitrate to reach groundwater via deep cracks that can form due to swell/crack properties of these soils. The east of the HB where Braxton soils are found, is monitored for evidence of cracking at high risk times (summer/autumn); slurry will not be discharged to areas where cracks form. Good soil management practices, as shown in the soil test trends appended to the application, mean that deep cracks are unlikely to form. Good pasture cover (and plant root structure) is always maintained, again minimising the risk of cracks to groundwater forming in the soil profile.

Downstream users of groundwater are dairy, sheep and cropping farms. These will not be adversely affected by the N loading of soils from slurry at the HB, as little or no N applied in slurry will be lost to groundwater; it will be taken up by plants and harvested as part of the cut and carry operation. Similarly, Drummond Township, Primary School and Kindergarten will not be affected by the N loading of soils from slurry at the HB. Groundwater nitrate levels in the vicinity and south of the HB are in the range of 1.0 – 8.5 g/m^3, so are below the NZ Drinking Water MAV of 11.3 g/m^3. The cumulative effect on groundwater nitrate levels from the N loading from slurry at the HB will extremely low due to the above reasons. The effects of the N loading from slurry effluent on groundwater will be minor, and much lower than when the HB was used in the past to IWG cows on fodder crop.

Summary of mitigations for Horner Block

- Slurry is applied at very low depth using slurry tanker with trailing shoe (less than or equal to 2.5 millimetres per application), when there is sufficient soil moisture deficit and nil risk of drainage;
- Soils are monitored for evidence of cracking; if and where this occurs slurry and fertiliser are not discharged;
- N loading (from slurry and fertiliser) is to a cut and carry block, so uses relatively high N inputs to grow grass. N is utilised efficiently to grow grass resulting in low N loss below the root zone;
- A maximum of 250 kg N/hectare will be applied from slurry annually with N fertiliser reduced to allow for the loading from slurry;
- Recommended buffers will be adhered to when discharging slurry.

Summary of surfacewater mitigations for effluent discharge at WW1&2 and Horner Block

Due to the implementation of good management practices and mitigation measures, there will be minimal risk to receiving surfacewaters in the Waimatuku, Oreti and Aparima catchments, the Waimatuku, Jacobs River and New River Estuaries, coastal waters and their values from the discharge activity. Effects on receiving surfacewaters due to the proposed discharge activities at WW1&2 and the Horner Block will be no more than minor.

The discharge of agricultural effluent at both WW1&2 and the Horner Block will be operated so that:

- Irrigation of effluent is deferred when there is insufficient soil moisture deficit to safely apply effluent or when there is risk of drainage following irrigation of effluent. Effluent is stored in two large effluent ponds at WW1&2, which have sufficient storage for proposed activity according to the Massey DESC. This is effective at avoiding the risk of contaminant loss to surfacewaters from effluent when soils are at or above field capacity.

- Low depth irrigation methods are used to apply effluent to land. A slurry tanker with a trailing shoe is always available for use at WW1&2 and the Horner Block, and can apply slurry effluent to depths as low as 1 mm per application. Slurry is always applied at no more than 2.5 mm per application, which increases the number of irrigation days when effluent can safely be applied to land without risk of drainage. The travelling irrigators are only used at WW1&2 to apply effluent to depths of less than 10 mm per application. Irrigation using the travelling irrigators is deferred by diverting effluent to the storage ponds unless there is sufficient soil moisture deficit. There is minimal risk to receiving surfacewaters when irrigating using these methods where there is sufficient soil moisture deficit. A low rate system may be installed at WW1&2 in the future, which will similar or less effect on surfacewaters.

- Recommended buffers to waterways are implemented, mitigating the risk of contaminants present in effluent (i.e. N, P, microbes) reaching surfacewaters via overland flow. Effluent is not applied over tile drains when there is risk of preferential flow via drains to surfacewaters, mitigating the risk of the same contaminants present in effluent reaching surfacewaters via artificial drainage.

- The discharge area is sufficiently large both in terms of the area (ha) per 100 cows, and the N loading from effluent to effectively mitigate the risk of contaminant loss from effluent to surfacewaters. WW1&2's application rate will not exceed 150 kg/hectare, and the Horner Block will not exceed 250 kg N/hectare. The high strength nature of slurry effluent has been allowed for in calculating the N loading from slurry. The on-site slurry tanker allows for very low application depths, which effectively controls the N loading per hectare from slurry and minimises the risk of contaminants present in effluent being lost to receiving surfacewaters.

Groundwater – mitigation of effects

Many good management practices and mitigation measures for effluent discharge at both WW1&2 and the Horner Block described above also apply to avoiding, remedying and mitigating adverse effects on groundwater. These practices and measures are not repeated here; please refer to above. Whilst the effects of the discharge and dairy farming activities on groundwater are assessed separately in Section 7.1 and 7.3 respectively, it is difficult to separate these effects in practice.

Nitrate in groundwater due to the discharge activity:

Given the nature of effluent management at the WW1&2 and Horner Block, in addition to the scale of the discharge activity including the N loading of soils from effluent (dairy shed/liquid and slurry), it is very unlikely that the discharge of effluent at WW1&2 and the Horner Block will adversely affect water quality through an increase in groundwater nitrate concentrations from effluent.

Despite its tendency to suffer from localised contamination, the bore at the south end of WW1&2 (E45/0622) has demonstrated relatively low groundwater nitrate concentrations over the last five years (1.0 – 3.5 g/m^3), albeit with evidence of wellhead contamination due to its design, and therefore elevated nitrate levels at times. These localised events should not adversely affect groundwater quality beyond the zone of reasonable mixing. A monitoring bore located mid-farm/east on lighter soils and in a different groundwater zone (E45/0665) shows higher levels of groundwater nitrate over the last three years, indicative of moderate to high land use impacts (3.5 – 8.5 g/m^3), but lower than at an ES monitoring bore located at Boyle Road to the south east, where groundwater nitrate levels are at or above the NZ Drinking Water Standards MAV of 11.3 g/m^3. Bores located to the south east show evidence of higher groundwater nitrate levels than at WW1&2.

Given that groundwater nitrate levels are lower at WW1&2 it is unlikely that the discharge of effluent is adversely affecting water quality through an increase in groundwater nitrate concentrations from effluent discharge. Groundwater nitrate levels have been reasonably stable since bore testing began. The "farming" effect on free draining soils is likely to have a greater effect on groundwater nitrate levels than effluent discharge at very low and low depths on low risk soils. For instance, farming practices such as growing fodder beet/IWG on free draining soils are expected to have a greater cumulative effect on groundwater quality. Moving away from this practice should see an improvement for groundwater quality, although it may be difficult to detect this due to effects from other properties and activities in the area.

There is minimal risk to the registered bore for drinking water supply at Heddon Bush School from the discharge of effluent (dairy shed/liquid and slurry) at WW1&2 and the Horner Block. The bore for school water supply (E45/0718) was recently tested (2017/2018) and returned nitrate concentrations in the range of 1.8 – 2.0 g/m^3. Given the following factors, adverse effects from the discharge activity such as an increase in groundwater nitrate levels would have been seen for some time in the vicinity of the school if they were present:

- the proximity of the school approximately 2.3 km south of the landholding;
- the direction of groundwater flow from much of the landholding (south towards the school);
- land use at and around the landholding, and north of the school since the 1980s. This includes cereal cropping, sheep farming, dairy farming and intensive winter grazing. Cereal cropping and IWG are activities that lose high levels of N through increased mineralisation processes;
- the length of time the land has been used for dairy farming (Woldwide 1 since 1992, Woldwide 2 since early 2000s);
- the estimated lag times for nitrate to percolate through the vadose zone, reach the water table and the underlying groundwater stream are short, and
- the estimated velocity of groundwater flow.

The evidence so far does not indicate that the discharge activity at WW1&2 and the Horner Block is having an adverse effect on the Heddon Bush School water supply through an increase in groundwater nitrate levels. The depth of the school bore further helps to protect it from land-use effects. The proposed activity is the same in nature and is of slightly increased scale compared to the existing discharge activity and will pose minimal risk of groundwater nitrate related adverse effects at Heddon Bush School.

The bore located at the south of WW1&2 has been described above and is believed to be in the same "stream" of groundwater flow as the Heddon Bush groundwater supply. Its nitrate levels are generally low, with the already described localised contamination events due to poor well design. The applicants are proposing to install a new monitoring bore using industry best practice methods, which should not have issues with wellhead contamination. The new bore will be located at the south of WW1&2, in the groundwater "stream" believed to flow towards Heddon Bush School. Water quality results from the bore will be monitored by the applicants and used to inform decision making relating to the management of the discharge activity.

Shallow groundwater in the Waimatuku Catchment is understood to discharge to the local stream network. An effect of groundwater nitrate could be an increase in nitrate levels in downstream receiving waters such as shallow streams (connected to groundwaters), the Waimatuku Stream and eventually coastal waters. The risk of nitrates in effluent reaching groundwater is mitigated through using deferred storage and low depth irrigation. There is minimal risk to receiving surfacewaters through the discharge of groundwater from the discharge activity.

Faecal contamination of groundwater due to the discharge activity

If faecal microbes from the discharge activity are/have been reaching groundwater, the testing of groundwater, especially from bores located in the south, could reveal this to be the case.

Groundwater testing of bores at and at WW1&2 are generally negative for *E.coli*, but at times have returned positive results with general low counts. As has already been explained, the south bore (E45/0622) experiences localised contamination due to its design, which makes it unsuitable for use a monitoring bore and makes interpretation of *E.coli* data from the bore questionable; *E.coli* data from the WW1 bore are corrupted by localised contamination. Following the zone of reasonable mixing, there is likely to be minimal adverse effect on the wider groundwater resource from this localised source. However, it is proposed to repair the existing bore and to install a new monitoring bore. These steps should eliminate the issue of localised contamination and provide a valid source of reliable groundwater *E.coli* data.

The mid-farm/east monitoring bore (E45/0665) has generally been negative for *E.coli* since it was installed in 2015. It has however returned three positive *E.coli* results in that time. The relatively high result in November 2017 is an outlier in the dataset and was likely to have been due to recent prolonged heavy rainfall, which occurred between November 3rd and 12th, and resulted in a high level and rate of drainage and the observed *E.coli* result (see figure 7.2). The subsequent test in April 2018 was negative for *E.coli* (<1 MPN/100 ml). The ES monitoring bore at Boyle Road, which is southeast of the WW2 bore and in the same groundwater zone, is tested every three months. It has consistently been negative for *E.coli* in recent years with the exception of December 2017 (5 MPN/100 ml). It too was subsequently negative for *E.coli* in March 2018 (<1 MPN/100 ml). This indicates that if groundwater contamination occurs due to very high and intense rainfall and subsequent rapid drainage, it is relatively short lived, which is in line with the length of time that *E.coli* and similar microbes are believed to remain viable in groundwater (three months or less).

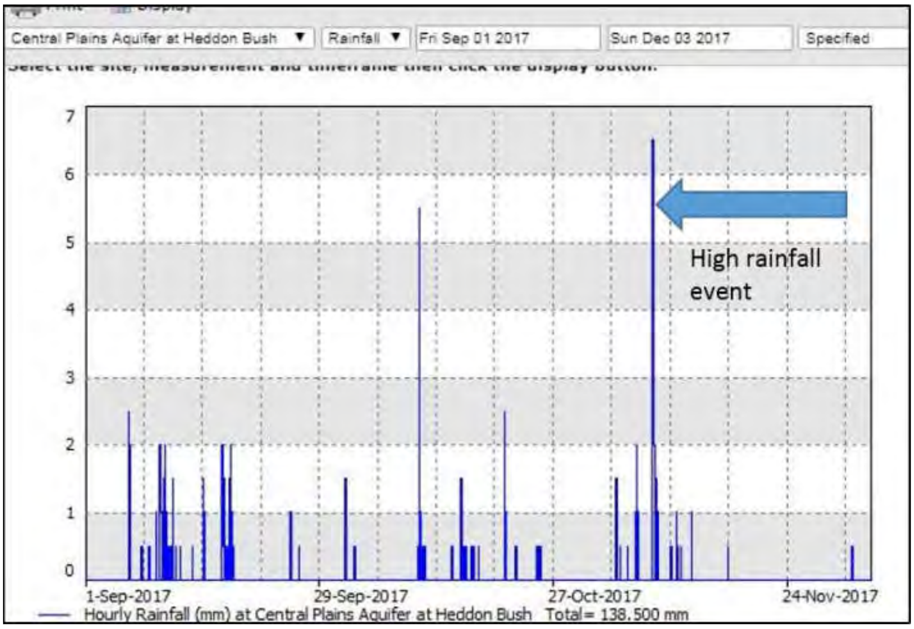

Figure 7.2. Rainfall at Central Plains Aquifer at Heddon Bush.

Slurry effluent is high strength in nature, including its microbial content. Applying slurry effluent at very low depth when there is sufficient soil moisture deficit (e.g. 2 mm depth per application), ensures that the microbial loading of soils is low enough to allow soils to filter microbes. This will allow them to be retained in the topsoil sufficiently long so that they die off and become unviable. U.V. radiation plays a role in this process. The N loading limits of 150 kg/hectare and 250 kg/hectare at WW1&2 and Horner Block respectively, will allow for control on the soil loading of microbes from effluent by proxy. So long as effluent irrigation is always deferred when the water table is high and there is risk of bypass drainage, microbes present in effuent will be filtered and attenuated onto soil particles without passing through the soil and will die off[25][26].

A risk of bypass drainage from the potential cracking process of Braxton soils also applies to microbes. On-site investigation found that the risk of Braxton soils at WW1&2 and Horner Block cracking is lower than previously thought. So long as soils are managed to minimise the risk of cracking, best practice effluent management is followed, soils are monitored for cracking and cracked areas are avoided, then there is minimal risk of microbes being transported to groundwater via deep cracks.

In summary the effect from the discharge of effluent (dairy shed and slurry) at WW1&2 and Horner Block in terms of microbial contamination of groundwater will be no more than minor.

~~There is minimal risk of microbial contamination of the registered bore for drinking water supply at Heddon Bush School from the discharge of effluent (dairy shed and slurry) at WW1&2 and the Horner Block. The bore has been tested quarterly since it was drilled and has consistently returned negative *E.coli* results (<1 MPN/100 ml). Given the factors listed on page 130, as well as the lifetime of *E.coli* in the environment (up to 3 months according to Edberg et al. 2000), adverse effects from the discharge~~

[25] McLeod et al. (2008). Regionalising Potential for Microbial Bypass Flow through New Zealand Soils. J. Environ. Qual. 37:1959-1967

[26] Liping Pang et al. (2008). Modeling Transport of Microbes in Ten Undisturbed Soils under Effluent Irrigation. Vadose Zone J. 7:97–111

activity such as microbial contamination would have been seen for some time in the vicinity of the school *if they were present*. The evidence so far does not indicate that the discharge activity is having an adverse effect on the Heddon Bush School water supply through faecal contamination of groundwater. The proposed discharge activity is the same in nature and is of slightly increased scale compared to the existing discharge activity; there will be little or no increase in faecal microbes due to the proposed activity. It is noted that the depth of the school bore further helps to protect it from land-use effects, as does the presence of an ozone purification treatment system.

The bore located at the south of the property (E45/0622) has been described above and is believed to be in the same "stream" of groundwater flow as the Heddon Bush groundwater supply. It is unsuitable for use as a monitoring bore as it suffers from localised contamination due to its design. The applicants are proposing to repair it to avoid localised contamination of groundwater. The will also install a new monitoring bore using industry best practice methods, which should not have issues with localised contamination. The new bore will be located at the south of WW1&2, in the groundwater "stream" believed to flow towards Heddon Bush School. *E. coli* results from the bore will be monitored by the applicants and used to inform decision making.

In conclusion there is minimal risk that consumers of groundwater, including at Heddon Bush School, will develop gastroenteritis due to faecal contamination of groundwater from the discharge activity.

Summary of mitigations for groundwater – WW1&2 and Horner Block

Due to the implementation of good management practices and mitigation measures, there will be minimal risk to underlying groundwater resources, including the Waimatuku, Central Plains and Upper Aparima Groundwater Zones, and consumers of groundwater including Heddon Bush School due to the discharge of effluent at WW1&2 and Horner Block. Effects on groundwater due to the proposed discharge activities will be no more than minor.

The discharge of agricultural effluent at both WW1&2 and the Horner Block will be operated so that:

- Irrigation of effluent is deferred when there is insufficient soil moisture deficit to safely apply effluent or when there is risk of drainage following irrigation of effluent. Effluent is stored in two large effluent ponds at WW1&2, which have sufficient storage for effluent from the proposed activity according to the Massey DESC.

- Low depth irrigation methods are used to apply effluent to land. A slurry tanker with a trailing shoe is always available for use at WW1&2 and the Horner Block, and can apply slurry effluent to depths as low as 1 mm per application. It typically applies slurry effluent to depths of 1.5 mm per application, which increases the number of irrigation days when effluent without risk of drainage. The travelling irrigators at WW1&2 apply effluent to depths of less than 10 mm per application. There is minimal risk to receiving groundwater when irrigating using these methods where there is sufficient soil moisture deficit. A low rate irrigation system may be installed at WW1&2 in the future.

- Soils are managed to minimise the risk of crack formation. They are monitored for cracks and effluent is not applied on Braxton type soils, if and where cracks form following extended summer dry periods. This mitigates the risk of contaminants loss via preferential flow down deep cracks to shallow groundwater.

- The discharge area is sufficiently large both in terms of the area (ha) per 100 cows, and the N loading from effluent. The high strength nature of slurry effluent has been allowed for in calculating the N loading from slurry effluent. The on-site slurry tanker allows for very low application depths, which effectively controls the N loading per hectare from slurry and minimises the risk of contaminants present in effluent being lost to groundwater during drainage events. The slurry tanker application depth allows for effective control of N loading and microbial loading of soils, which allows microbes to be retained in the topsoil, filtered and attenuated until they become unviable.

- Installation of a new monitoring bore is proposed at the south of WW1&2 to eliminate monitoring issues relating to localised contamination of the shallow E45/0622 bore. The bore will be used to monitor groundwater quality flowing south, in the predominant direction of groundwater flow at WW1&2 and in the direction of Heddon Bush School. Data collected from monitoring groundwater quality will be used to inform on decision making, including effluent management. The existing house bore will be upgraded to prevent localised contamination of the groundwater resource.

Soil health

There is little or no risk to the life supporting capacity of soils at WW1&2 or the Horner Block due to the effluent discharge activity. The utilisation of land treatment for effluent allows for the sustainability of the soil ecosystem. The soils are suitable for effluent irrigation and the discharge follows current good management practice. These include practices of a general nature and those specific to the contaminant transport pathway for the physiographic zones (artificial drainage, deep drainage).

The existing storage ponds allows for deferred storage until the soil moisture content is suitable for irrigation for 1,500 cows on the farm. The land disposal area is larger than the best practice recommendation of 8 hectare per 100 cows. The land disposal areas at the Horner Block and WW1&2 is sufficiently large to receive slurry effluent from the ponds, without exceeding the 250 kg N/hectare limit for the Horner Block, and 150 kg N/hectare for WW1&2. The WW1&2 N loading is below the recommended restriction of 150 kg N typically placed on discharge permits by Environment Southland. The N loading to the Horner Block is appropriate due to the nature of activities carried out there. This system is sustainable in the long term as it allows the effluent to be used both as a fertiliser and a soil conditioner, which improve the soil's health.

An ongoing soil monitoring programme is carried by the applicants and their fertiliser supplier (Ravensdown) at WW1&2 and Horner Block. Trends in soil tests are evaluated and used to inform on decision making, including effluent management. See the appended reports from Ravensdown for the WW1 and WW2 dairy units and the Horner Block. Good nutrient management is evident in soil fertility trends and is indicative of healthy soils. Effects on the soil resource due to the proposed effluent discharge activity will be no more than minor.

Effluent storage and infrastructure

The effluent system meets the needs of the proposed activity according to the Massey DESC.

WW2's pond stores slurry, is clayed lined and does not have a leak detection system. It has been drop-tested but could not meet all Appendix P criteria due to the high solid content of slurry. Based on the CPEng peer reviewed drop test report, in 2017 Environment Southland accepted that pond was not leaking. The applicants believe that by storing slurry, the risk of the pond leaking is reduced. This is because the characteristics of slurry versus liquid effluent in ponds/lagoons are quite different. Due to a much higher DM content [27], slurry has relatively low viscosity compared to liquid effluent and has self-sealing properties [28]. Whilst the process is not fully understood, self-sealing of slurry ponds reduces the risk of leakage through clay/earthen-lined ponds. Wind-driven wave action can cause bank erosion in ponds where energy carried in waves damages the clay substrate. This does not arise when storing slurry since the pond surface is solid and does not move via wave action. WW2's pond was designed and built in c.2009 to meet the required standards at the time. It was visually inspected by a SQP in 2018. The inspection confirmed that there were no visible cracks, holes of defects that would allow effluent to leak. Based on these factors, the applicants believe that WW2's pond is fit for purpose and that there is minimal risk to ground, surfacewaters and soils through using it to store effluent (slurry) from the wintering barn, dairy shed and silage pad at the WW2 unit.

WW1's pond was upgraded in autumn 2018, when its storage capacity was increased and a synthetic liner (1.5 mm HDPE) was installed. The liner overlies a leak detection drain system, the specification for which was provided by a CPEng and approved by the Council engineer in 2018 as meeting Practice Note 21 requirements for small ponds. CPEng sign off for the pond was submitted to Council as required. The leak detection system has a ring drain, which terminates at a 400 mm diameter inspection well (piezo). The leak detection inspection well has been inspected regularly and either had no liquid or had liquid when the water table was high. The liquid had was clear and had no odour, indicating that it did not contain effluent. There is therefore no evidence of leakage from the pond. Based on operating with the normal operating parameters of a leak detection system, the specifications of which were provided by a CPEeng and approved by the Council engineer, the applicants believe that WW1's pond is fit for purpose and there is minimal risk to ground, surfacewaters and soils through using it to store effluent (slurry) from the wintering barn and dairy shed at the WW1 unit.

WW1 and WW2 units both have ancillary structures that store effluent including a sand trap, dairy shed pump sump and wintering barn collection sump. All have been visually inspected by a SQP and show no visible cracks, holes or defects that would allow effluent to leak. Structures connected to the dairy shed cannot be diverted during the milking season. Drop tests can be carried out on the dairy shed ancillary structures in the off-season if required. An Appendix P drop test on wintering barn collection sumps will be carried out as soon as possible and prior to the wintering barns being used in May. Results will be submitted to Council accordingly. The applicants believe that ancillary structures that contain, store or treat effluent at WW1&2 are fit for purpose and that there is minimal risk to ground, surfacewaters and soils from using them.

Two low depth travelling irrigation systems used at the dairy platform have been tested as per consent conditions and found to meet the required depth of less than 10 mm/application (see Appendix). The slurry tanker with the trailing shoe has been tested in the past and shown to achieve very low application depths; it can be retested if necessary. A low rate system such as pods or a cannon/rain-

[27] Houlbrooke, Longhurst, Orchiston & Muirhead (2011) Characterising dairy manures and slurries. Report prepared for Surface Water Integrated Management (SWIM), AgResearch

[28] Parker, David & Schulte, D.D. & Eisenhauer, D.E. (1999). Seepage from earthen animal waste ponds and lagoons - An overview of research results and state regulations. Transactions of the ASABE (American Society of Agricultural and Biological Engineers). 42. 485-493. 10.13031/2013.13381.

gun system may be installed in the future, once the current round of investment and expansion has been completed.

Summary

It is reasonable to conclude that there will be little or no risk to groundwater or surface waters including cumulatively, or to the soil resource by granting replacement of the existing discharge permit to allow for the discharge of effluent from 1,500 cows at the WW1&2, and by granting consent to discharge agricultural effluent (slurry) from WW1&2 to 97 hectares of land at the Horner Block. Actual and potential effects from the activity have been considered and are no more than minor.

Alternatives to effluent discharge methods

The irrigation systems in place are designed to meet best practice guidelines – specifically the use of very low depth, low depth irrigation and deferred storage of effluent. The applicants believe their system is both cost-effective and easy to manage.

An umbilical system has been included in the discharge permit because it provides a method of discharging large volumes of effluent at very low depths to different parts of the effluent discharge area. The umbilical system will be used as a potential back up to the very low depth slurry tanker.

The umbilical system is a high rate/low depth application method. The depth of application is closely controlled by tractor speed. The depth of application will not exceed 3 mm for the umbilical system and it can apply slurry at lower depths (e.g. 2 mm) by increasing the tractor travel speed. At this depth it poses no more potential for adverse effects on the receiving environment as the low depth system.

Low rate irrigation has been included in the discharge permit because it is a best practice management irrigation method. A low rate pod or cannon/rain-gun irrigation system may be installed and used to complement the low depth travelling irrigator irrigation system and low depth slurry tanker.

The pods and cannon travelling irrigator systems are low rate/low depth application methods. They pose no more potential for adverse effects on the receiving environment as the low depth irrigation systems.

7.2 Water Take

The water take is from the Waimatuku Groundwater Zone.

The abstraction should have a less than minor effect on aquifer sustainability and water availability. The Waimatuku Groundwater Zone has low allocation status and the proposed take is moderate, although it is increasing relative to applicant's existing take. The applicants seek a maximum abstraction of 180,000 litres of groundwater per day. This is consistent with a total of 120 L/cow/day by allocating 70 L for stock drinking water and 50 L for shed wash down water for 1,500 cows. This equates to an annual take of 55,296 m^3 based on seasonal milk supply and a winter take for drinking water for stock housed in barns. The take is considered reasonable in terms of Policy 21 of the Regional Water Plan. Based on the estimated recharge rate to the Waimatuku Groundwater Zone (Lincoln Environmental, 2003), annual recharge of the aquifer underlying the property is approximately 2,344,340 m^3. The annual water take is 2.4% of this volume.

Groundwater is abstracted from three bores at WW1&2 for dairy shed supply and stock drinking water, and bores are over 50 metres apart. The rate of take from individual bores does not exceed 2 L/sec and should not cause stream depletion effects on adjacent water bodies. Three water storage tanks are utilised at each dairy shed to ensure that the rate of take does not exceed 2 L/sec. The nearest neighbouring bore is over 700 m from the abstraction point and should not experience drawdown effects due to the take. There will be little or no effect on other water uses due to the water take.

Water efficiency will be a key focus on farm. Simple tasks such as keeping water reticulation systems and dairy shed plumbing in a good state of repair will prevent water leaks and reduce water wastage. Water metering devices have been installed to ensure the water use is monitored via a standard cumulative water meter and will allow the data to be supplied to Council as per the consent conditions.

Overall the abstraction should have a less than minor effect on water availability, other water users or the Waimatuku Groundwater Zone.

Assessment of Alternatives for Water Supply

There have not been any improvements in technology, which would achieve a better environmental result than the current groundwater supply to the farm. Effects on bore yields on neighbouring bores are expected to be no more than minor; the proposed groundwater take is greater than the existing take but is still low relative to recharge rates in the groundwater zone. There is no surface water take. There will be no effect due to this activity on in-stream life, wetlands, recreational activities or marginal strips.

7.3 Assessment of effects from the farming activity

This section provides an assessment of effects from the farming activity at WW1&2 in its entirety, in accordance with Schedule 4 of the RMA. Based on advice from Environment Southland, it has been structured to answer three broad questions:

1. What are the effects from the whole activity on the receiving environment?
2. What are the effects from the additional cows over and above what is already in place?
3. What are the broad scale cumulative effects from farming on the receiving environment?

The discharge activities at WW1&2 and the Horner Block form part of the overall farming activity. Effects considered and assessed in section 7.1 also fall within the AEE for the overall farming activity.

An assessment of effects for activities at the Horner Block is provided on pages 124 and 125. Rather than duplicating the material, please see for details.

Activities at WRO form part of the overall farming activity at WW1&2. Due to the complexity of assessing effects at different farms (dairy platform versus effluent receiving versus dry stock) that lie in fundamentally different catchments, activities at WRO are considered and assessed in a separate AEE, in accordance with Schedule 4 of the RMA.

Effects from whole activity on the receiving environment

Introduction

When considering expansion applications, Environment Southland understand Policy 39 of the pSWLP to direct that the farming activity is not the permitted baseline and as such, actual or potential effects from the “whole activity” as proposed, on the receiving environment must be assessed. This section aims to provide such an assessment in accordance with Schedule 4 of the RMA.

The “whole activity” is understood to mean the sum of all proposed activities at Woldwide 1&2 dairy farm, which includes a 1,500-cow dairy platform, two wintering barns and the range of activities such as fertiliser application, pasture management and supplement. The discharge of agricultural effluent at WW1&2 and the Horner Block is also part of the “whole activity,” as are activities at WRO. Activities also include site-specific GMPs and mitigation measures that will be implemented across the operation. Within the assessment of the whole activity, individual activities and mitigation measures are highlighted and discussed where appropriate.

For WW1&2, the receiving environment includes the Waimatuku catchment (including Waimatuku Estuary), Waimatuku groundwater zone, Oreti catchment (including New River Estuary) and Central Plains groundwater zone. For the Horner Block, the receiving environment includes the Waimatuku catchment (including Waimatuku Estuary), Waimatuku groundwater zone, Aparima catchment, Jacobs River Estuary and Upper Aparima groundwater zone. Where P is assessed, it can generally be used as a proxy for sediment and microbial contaminants.

In the context of assessing actual and potential effects from the whole activity, it is recognised that all dairy farms lose contaminants (nutrients, sediment and microbes) to some degree. So long as losses are minimised through the implementation of effective GMPs and mitigation measures, and effects on receiving ground and surfacewaters are no more than minor, then land at Woldwide 1&2 dairy farm can be used and developed by the applicants to provide for their social, economic and cultural wellbeing in accordance with policy 13 of the pSWLP. The applicants will provide certainty to the consent authority regarding activities and effects through operating under a land use consent for farming at WW1&2.

In operating an economically viable dairy farm at WW1&2, the applicants seek to minimise contaminant losses across the whole activity. Their success in achieving this has support from a desk top comparison, which places their N loss (40 kg/ha/year as per Overseer) below the average N loss (46 kg/ha/year) from all Fonterra dairy farms (n=350) within a 20 km radius of WW1&2. At first glance this may not appear to be significant. However, the farming activity at WW1&2 includes the wintering of 1,250 cows whereas many farms within a 20 km radius winter some or all cows off farm. In the dataset:

- 74 farms (21%) winter no cows in June;
- 122 farms (35%) winter between 1% and 40% of the peak herd number at home.

Many N loss figures in Fonterra N reports only reflect the milking platform and include no/limited wintering of cows. By including and accounting for the wintering of all cows on-site at WW1&2, the efficiency of the operation in achieving below average N loss at WW1&2 is clear. Please see the Appendix for data sourced from Fonterra (average annual N loss per hectare for the last 3 years for farms within a 20 km radius; monthly cow numbers for farms within a 20 km radius).

At the farm scale it is difficult to quantify contaminants being lost to receiving surfacewaters and groundwater, and their contribution to effects on receiving waters; there will be much seasonal and spatial variation in this. Furthermore, measuring the volume of drainage water leaving a sub-catchment and the concentration of nutrients in drainage water would require expensive equipment as well as long term monitoring to allow for temporal and spatial variation; this is not practical given available scientific methods. For these reasons, Overseer is used as a tool to help understand the nutrient interactions of farm systems based on soil properties, rainfall, drainage, feed requirements and other inputs such as fertiliser. The output from Overseer provides an indication of how much nutrient (N and P) may be lost below the root zone but it does not describe how much nutrient ends up in the receiving environment and what the effect of losses is likely to be. Assessing the effect of modelled nutrient losses from individual properties is complex because nutrients travel via different pathways through the receiving environment undergoing attenuation in the vadose zone, processing, mixing, dilution and dispersion processes, which can significantly change the quantity and nature of these nutrients in the receiving water bodies. The assessment here uses knowledge of soil properties, drainage characteristics and rainfall infiltration, hydrology, the receiving environment and Overseer predictions to estimate:

1. The quantity of nutrients (N and P) from the whole activity lost to the receiving waters using Overseer predictions as a starting point, and
2. What the actual or potential effects from the whole activity on receiving ground and surfacewaters are likely to be.

Notes:

1. *Land referred to as Marcel/SH96 is part of Woldwide 1&2 dairy farm and is assessed here as part of the "whole activity." It is not assessed/considered separately as it is authorised for dairy farming under a land use consent (#20171278-03) and is part of the existing environment. The entire application and nutrient budgets have been structured to reflect this.*

2. *The Horner Block is a separate landholding and is not part of the landholding at WW1&2. However, some slurry generated at WW1&2 is discharged at very low depth at the Horner*

Block. Effects at the Horner Block are considered as part of the "farming activity" as Environment Southland regard it to make up part of that activity.

Quantity of N lost below the root zone to receiving surfacewaters

Drummond and Glenelg soils are free draining and generally do not pose a direct risk to surfacewaters via artificial drainage channels/overland flow. The mid-west part of WW1&2 (approximately 100.5 hectares or 21%) has Braxton type soils; these have subsurface drainage installed and drain to the Waimatuku catchment and estuary.

QUANTITY OF N LOST BELOW THE ROOT ZONE TO THE WAIMATUKU CATCHMENT

Braxton soils are predicted by Overseer to lose 2,674 kg N/year below the root zone. A portion of this will be transported in drainage waters to shallow streams in the Waimatuku catchment. Some will be lost to the atmosphere via denitrification processes in the vadose zone and a small amount will be transported to groundwater.

A conservative estimate for the concentration of N in drainage waters to the Waimatuku catchment is calculated below using the average annual N loss figure from Braxton soils from Overseer. The mean annual land surface recharge rate was used to calculate an estimate of drainage volume to surfacewaters.

100 ha = 1,000,000 m^2

Recharge rate estimate (Lincoln Environmental, 2003) = 0.467 m

(1) *Area (m^2) X drainage (m) = drainage volume (m^3)*

Approximate drainage volume annually = 1,000,000 m^2 x 0.467 m = 467,000 m^3

If <u>all</u> 2,671 kg of N lost to water annually from the Braxton block is transported via subsurface/artificial drainage channels and overland flow to the Waimatuku catchment, then the average annual N concentration of drainage water to the Waimatuku catchment is predicted to be:

2,671 kg/467,000 m^3 = 5.7 g/m^3 = 5.7 ppm

As already mentioned, some N will be lost to the atmosphere via denitrification/attenuation processes in the vadose zone, and a small quantity of N will be lost to groundwater. Based on these factors, the concentration of N in water draining to surfacewaters will on average be less than 5.7 ppm. As such 5.7 ppm N is an estimate for the average concentration of N in drainage waters from the whole activity reaching streams in the Waimatuku catchment, without taking attenuation processes into account.

FATE OF N IN RECEIVING STREAMS – WAIMATUKU CATCHMENT

Drainage water reaching receiving streams in the Waimatuku catchment undergoes mixing and nutrients are diluted. The dilution process is likely amplified by significant rates of groundwater discharge to surfacewaters in the upper Waimatuku catchment and should off-set adverse N effects from the whole activity in the Waimatuku catchment to an extent. Due to mixing, dilution and dispersion processes occurring on a catchment scale, this cumulatively gives a median N concentration of 3.65 ppm for the lower Waimatuku catchment (5-year median Total Nitrogen for SOE site at Waimatuku Stream at Lornville Riverton Highway).

CONCENTRATION OF N IN DRAINAGE WATERS TO LOWER ORETI CATCHMENT

Direct losses to the Lower Oreti receiving suracewaters are expected to be low due to the free draining nature of soils (draining to the aquifer) that lie in the Lower Oreti catchment, and cumulatively will give a median concentration of 1.06 ppm for the Lower Oreti catchment (5-year Median Total Nitrogen at SOE site at Oreti River at Wallace Town).

Quantity of P lost to receiving surfacewaters

The major pathway for P loss (and by proxy sediment and microbes) is from Braxton soils via artificial drainage and overland flow following major drainage events. Drummond and Glenelg soils have good P retention and primarily drain via matrix flow, reducing their risk of P loss.

CONCENTRATION OF P IN DRAINAGE WATERS TO WAIMATUKU CATCHMENT

Overseer predicts relatively low average P losses of 0.7 kg/ha/year or 357 kg/year due to the whole activity, with an average P loss of 0.4 kg/ha/year for Braxton soils. Since there are 100 hectares of Braxton soils, an annual average of 44 kg of P is predicted to be lost to the Waimatuku catchment. By pro-rataing “other sources” P loss across the farm, Overseer predicts a further 54 kg of P will be lost from tracks and lanes to surfacewater drainage in the Braxton area. Using the annual drainage volume from Braxton soils as calculated in the previous section, the average concentration of P in drainage waters reaching the Waimatuku catchment is estimated at $2.0*10^{-4}$ ppm.

P loss is split between “Other Sources,” which is loss from tracks, lanes and infrastructure to waterways via overland flow, and “Blocks,” which is P loss from paddocks due to dairy farming. “Other sources” P loss is estimated by Overseer to be 256 kg/year, with “Block” loss estimated to be 100 kg/year. “Other sources” P loss is calculated by a sub-model, which assumes that 30% of P that lands on tracks, lanes, yards and other infrastructure, ends up in waterways[29]. Overseer does not account for individual farm layout, however, and in this case tracks and lanes for the most part do not run close to or parallel to waterways. This is expected to reduce the quantity of P reaching waterways from tracks and lanes via runoff and will reduce the concentration of P in drainage waters below the figure calculated above. Additionally, by appropriately managing locations where overland flow from tracks and lanes etc. can potentially reach waterways (such as adjacent to the wintering barn at Woldwide 1), loss of “Other sources” P can be further reduced although once again, Overseer does not recognise this. Given available tools, it is very difficult to accurately quantify this reduction at the farm scale.

FATE OF P IN RECEIVING STREAMS – WAIMATUKU CATCHMENT

Due to physical interactions, P tends to be adsorbed by soil particles in surfacewaters and is taken out of solution to a large extent. A small portion of P, however, will remain soluble and available for uptake by aquatic plants in receiving water bodies. Some adsorbed P will subsequently be released from sediments as soluble P to be taken up by plants in the future. Mixing of drainage and receiving waters should result in dilution of soluble P, which should off-set potential adverse effects in receiving waters to an extent. A combination of adsorption, mixing and dilution processes occurring on a catchment scale, cumulatively gives a median P concentration of 0.06 ppm for the lower Waimatuku catchment (5-year median Total Phosphorous for SOE site at Waimatuku Stream at Lornville Riverton Highway).

CONCENTRATION OF P IN DRAINAGE WATERS TO LOWER ORETI CATCHMENT

Losses to the Lower Oreti receiving suracewaters from the whole activity are expected to be low due to the nature of soils and topography that lie in the Lower Oreti catchment, and cumulatively will give

[29] Gray, Wheeler and McDowell (2016). Review of Phosphorous submodel in Overseer. Report prepared for AgResearch.

a median concentration of 0.012 ppm for the Lower Oreti catchment (Median Total Phosphorous at SOE site at Oreti River at Wallace Town).

Actual or potential effects from the whole activity on receiving surfacewaters

Since surfacewater drainage is primarily to the Waimatuku catchment, actual and potential effects due to contaminants N, P, sediment and microbes from the whole activity may be seen for the Waimatuku catchment and estuary. Since drainage is primarily to the aquifer in the Lower Oreti catchment, the underlying risk to the Lower Oreti catchment is reduced somewhat, with potential effects (Oreti River and New River Estuary) due to groundwater discharge of N to surfacewaters being the main risk.

Table 7.1 describes key measures, which will be implemented over and above GMPs, to mitigate effects from the whole activity on the on the Waimatuku and Oreti surfacewater catchments, including the Waimatuku and New River estuaries, and on the groundwater resource (Waimatuku and Central Plains aquifers). The effectiveness and level of effectiveness is also assessed.

Table 7.2 describes actual or potential effects from the whole activity on the Waimatuku and Oreti surfacewater catchments, including the Waimatuku and New River estuaries. Further comment is subsequently provided on actual or potential effects from the whole activity in each catchment.

Table 7.1 Specific mitigation measures proposed for the dairy farming activity, their effectiveness and assessed level of effectiveness.

No.	Specific mitigation measures proposed for N, P, sediment and microbial contaminant loss.	Effectiveness of mitigation measure	Level of effectiveness
1	Continued development of soils and pastures through removal of fodder crop rotation, implementation of grass to grass cultivation methods and a focus on sustainable agronomy;	Over time this leads to less mineralisation of N, increased soil organic matter content, water holding capacity, improved soil structure and consequently less N, P, sediment and microbial contaminant loss in artificial drainage, runoff and less N loss to groundwater via deep drainage.	High – this measure mitigates N, P, sediment and microbial contaminant loss and is implemented across the entire dairy farm. It will be particularly effective at reducing N loss to groundwater on leakier soils at the north east of WW1&2.
2	No land cultivated into fodder crop and intensively winter/summer grazed: Fodder crop/IWG by R2 heifers and summer grazing on turnips by cows have been carried out annually at WW1&2 landholding. These practices will no longer occur at WW1&2;	Nutrient (N and P) loss from fodder crop blocks is high due to mineralisation processes in soils, inputs of nutrients from animal dung and urine and fallow periods post grazing. Eliminating these practices is effective at reducing nutrient losses via deep drainage, artificial drainage and to less of an extent, overland flow pathways. Sediment and microbial contaminant loss from fodder crop blocks is high due to soil compaction, pugging and breakdown of the soil structure, and inputs of faecal microbes from animal dung and urine. Fallow periods following the grazing of crop blocks generates runoff across bare land, carrying contaminants to waterways. Elimination of these practices will be effective at reducing contaminant losses via artificial drainage and overland flow pathways.	High Where IWG is carried out on free draining soils, N loss to groundwater is high. P, sediment and microbial contaminant loss is high where soils are pugged following IWG and land lies fallow.
3	Expansion of the size and use of the wintering barn facilities	An additional 225 animals (cows and R2 heifers) will be wintered in the WW1 wintering barn. Both barns will be used more in the shoulders of the season (May, August and September) than they have	High – reduces loss of N and P, sediment and microbial contaminants to ground and

		been in the past. This is effective as effluent that would otherwise be deposited as dung and urine on paddocks at high risk times is captured and stored; less pugging of soils and accumulation of N in soils at high risk times occurs. The barns will be also used to stand cows off during inclement weather events during the season, which will also reduce soil damage, compaction and runoff risk associated with severe weather events.	surfacewaters, which otherwise is likely to occur at high risk times (May, August, September and during severe weather events during the season).
4	More efficient use of N fertiliser, e.g. effluent block will have less N fertiliser applied than non-effluent block;	This is effective at reducing N loss to water in drainage events following fertiliser application.	Moderate – the reduction in N loss will be seen across the effluent receiving area, reducing N lost in drainage to ground and surfacwaters in that area.
5	Conditioning very low depth application of slurry with the trailing shoe slurry tanker;	In recognition of the high strength nature of slurry and avoiding the overloading soils with N and microbes from slurry, this is effective at providing Environment Southland with certainty that slurry will be applied at less than or equal to 2.5 millimetres depth per application. In practice, an application depth of 1.5-2.0 millimetres per application will be used when applying slurry with the trailing shoes slurry tanker. This activity is assessed separately in section 7.1 (AEE for discharge activity).	Moderate – soils and pastures are not overloaded with nutrients from slurry, which reduces both N and P loss, and microbial contaminant loss from slurry receiving areas. This protects both ground and surfacwaters.
6	Lane adjacent to WW1 wintering barn will be contoured to drain away from the adjacent stream *see section 6 for further details	The cow lane in between WW1's wintering barn and a stream will be contoured away from the adjacent stream to avoid the risk of runoff flowing into the waterway. This measure has been actioned in March 2019. This will be effective at preventing runoff to the stream, which otherwise could be a greater risk with additional cow traffic on the lane. Good grass cover will always be maintained on the stream bank to further protect the stream.	Moderate – prevents a potential point source discharge of nutrients N and P to surfacewaters in the Waimatuku catchment

7	Eliminate direct contamination of house bore (45/0622), which is also used by ES at a monitoring bore;	Measures to eliminate contamination of the bore will be carried out: the casing will be extended far enough above ground level to ensure stormwater cannot enter the well. A sloping concrete pad will be placed around the casing. Any holes in the well liner will be sealed, the piping and fittings will be serviced, and any leaks will be repaired.	Minor – this will prevent localised contamination of groundwater in the Waimatuku GW zone with N, P and microbes;
8	Olsen P levels are slightly below optimum level. Once target Olsen P levels are achieved, P fertiliser will be applied to maintain Olsen P levels within optimum range. Target Olsen P levels are 30.	This will avoid the loss of excess P to water in artificial drainage and runoff following prolonged wet periods.	Moderately effective for mitigating P loss to surfacewaters across farm. Overall due to flat topography and soil types, the risk of P loss is relatively low.
9	Tracks/lanes management and layout to reduces runoff to streams;	Overseer assumes that 30% of P that lands on all tracks/lanes ends up in waterways. Given the farm layout (tracks and lanes do not run close/adjacent to waterways for the most part) and management of track/lanes, culvert crossings and associated buffers, P loss as assumed by Overseer is reduced. The entire landholding has been operated as a dairy farm for many years and already has a well-developed lane network. No new land is coming into the dairy farm. Some flexibility to improve the existing network of farm lanes is needed as part of operating and managing the dairy farm. Any future lane development will be very minor in scale with the purpose of eliminating soil compaction/pugging issues as they arise over time. Lane contours will be maintained to drain away from any adjacent waterways and prevent runoff.	Highly effective at mitigating P, sediment and microbial contaminant loss to surfacwaters across the landholding.

Table 7.2 Actual and potential effects from the whole activity (N, P, sediment and microbes) in surfacewaters. This table links to table 6.5 (mitigation measures).

Contaminant	Potential effect in receiving surfacewaters	Related effects	Specific mitigations proposed for whole activity	Likelihood of effect due to whole activity	Risk of effect due to whole activity
N, P	Increased algal growth in the water column, especially when flows are low and/or temperatures are elevated in shallow streams and the Waimatuku Stream: • Degrades water quality and blocks light (increases turbidity and reduces clarity)	Ecological: exclusion of macrophytes, reduced visibility for fish and other aquatic organisms, loss of habitat, decreased suitability for recreational activity	As per table 7.1 Measures mitigating N loss are #1, 2, 3, 4, 5, 6, 7 and 9; Measures for mitigating P loss are #1, 2, 3, 5, 6, 7, 8 and 9 Particularly, the removal of fodder beet/IWG from high risk soils and greater capacity and use of the wintering barns at high risk times are effective at mitigating N and P loss from the whole activity. Capturing and storing of dung/urine at high risk times, in conjunction with the application of nutrients at very low depth (slurry) at low risk times (when pastures are actively growing, and soil moisture conditions are suitable) are also major mitigation measures.	Low likelihood of effect and related effects occurring due to the nature and scale of activity and implementation of migration measures: N and P losses are minimised across the whole activity while still operating an economically sustainable dairy farm; however, some nutrients are inevitably lost as predicted by Overseer, but N losses are low relative to other dairy farms (see section 7.3.1). This shows that losses are minimised as much as practical across the whole activity. N and P lost in drainage undergo attenuation (denitrification and adsorption respectively), mixing and dilution in the vadose zone and receiving waters; the concentration of available nutrients in receiving waters for phytoplankton from to the whole activity is low and the likelihood of associated algal blooms and related effects is low. Summary: N and P losses are minimised across the whole activity, are low for dairy farming in the wider area, and due to physical processes are unlikely to lead to algal blooms and related effects in the	No more than minor

				Waimatuku Stream, Estuary, Oreti River and New River Estuary.	
N, P	Increased algal growth in the water column: • Potentially increasing BOD	Ecological: reduced DO causing stress on aquatic organisms, loss of species and habitat	As per above	Very low likelihood since point source discharges affect BOD rather than diffuse sources. Although the discharge of FDE is a point source discharge, it is to land rather than water is managed appropriately.	Less than minor – point source discharges affect BOD rather than diffuse sources
N, P	Increased periphyton growth on stream beds, especially in smaller streams (Waimatuku) when temperatures are elevated, or flows are low: • Smother streambed Increased aquatic weed growth on stream beds when temperatures are elevated, or flows are low: • Choke waterways	Ecological: loss of habitat, effects on invertebrates and organisms in associated food webs, reduced biodiversity	As per above	Low likelihood of effects and related effects occurring due to the nature and scale of activity and implementation of migration measures: As per row 1 above. Summary: N and P losses are minimised across the whole activity, are low for dairy farming in the wider area, and due to physical processes are unlikely to lead to increased periphyton growth, increased aquatic weed growth and related effects in the Waimatuku Stream, Estuary, Oreti River and New River Estuary	No more than minor
N, P	Increased periphyton growth, especially in streams and rivers when temperatures are elevated, or flows are low: • Promote the growth of toxic matts of cyanobacteria (blue green algae)	Toxic effects on biota including domestic animals. Also, people using waterways for recreational activities are at risk of adverse health effects	As per above	Low likelihood due to the natures and scale of activity and implementation of migration measures: As per row 1 above except that there is likelihood of toxic cyanobacteria growth and related effects occurring in the Waimatuku Stream, Estuary, Oreti River and New River Estuary due to the whole activity.	No more than minor

N	N toxicity effects if N concentration is high enough, particularly in the Waimatuku Stream	Ecological: loss of habitat, fish kills Animal health due to nitrate toxicity	As per above for N loss mitigation	Low likelihood since N concentration in receiving waters is lower than toxicity level and encouragingly N levels have decreased over the last two consecutive years in the Waimatuku Stream: The scale of the activity and implementation of proposed migration measures further reduce the likelihood of the effect occurring.	No more than minor
P	Increased nuisance plant growth on estuaries (Waimatuku and/or New River): P sorbed to soil particles following runoff is deposited in sediment and then released from bed into the water column	Weed-driven habitat modification and loss; effects on invertebrates and organisms in associated food webs leading to reduced biodiversity	As per above for P loss mitigation	Low likelihood due to nature and scale of activity and implementation of proposed migration measures: The layout of the farm, optimal management of infrastructure CSAs and implementation of mitigation #6 reduce sediment loss in runoff to the Waimatuku and Oreti catchments. By reducing sediment loss (and sorbed P) as much as practical while still operating an economically viable dairy farm, P loss is reduced below modelled levels as per Overseer. Mitigating sediment loss from the whole activity and its associated deposition in the Waimatuku and New River Estuaries means that less P will be released back into the water column from sediment in the future. The concentration of soluble P (released from sediment) in receiving estuaries from to the whole activity is low and the likelihood of algal blooms and related effects is low.	No more than minor

Sediment	Following runoff, increased turbidity and reduced water clarity in Waimatuku Streams, Oreti River and respective estuaries.	Ecological: exclusion of macrophytes, reduced visibility for fish and other aquatic organisms, loss of habitat, decreased suitability for recreational activity	As per table 1. Measures 1, 2, 3, 5, 6, 7, 9 are the main mitigation measures for sediment loss.	Low likelihood due to nature and scale of activity and implementation of proposed migration measures: Runoff occurs following high drainage events. The layout of the farm, optimal management of paddock and infrastructure CSAs and implementation of mitigation #6 reduce sediment loss in runoff to the Waimatuku and Oreti catchments. Sediment loss is reduced as much as practical while still operating an economically viable dairy farm. Maintaining sediment loss at a minimal level helps to improve water clarity and reduce turbidity in receiving waters including, streams, rivers and estuaries.	No more than minor
Sediment	Following runoff, increased deposition of sediment in Waimatuku Stream & Estuary, Oreti River and New River Estuary. • Smother streambed	Ecological: loss of habitat and increased anoxic conditions (estuaries), effects on invertebrates and organisms in associated food webs, reduced biodiversity	As per above	Low likelihood due to nature and scale of activity and implementation of proposed migration measures: Runoff occurs following high drainage events. The layout of the farm, optimal management of paddock and infrastructure CSAs and implementation of mitigation #6 reduce sediment loss in runoff to the Waimatuku and Oreti catchments. Sediment loss is reduced as much as practical while still operating an economically viable dairy farm. Maintaining sediment loss at a minimal level reduces deposition of sediment on the bed of receiving waterways including, streams, rivers and estuaries.	No more than minor

Microbial contaminants	Following run-off, elevated levels of microbial contaminants in streams, Waimatuku Stream, Oreti River and respective estuaries: • Exposure to pathogens	People using waterways for recreational activities and food gathering are at risk of adverse health effects (gastroenteritis)	As per above	Low likelihood due to nature and scale of activity and implementation of proposed migration measures: Runoff occurs following high drainage events. The layout of the farm, optimal management of paddock and infrastructure CSAs and implementation of mitigation #6 reduce microbial contaminant loss in runoff to the Waimatuku and Oreti catchments. Microbial contaminant loss is reduced as much as practical while still operating an economically viable dairy farm. Maintaining microbial contaminant loss at a minimal level reduces the risk of exposure to pathogens and related effects.	No more than minor

Further comment on actual and potential effects on the Waimatuku Estuary and New River Estuaries

Due to the nature of drainage from the whole activity, actual and potential effects described in table 7.2 may apply to the Waimatuku Estuary. Waimatuku Estuary is a sensitive environment that is adversely affected by nutrients, sediment and microbial contaminants from land use in the catchment, such as dairy farming. Contaminant losses to the Waimatuku Estuary from the whole activity are minimised due to the implementation of site-specific GMPs and key mitigations that reduce N accumulation, N mineralisation processes, protect soil structure and reduce runoff. These are described in tables 7.1 and 7.2. These measures are complemented by the general strategy of good nutrient and soil management as demonstrated in soil fertility trend reports from Ravensdown. Since contaminant losses from the whole activity to the Waimatuku Estuary are low, and undergo attenuation, mixing and dilution in receiving waters, effects from the whole activity on the Waimatuku Estuary are expected to be low. Broad scale cumulative effects on the Waimatuku Estuary are discussed in section 7.3.3.

Due to the predominant nature of drainage (to the aquifer) from the whole activity to the Oreti catchment, there is lower risk of actual and potential effects described in table 7.2 occurring in the New River Estuary. The major pathway for contaminants reaching the New River Estuary from the whole activity is via runoff following severely adverse weather events and via groundwater discharging N to streams and waterways draining the Oreti catchment to New River Estuary. New River Estuary is a sensitive environment that is adversely affected by nutrients, sediment and microbial contaminants from land use in the catchment, such as dairy farming. So long as site-specific GMPS and mitigations are implemented as described, reduced N accumulation and N mineralisation processes, the protection of soil structure and minimal runoff should be achieved and effects on New River Estuary are expected to be low. Broad scale cumulative effects on the New River Estuary are discussed on in section 7.3.3.

Actual or potential effects from the whole activity on groundwater

INTRODUCTION

Adverse effects on groundwater can occur from the expanded dairy farm activity where contaminants present in dung, urine, effluent, fertiliser and silage pad leachate, such as nutrients N (nitrate) and microbes (pathogens such as campylobacter) reach groundwater via leaching/deep drainage pathways. A major risk of elevated nitrate levels in groundwater is to users (consumers) of groundwater as nitrate becomes toxic to living organisms such as humans, animals and fish at high levels. The New Zealand Drinking Water Standard maximum allowable value for nitrate is 11.3 ppm. Another risk is to consumers of groundwater is waterborne gastroenteritis through the ingestion of groundwater contaminated with pathogens such as campylobacter. This was demonstrated in Havelock North in 2016, when over 5,000 people became ill with campylobacteriosis. Adverse effects on other users of groundwater such as Heddon Bush School, other farms, small industries or settlements/domestic users can occur and need to be avoided or mitigated.

There is risk to groundwater from the whole activity at the landholding from two soil processes:

1. Drummond/Glenelg soils are free draining and therefore have risk of contaminant loss via deep drainage to underlying aquifers due to their physical properties. Approximately 378 hectares (or 79%) has Drummond and Glenelg soil types.

2. Braxton soil types have swell/crack characteristics that can allow contaminants present in dung and urine to be washed down to the underlying groundwater resource via deep cracks that can form during prolonged dry summer conditions. Parts of WW1&2 with Braxton soils types (approximately 100.5 hectares or 21%) require appropriate management to mitigate the risk of contaminant loss to groundwater if and where deep cracks form.

Water percolating through the vadose zone to the underlying aquifer undergoes mixing and nutrients are diluted. As is explained in section 5, land use nitrate effects on groundwater in the area start to be seen within a year, and certainly are evident within three years. Since much of the wider area has been used for dairy farming, cereal cropping, IWG and sheep farming for many decades, effects on groundwater have been present for decades. The hotspot at Heenen's Corner to the southeast in the Central Plains groundwater zone is likely to reflect this. In terms of the whole activity, there will be extensive mixing within a large aquifer and some dilution thereafter, which will change background N concentrations by a small degree, and cumulatively will give a concentration within a range of 1.0 – 8.5 ppm for most of the landholding.

Table 7.3 describes actual or potential effects from the whole activity on the Waimatuku and Central Plains groundwater zones, including potential effects on the registered drinking water bore supply at Heddon Bush School. Further assessment is also provided on actual or potential effects from the whole activity on each groundwater zone.

Table 7.3 Risk of adverse effects from the proposed dairy farming activity due to contaminants N and microbes in groundwater. This table links to table 7.1 (mitigation measures).

Potential effect of N in groundwater	Related effects	Specific mitigations proposed for whole activity	Likelihood of effect due to whole activity	Risk of effect due to whole activity
Human health effects (i.e. methemoglobinemia) from groundwater consumption at Heddon Bush School (Waimatuku GW zone) if groundwater nitrate concentrations are excessive (NZ Drinking Water Standard MAV is 11.3 ppm)	n/a	See table 7.1 for explanations of effectiveness of mitigation measures. Measures #1, 2, 3, 4, 5, 6, 7 and 9	Low likelihood due to the: • nature and scale of activity; • evidence of low groundwater nitrate levels at the south of the property and at Heddon Bush School in 17/18; and • implementation of mitigation measures. N losses are minimised across the whole activity while still operating an economically sustainable dairy farm; however, some N is inevitably lost as predicted by Overseer, but N losses are low relative to other dairy farms (see section 7.3.1). N lost below the root zone undergoes some denitrification in Braxton soils, then mixing and dilution in the aquifer (Waimatuku). The risk of N reaching the Waimatuku aquifer through deep cracks the can form in Braxton soils is mitigated through appropriate pasture and soil management to avoid crack formation, and the avoidance of grazing/discharging effluent to areas where cracks have formed. The evidence from water quality sampling of a bore at the south of WW1&2 and a bore at Heddon Bush School indicates that nitrate levels are low (less than 2.1 ppm at the school in 2018) despite the presence of the dairy farm north of the school for decades.	No more than minor

			This indicates that nitrate losses from the whole activity to the Waimatuku GW zone are low; Evidence supports low nitrate loss to the Waimatuku GW zone from the whole activity. The concentration of nitrate in groundwater at Heddon Bush School is low; therefore, the likelihood of associated adverse health effects (methemoglobinemia) on consumers of groundwater at Heddon Bush School due to the whole activity is low.	
Human health effects (methemoglobinemia) on groundwater consumers in the Central Plains groundwater zone to the south east where groundwater nitrate concentrations are excessive (NZ Drinking Water Standard MAV is 11.3 ppm)	n/a	See table 7.1 for explanations of effectiveness of mitigation measures. Measures #1, 2, 3, 4, 5, 6, 7 and 9 Particularly, the removal of fodder beet/brassica cropping/IWG practices from the north east of Ww1&2 where lighter/more leaky soils are found is a key mitigation.	Low likelihood due to the: • nature and scale of activity; • evidence of groundwater nitrate levels on the east side of the landholding generally being between 3.5-8.5 ppm; and • implementation of migration measures N losses are minimised across the whole activity while still operating an economically sustainable dairy farm; however, some N is inevitably lost as predicted by Overseer, but N losses are low relative to other dairy farms (see section 7.3.1), which shows that N losses are minimised across the whole activity. Ceasing the practice of fodder beet/IWG on lighter, free draining soils removes a practice that loses high levels of N to GW in the Central Plains zone. Less N mineralisation and less N accumulation at high risk times will occur. The removal of IWG is facilitated by greater capacity and use of the wintering barns. N lost below the root zone undergoes minimal denitrification in Oxidising soils that overlie the Central	No more than minor

			Plains GW zone, so N accumulates in soils and in the aquifer. This is reflected in high GW nitrate levels seen to the east and south east, with a hotspot at Heenan's Corner. GW sampling at a monitoring bore on the east side of WW1&2 has a mean nitrate concentration of 8.16 ppm, which is lower than levels seen to the south east. This indicates that despite the presence of leaky soils overlying the Central Plains aquifer, nitrate losses to GW are being kept to a minimum while still operating a viable dairy farm. By removing IWG on fodder beet from leaky soils, the concentration of N in GW flowing towards Heenan's Corner from the whole activity should be reduced over time; however, N losses from neighbouring farms and activities are not allowed for here. Nitrate related effects on consumers of GW in the Central Plains GW zone (farms, rural/domestic) from the whole activity are expected to be low.	
Ecological effects due to discharge of groundwater with elevated nitrate to shallow streams in Waitmatuku and Oreti catchments	Fish kills due to nitrate toxicity; Eutrophication of receiving surfacewaters (Waimatuku, Oreti); Recreational effects; fishing in Waimatuku is reduced;	See table 7.1 for explanations of effectiveness of mitigation measures. Measures #1, 2, 3, 4, 5, 6, 7 and 9	Low likelihood since N concentration in receiving waters is lower than toxicity level, and the nature and scale of the activity and implementation of proposed migration measures further reduce the likelihood of the effect occurring. Evidence indicates that relatively low levels of N are being lost to the Waimatuku GW zone from the whole activity so GW discharging to the Waimatuku catchment is expected to have low N from the whole activity. Ecological effects and related effects are expected to be low. Evidence indicates that higher levels of N are being lost to the Central Plains GW zone but this is being kept to a	No more than minor

			minimum while still operating a viable dairy farm. A major mitigation measure (removing fodder beet/IWG) from leaky soils should reduce N loss to the aquifer. The Oreti River is a major river that has a diluting effect on N. Ecological effects and related effects on the Oreti River due to the discharge of GW to the Oreti catchment are low.	
Human health effects due to faecal contamination of groundwater at Heddon Bush School (Waimatuku GW zone) and rural consumers of GW (Central Plains GW zone)	Gastroenteritis (e.g. camplyobacteriosis) by consuming contaminated groundwater	As per table 7.1 Measures #1, 2, 3, 5, 6, 7 and 9	Low likelihood due to implementation of mitigation measures: Very low depth slurry application (max 2.5 mm per application) to limit microbial loading of soils from slurry. Sunlight and soil processes act on microbes reducing their viability and likelihood of causing waterborne infection; Protecting soils and maintaining good pasture cover to avoid crack formation in Braxton soils. Monitoring for soil cracks and avoidance of cracks when grazing stock or discharging effluent or slurry; limited viability of microbes in groundwater; and use of an ozone purification system at Heddon Bush School.	No more than minor
Human health effects due to long term consumption of nitrate in GW (bowel cancer)	n/a		Please see commentary provided on page 158.	

ACTUAL AND POTENTIAL EFFECTS FROM GROUNDWATER NITRATE ON HEDDON BUSH SCHOOL DUE TO WHOLE ACTIVITY – FURTHER COMMENT

As is described in section 5, groundwater nitrate levels at the south flowing toward Heddon Bush School are consistently low (despite an issue with localised well contamination). Given the following factors, elevated groundwater nitrate levels and related effects, would have been seen for some time in the vicinity of the school, if they were present:

- the proximity of the school approximately 2.3 km south of WW1&2;
- the direction of groundwater flow from much of WW1&2 (south towards the school);
- land use at and around WW1&2, and north of the school since the 1980s. This includes cereal cropping, sheep farming, dairy farming and intensive winter grazing. Cereal cropping and IWG are activities that lose high levels of N through increased mineralisation processes;
- the length of time the land has been used for dairy farming (WW1 since 1992, WW2 since early 2000s);
- the estimated lag times for nitrate to percolate through the vadose zone, reach the water table and the underlying groundwater stream are short, and
- the estimated velocity of groundwater flow.

Sampling of the school bore over three dates in late 2017 and early 2018 returned a mean nitrate concentration of 1.9 ppm. This indicates that groundwater nitrate levels at the school are low and pose minimal risk to health. It also indicates that there are minimal effects on groundwater quality at the school from the dairying activity 2.3 km north of the school; effects from activities (at WW1&2 and other farms) over the past decades would have been seen for some time at the school, if they were present. Simply put, the land did not operate in a “vaccum” prior to the official establishment of dairy platforms at WW1 and WW2. Finally, the school bore is drilled to a depth of over 14 metres, which further reduces any potential risk to consumers of groundwater at the school.

ACTUAL AND POTENTIAL EFFECTS FROM GROUNDWATER MICROBIAL CONTAMINATION ON HEDDON BUSH SCHOOL DUE TO WHOLE ACTIVITY – FURTHER COMMENT

The south bore at WW1&2 (E45/0622) suffers from localised contamination due to its design. This is reflected in the positive *E. coli* results for that bore, which corrupt the dataset making the bore unsuitable for monitoring purposes. Following the zone of reasonable mixing, there is likely to be minimal adverse effect on the wider groundwater resource from this localised source. *It is proposed to install a new monitoring bore at the south of the farm, which will eliminate the issue of localised contamination, making E.coli results valid, reliable and an important information source that can be used in decision-making. It is also proposed to carry out remedial work on the existing bore, to prevent localised contamination in the future.*

According to the principal at Heddon Bush School, the school bore has been tested quarterly since it was drilled and has consistently returned negative *E.coli* results (<1 MPN/100 ml). Given the bullets points summarised in the previous section as well as the lifetime of *E.coli* in the environment (up to 3 months[30]), adverse microbial effects on the school bore should have been detected in quarterly testing if they were present. The evidence so far does not indicate that whole activity WW1&2 is having (or will have) an adverse effect on the Heddon Bush School water supply through faecal contamination of groundwater. Furthermore, the depth of the school bore further helps to protect it from land-use effects, as does the presence of an ozone water purification treatment system.

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[30] Edberg, Rice, Karlin and Allen (2000). *Escherichia coli*: the best biological drinking water indicator for public health protection. Journal of Applied Microbiology 2000, 88, 106S – 116S.

ACTUAL AND POTENTIAL EFFECTS FROM GROUNDWATER MICROBIAL CONTAMINANTS IN THE CENTRAL PLAINS GW ZONE DUE TO WHOLE ACTIVITY – FURTHER COMMENT

Groundwater testing of the monitoring bore at the east overlying the Central Plains zone has generally been negative for *E.coli* since it was installed in 2015. It has returned three positive results in that time, with one result likely to be an outlier in the dataset. The relatively high result in November 2017 was likely to have been due to recent heavy rainfall that occurred between November 3rd and 12thand resulted in a very high level of drainage and the observed positive *E. coli* result. The subsequent test in April 2018 was negative for *E.coli* (<1 MPN/100 ml). The ES monitoring bore at Boyle Road to the south east and in the same groundwater zone, has consistently been negative for *E.coli* in recent years with the exception of December 2017. It too was subsequently negative for *E.coli* in March 2018 (<1 MPN/100 ml). This indicates that if groundwater contamination occurs due to an extreme rainfall event and subsequent high level and rate of drainage, it is relatively short lived, which is in line with the length of time that *E.coli* and similar microbes are believed to remain viable in groundwater (three months or less). Land immediately south of WW1&2 is agricultural (dairying, dry stock and cropping) with an associated very low human population density. Based on these factors, the likelihood of effects on human health such as gastroenteritis occurring is low.

ACTUAL AND POTENTIAL EFFECTS FROM GROUNDWATER NITRATE – CHRONIC HUMAN HEALTH EFFECTS (BOWEL CANCER)

Bowel cancer is a complex, chronic human disease that has relatively high prevalence in Western, developed nations. Diet is understood to be one factor in the development developing bowel cancer, which is multifactorial disease[31]. A potential link between the long-term consumption of drinking water with elevated nitrate and bowel cancer has been investigated in recent years[32 33]. Nitrate can become a carcinogen when it is ingested and converted to nitrite by gut bacteria in humans. However, certain other dietary amino compounds are also required for nitrite become carcinogenic.

A large scale, longitudinal study carried out in Denmark and published in 2018[34] found that people who were exposed to the highest concentration of nitrate in drinking water had a 15 per cent greater risk of getting colorectal cancer compared to those who had least exposure. The study identified an association at the population level, between consumption of nitrate in drinking water and risk of developing bowel cancer. According to Professor Ian Shaw at the University of Canterbury and reported by Tom McDougall in Agriview NZ[35], "In my opinion nitrate is associated with colon cancer because it can be converted to nitrite by gut bacteria and form nitrosamines with dietary amino compounds. Nitrosamines are profound carcinogens. Links with water nitrate would, therefore, not be definitive because other components of the diet would be necessary to facilitate carcinogenesis. If exposure to an appropriate dietary mixture, plus the right bacterial species in the microbiome do not coincide carcinogenesis will not occur. This is a complex scenario that cannot be attributed to a single exposure to a single chemical." Whilst the Danish study picked up a "signal" at the population level, due to the complex and

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[31] Ryan-Harshman& ALdoori. Diet and colorectal cancer: Review of the evidence. *Can Fam Physician*. 2007 Nov; 53(11): 1913–1920. PMID: 18000268

[32] Jörg Schullehner, Birgitte Hansen, Malene Thygesen, Carsten B. Pedersen, Torben Sigsgaard. **Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study**. *International Journal of Cancer*, 2018; DOI: 10.1002/ijc.31306

[33] Espejo-Herrera et al. Colorectal cancer risk and nitrate exposure through drinking water and diet. *Cancer Epidemiology*, 2016. DOI: **https://doi.org/10.1002/ijc.30083**

[34] Jörg Schullehner, Birgitte Hansen, Malene Thygesen, Carsten B. Pedersen, Torben Sigsgaard. **Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study**. *International Journal of Cancer*, 2018; DOI: 10.1002/ijc.31306

[35] https://www.agriview.nz/forum?author=5acff4fa2b6a28b7ea99c4f1

multifactorial nature of bowel cancer pathology, causation cannot be directly attributed to consumption of nitrate in groundwater.

A case-control study carried out in Spain[36] over several years also investigated whether colorectal cancer risk is linked to nitrate exposure through drinking water and diet. Increased risk was associated with gender and in subjects with high red meat intake. A positive association between CRC risk and waterborne ingested nitrate was suggested among subgroups with other risk factors. This again highlights the multifactorial nature of bowel cancer, which cannot be attributed to exposure to a single chemical.

Land immediately south of WW1&2 in the direction of GW flow is agricultural (dairying, dry stock and cropping) with an associated very low human population density. Heddon Bush School represents a small population centre but has been demonstrated to have low levels of groundwater nitrate. Given the nature of the link identified in the above studies, it is very unlikely that there is a risk of human consumers of groundwater south of WW1&2 developing bowel cancer due to the proposed activity.

[36] Espejo-Herrera et al. Colorectal cancer risk and nitrate exposure through drinking water and diet. *Cancer Epidemiology*, 2016. DOI: **https://doi.org/10.1002/ijc.30083**

Effects from additional cows over and above what is already in place

Introduction

An additional 160 cows at the WW1&2 will add nutrients to the farming system and can potentially cause treading damage to soils (compaction) and CSAs. In the absence of any other changes/off-sets to the system, additional cows would be expected to increase contaminant losses to the receiving environment with a likely increase in effects on the receiving environment also occurring. To meet requirements set out in council policy, actual and potential effects on the receiving environment from an additional 160 cows must be off-set through changes to the farm system, allowing water quality to be maintained or improved despite additional cows. The additional of 160 cows is one input to the farming system; so long as contaminant losses from the system in its entirety do not increase and adverse effects on receiving waters are avoided or mitigated, there should be no greater effect from additional cows over and above what is already in place.

Overseer nutrient budgeting has been used to model nutrient losses below the root zone from the proposed system, which includes an additional 160 cows and a range of changes to the system that will also occur. The existing system has also been modelled in Overseer and reflects average annual nutrient losses below the root zone over four years of farming at the landholding (and is based on four separate nutrient budgets). While Overseer is useful at modelling long-term average nutrient losses of farming systems, it has limitations. As already mentioned, it does not predict transformations, attenuation or dilution of nutrients between the root zone and the receiving water body. Also, Environment Southland have raised a concern that Braxton soils may not be modelled well in Overseer. Overseer is one tool, albeit a useful one, used in determining nutrient losses from additional cows over and above what is already in place. By quantifying nutrient losses below the root zone Overseer is a starting point, with knowledge of soil processes, drainage, hydrology, receiving waters and various farming practices also used to assess effects from additional cows over and above what is in place.

By using the same tool (Overseer) to quantify nutrient losses below the root zone for the proposed and pre-expansion systems, consistency is maintained across the analysis and associated assessment of effects. Any limitations of Overseer, such as potentially underestimating N loss from Braxton soils, will occur in all nutrient budgets. This should ensure that comparisons made between respective systems are valid and relative differences are real.

Contaminant losses and effects - over and above what is in place

The average annual N loss for the proposed system with additional cows is predicted by Overseer to be 40 kg/ha; the prior average annual N loss is predicted at 41 kg/ha. Overall N loss for the proposed system with additional cows is 215 kg/year lower than losses for the pre-expansion system. The average annual P loss for the proposed system with additional cows is predicted by Overseer to be 0.7 kg/ha; the prior average annual P loss is predicted at 0.7 kg/ha. In conclusion, losses of N and P below the root zone are predicted by Overseer remain stable or decrease slightly despite additional cows.

Changes to the farming system are off-setting additional nutrients from additional cows and act as mitigation measures that form part of the proposed farming system. Key off-sets that are recognised by Overseer are the removal of fodder crop/IWG and increased capacity and use of wintering barns. Collectively, less N will accumulate in soils at high risk times, less N mineralisation will occur, and greater soil organic matter will be retained than before. The outcome will be less N lost below the root zone and ultimately to groundwater and/or receiving surfacewaters. The removal of cows and heifers (including additional cows) from paddocks over high risk months and the avoidance of fallow periods following IWG of fodder crops will reduce pugging of soils and runoff of N, P, sediment and microbes to receiving waters. Paddocks formerly used for winter feed will instead be grazed outside winter time, when plants are actively growing and taking up nutrients. Nutrients from additional cows will be collected and stored in ponds at high risk times to be applied to land at very low depth when pastures are actively growing/taking up nutrients and the risk of drainage is minimal.

Evidence from trial data measured in two field studies carried out in Southland and summarised in a review[37] show that fodder crop blocks under IWG lose high levels of N in drainage. Particularly, results from the Woodlands trial showed that per hectare N losses from fodder crop (kale) were 4 to 5 times greater than losses measured under dairy pasture on equivalent soil types and land use. Relatively high concentrations of nitrate-N were measured in drainage over three years from IWG forage crops on shallow soil types at the Five Rivers site. Much lower nitrate-N concentrations were subsequently measured in drainage when cropped areas were returned to pasture, then grazed by deer followed by sheep. Comparison of measured trial data (57 kg N/ha/year +/-43) versus Overseer data (48 kg N/ha/year) for fodder cropping/IWG at the Fiver Rivers site showed that Overseer underestimated the quantity of N lost below the root zone somewhat.[38] Overseer has undergone several version changes since the report was published, which has seen predicted N losses increase from fodder crop/IWG blocks in particular. Evidence from trial data in Southland broadly supports a reduction in N loss below the root zone with the removal of fodder cropping/IWG in conjunction with a change to full dairy pasture at WW1&2. This is especially the case on free draining Drummond and Glenelg soils.

Some changes to the farming system from additional cows are not recognised by Overseer. For example, contouring a cow lane adjacent to WW1 wintering barn to ensure that any overland flow from the lane flows away from the adjacent stream, thus avoiding potential runoff down into the waterway. The stream bank will always be vegetated with good grass cover to further protect of the waterway by facilitating filtration and attenuation processes. The potential risk to the stream will be avoided, which otherwise could be a greater risk with additional cows. This will reduce the risk of P, sediment and microbial loss to surfacewaters draining to the Waimatuku catchment and estuary and their associated effects.

Given the range of GMPs and key mitigation measures that will be implemented in conjunction with the addition of 160 cows to the milking herd, no increase in N or P loss is predicted relative to the prior system. The proposed system is expected to have less accumulation of N at high risk times, generate less mineral N in soils and greater soil organic matter content, less pugging of soils and reduced runoff. Potential effects from additional cows such as increased treading damage causing compaction and runoff will be avoided by good stock management, always providing stock with enough feed and water to minimise stress and by standing cows off in the barns during severe weather events. Based on these factors with support from Overseer predictions, effects on groundwater and receiving surfacewaters due to an adapted system with additional cows would be expected to be similar or less than under the prior farming system and certainly be no greater than what is already in place.

Specific effects from the whole activity, which includes additional cows, are described and considered in the context of soil processes, drainage, attenuation, hydrology and receiving waters in section 7.3.1. To avoid repetition, please see section 7.3.1 for details.

[37] Monaghan (2012). The impacts of animal wintering on water and soil quality. Report prepared for Environment Southland.
[38] Smith & Monaghan (2013). Comparing Overseer estimates of N leaching from winter grazed forage crops with results from Southland trial sites. Report prepared for Environment Southland.

Cumulative effects from farming on the receiving environment

Introduction

S 3 of the RMA defines cumulative effects as effects that arise over time or in combination with other effects. This assessment aims to identify and consider effects on the receiving environment that arise over time, accounting for other land use activities in the catchment and other influences such as hydrology, drainage properties and nutrient attenuation. Since the landholding lies in two catchments, each has been considered separately.

Oreti catchment and New River Estuary catchment

The easternmost part of WW1&2 lies in the Lower Oreti catchment. Sitting at the base of the Oreti catchment, New River Estuary has been impacted over time by land use activities in the wider catchment. New River Estuary drains a catchment area of 4,314 km^2 comprising 55% intensive pasture, 14% low producing pasture, 20% native forest, and 9% exotic forest[39]. Urban land use also contributes to effects on New River Estuary, with urban and industrial wastes from Invercargill city being other sources of contaminants. Approximately 194 hectares of WW1&2 is mapped to the Lower Oreti catchment, which is part of the wider New River Estuary catchment (431,400 ha). The land area at WW1&2 draining to the Oreti and ultimately New River Estuary catchment amounts to 0.04% of the total catchment area.

Agricultural land use in the New River Estuary catchment is made up of sheep & beef, dairy farming and forestry. In 2014, there were 271 dairy farms, 821 sheep & beef farms and 33 forestry blocks[40]. Sheep & beef farming remains the dominant land use although there is crossover since some sheep & beef enterprises carry out dairy support activities such as IWG. The study concluded that “sheep & beef remains the dominant land use by area in the Southland region, but losses from dairy farms are greater per hectare. Overall, the contributions from both land uses are significant. However, given the higher per hectare losses, it follows that mitigation on dairy farms provides a greater per hectare benefit for water quality.” Using information reported by Environment Southland webpage, the area under dairy farming or dairy support in the Oreti and Invercargill catchments totals 106,514 hectares[41]

The wider New River Estuary catchment is characterised by the major Oreti river and other significant tributaries, which provide for potential dilution of contaminants. There are several groundwater zones, reflecting different aquifer profiles. The Central Plains GW zone underlies the westernmost side of the catchment. Groundwater discharge occurs via the numerous small streams which cross the Central Plains GW zone. This drainage is aided by extensive mole, tile and artificial drainage networks, which act to both intercept soil drainage and control the water table. By this mechanism, a large portion of annual recharge is rapidly routed from the catchment with a much small component of deeper groundwater flow following the overall catchment drainage. Groundwater nitrate levels at the top of the catchment/CP zone are high, with some hotspots; levels at the south of the catchment are much lower. The denitrification potential rating for the

[39] Stevens, L.M. 2018. New River Estuary: 2018 Macroalgal Monitoring. Report prepared by Wriggle Coastal Management for Environment Southland. 29p.
[40] Assessment of Farm Mitigation Options and Land Use Change on Catchment Nutrient Contaminant Loads in the Southland Region. Aqualinc Report C13055/04, 2014 Prepared for Environment Southland.
[41] Environment Southland (n.d.) https://www.es.govt.nz/environment/estuaries/Pages/Estuaries-in-the-Oreti.aspx

Central Plains GW zone ranges from very low at the top of the zone, low mid zone and intermediate/high at the base of the zone[42].

N LOAD - ORETI RIVER

A report prepared for Environment Southland assessed farm mitigation options and land use change on catchment nutrient contaminant loads in Southland[43]. Nutrient loss estimates were based on the Overseer farm nutrient budgeting model, which was also used to estimate how loss rates would change under three levels of on-farm mitigation measures. Information from the report has been used to estimate the contribution to the total N and P loads of the New River catchment from the farming activity at WW1&2. The report estimates that dairy farming contributes 52% of the agricultural source load of N in New River catchment, with sheep and beef contributing the balance (48%). Dairy farming contributes 67% of the agricultural source load of P in New River catchment, with sheep and beef contributing 32%. Significantly, wintering-off dairy cows within the catchment is a component of the sheep & beef activity.

Catchment	Current catchment agricultural source loads (t/year)		Total catchment source nitrogen load (t/yr)	Estimated realised nitrogen loads (t/yr)	Estimated attenuation (%)
	Nitrogen	Phosphorus			
Bluff_Harbour	19	1	36	29	20
Haldane_Estuary	23	0	39	26	33
Jacobs_River_Estuary	1958	53	2133	1300	39
Lake_Brunton	20	0	20	14	30
New_River_Estuary	4969	139	5513	3718	33
Toetoes_Harbour	6256	142	6617	4392	34
Waiau_River	2714	35	4970	1864	62
Waikawa_Harbour	144	4	176	180	-2
Total/average	16,102	374	19,404	11,524	31 (average)

Figure 7.3 Estimated loads of N and P in the eight study catchments[44]

Approximately 8,959 kg N/year may be lost from 194 hectares of land at WW1&2 mapped in the Lower Oreti catchment according to Overseer nutrient budget analysis (see proposed Block Nitrogen report). Assuming an attenuation rate of 33% from the above table, approximately 5,967 kg N/year could over time end up in receiving waters. This amounts to 0.16% of the estimated realised N load for New River Estuary catchment.

A similar calculation can be carried out to estimate the P load from WW1&2 to New River Estuary catchment without using an attenuation rate. 126 kg of P (100 kg of which is "Other Sources") may be lost annually from 194 hectares of WW1&2 that lie in the Oreti/New River Estuary catchment (see proposed Block Phosphorous report from Overseer). This amounts to 0.09% of the current catchment agricultural source P load in New River Estuary catchment.

Both estimates show that the farming activity at WW1&2 contributes a very small proportion of the nutrient (N and P) loading to New River Estuary catchment and represents a very small proportion of total nutrient

[42] Rissman (2011). Regional Mapping of Groundwater Denitrification Potential and Aquifer Sensitivity. Technical Report.

[43] Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

[44] Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

load in that catchment. It follows that cumulative effects from the activity will be minimal. Relative to other dairy farms, the applicants are operating at the lower end of the scale for nutrient losses despite wintering 1,250 cows at WW1&2 (in barns), and nutrient losses will not increase with additional cows. This assurance is provided to the Consent Authority through the capping of N loss per hectare through a consent condition. The investment in wintering barns is allowing for the removal of fodder cropping/IWG, which on a catchment scale is an activity that has a significant contribution to cumulative adverse effects in the Lower Oreti River and New River Estuary catchment. Arguably, the applicants are operating at an M3 mitigation level for dairy farming according to the Aqualinc study, given the range of site-specific GMPs and mitigation measures that will be implemented under the proposal. While the limit-setting process will primarily address the challenge of improving water quality in the coming years, this proposal is expected to allow water quality in New River Estuary catchment to be maintained if not improved in the meantime. Accounting for effects from all other land uses in the catchment, cumulative effects on New River Estuary from the proposed activity at WW1&2 are minimal.

Waimatuku catchment and Estuary

As is described in section 5, the mid-western part of WW1&2 lies at the top of the Waimatuku catchment. Very limited data could be sourced about the wider Waimatuku catchment. It is a relatively small catchment with an estimated size of 25,500 hectares as approximately measured on Beacon Mapping Services. Approximately 306 hectares of WW1&2 lies within the catchment, which is equivalent to an estimated 1.2% of the total catchment land area. Waimatuku Estuary is a small estuary (20 ha) at the bottom of the catchment and has been impacted over time by land use activities in the catchment. Land use in the wider catchment is dominated by sheep & beef, dairy farming and dairy support although specific information on land use in the catchment could not be found. LAWA report that 90% of the land area is the Waimatuku catchment is exotic grassland, with the balance split between herbaceous vegetation and horticulture[45]. A desktop count on Beacon Mapping Service of current discharge permits in the Waimatuku catchment indicate that there are approximately 55 dairy platforms in the Waimatuku catchment.

The Waimatuku catchment is characterised by the lack of a major river, which reduces the potential for dilution of contaminants. Headwaters of the Waimatuku Stream are fed by Bayswater Bog, with small springs in the Drummond area also contributing to baseflow. Shallow groundwater makes a significant contribution to baseflow discharge in the catchment with recharge circulating relatively rapidly through upper levels of the unconfined aquifer and discharging via the local stream network. According to Topoclimate, a range of soil types such as heavy Braxton and Pukemutu types, and lighter Glenelg systems dominate the upper and mid catchment. Heavier soils have moderate to good denitrification potential with lighter Oxidising soil types having little or no denitrification potential. Groundwater nitrate levels are low at the top of the catchment and underlying Bayswater Bog, elevated mid catchment and are low towards the catchment base. Denitrification potential predominantly for the Waimatuku GW zone is rated as low[46].

NUTRIENT LOADS – WAIMATUKU CATCHMENT

Specific data detailing the total nutrient load (from all land use or farming) in the Waimatuku catchment could not be found in the literature. Attempting to calculate the total nutrient load for N and P using empirical calculations has a high degree of uncertainty so has not been attempted here. Approximately 10,420 kg N/year may be lost from 306 hectares of land at WW1&2 mapped in the Waimatuku catchment according to Overseer nutrient budget analysis (see proposed Block Nitrogen report). Assuming an N attenuation rate of between

[45] https://www.lawa.org.nz/explore-data/land-cover/

[46] Rissman (2011). Regional Mapping of Groundwater Denitrification Potential and Aquifer Sensitivity. Technical Report.

33% (New River catchment) and 39% (Aparima catchment)[47], somewhere in the region of 6,775 kg of N/year may end up in the Waimatuku, either directly from drainage to surfacewaters or via groundwater discharge. What contribution this makes to the total N load in the Waimatuku catchment is unknown (since the total N load has not been calculated) but it may be similar or somewhat greater than 1.2%, which is an estimate of WW1&2's proportion of the total catchment land area.

A similar difficulty arises with P. 230 kg of P (156 kg of which is "Other Sources") may be lost annually from 306 hectares of WW1&2 that lie in the Waimatuku catchment (see proposed Block Phosphorous report from Overseer). Due to adsorption and attenuation of P, much of this will be taken out of solution. What contribution this makes to the total P load in the Waimatuku catchment is unknown (since the total P load has not been calculated) but it may be similar or slightly less (due to attenuation) than 1.2%, which is an estimate of WW1&2's proportion of the total catchment land area.

It is likely that the farming activity at WW1&2 contributes a small proportion of the nutrient (N and P) loading to the Waimatuku catchment and represents a small proportion of total nutrient load in that catchment. It follows that cumulative effects from the activity will be minimal. Relative to other dairy farms, the applicants are operating at the lower end of the scale for nutrient losses despite wintering 1,250 cows at WW1&2 (in barns), and nutrient losses will not increase with additional cows. This assurance is provided to the Consent Authority through the capping of N loss per hectare through a consent condition. The investment in wintering barns is allowing for the removal of fodder cropping/IWG, which on a catchment scale is an activity that has a significant contribution to cumulative adverse effects in the Waimatuku catchment. Arguably, the applicants are operating at an M3 mitigation level for dairy farming according to the Aqualinc study[48], given the range of site-specific GMPs and mitigation measures that will be implemented under the proposal. While the limit-setting process will primarily address the challenge of improving water quality in the coming years, this proposal is expected to allow water quality in Waimatuku catchment to be maintained if not improved in the meantime. This is supported by an improving trend over the last two consecutive years for N in the lower lower Waimatuku catchment. Accounting for effects from all other land uses in the catchment, cumulative effects on the Waimatuku catchment from the proposed activity at WW1&2 are minimal.

Intensive Winter Grazing

No intensive winter grazing of cows or heifers will occur at the WW1&2. A s such, no AEE for winter grazing is required as this activity.

IWG will be carried out at WRO. An AEE is provided for this activity in the WRO section of the application.

Consideration of alternatives for land use

The land at WW1&2 has been developed and used for dairy farming for many decades. Through their investment and experience farming, the applicants have developed a dairy farming model to suit the land. Given the level of investment, time and commitment to sustainability in the long term, the proposed dairying activity represents the best use of land at WW1&2. If this application is unsuccessful, the applicants will consider other uses for land at WW1&2 not under an existing land use consent for farming. Activities such as

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47 Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

48 Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

beef bull grazing (and associated IWG) or cereal cropping are realistic options. Neither of these activities will achieve a better outcome for the land environmentally as the dairying proposal.

8. Consultation

The applicants have requested that the application be publicly notified in accordance with s95A of the Act. During the hearing process, the public including potentially affected parties, will have the opportunity to submit their views and be consulted in due process.

9. Conclusion

The applicants seek replacement consents for their current land use consent for expanded dairy farming, effluent discharge to land and groundwater take for a 1,500-cow dairy operation. The expansion is due to an increase of 160 cows to a maximum of 1,500 cows. The expansion will occur in conjunction with key changes to the existing farm system; these changes are expected to result in a farming system with effects on receiving ground, surfacewaters and soils that are minimal, and that are less than existing effects.

The application includes a policy assessment, an assessment of environmental effects and Farm Environmental Management Plan that demonstrate that the expected, actual or potential adverse effects generated by the continuation of the proposed activities on the environment can be avoided, remedied or mitigated to the extent that they are considered to be no more than minor.

The key concern with the expansion and effluent discharge is the potential for the activities to have adverse effects on groundwater and surface water quality, and on soils. Provided any consent conditions imposed by the Council are adhered to, and management practices are implemented in line with the attached Farm Environmental Management Plans, the activities should have minimal adverse effect on the environment.

The water take is should have little adverse effect on neighbours' bores, and a less than minor effect on aquifer sustainability, current allocation and stream depletion.

Overall the proposal is considered consistent with the purpose of the Resource Management Act 1991 and does not conflict with the purpose of the Act, or with Council policy. The adverse effects of the dairying activity, the water take and the discharge of dairy shed effluent onto land should be no more than minor.

TIAKI

FARM SOURCE SUSTAINABLE DAIRYING

PHOSPHORUS MITIGATION PLAN

FARM SOURCE

Fonterra

Dairy for life

ABOUT YOUR FARM PLAN

This Farm Plan document is the result of a tailored farm environment planning service provided to you through Tiaki Sustainable Dairying. It's part of the advantage you get through Farm Source as a member of the Fonterra Co-Operative. The purpose of this plan is to describe the environmental conditions present on your farm and the management of these conditions. From this, mitigations to potential impacts to water quality are documented and additional mitigations maybe planned, with sensible timeframes. Underpinning this plan, are the agreed national Good Farming Practices that are supported by the agricultural and horticultural sectors. Industry bodies along with Regional Councils and Central Government have developed the Good Farming Practice: Action Plan for Water Quality 2018 in a commitment to swimmable rivers and improving the ecological health of our waterways. The Dairy Industry Strategy (Dairy Tomorrow), as well as the Good Farming Practice: Action Plan for Water Quality 2018, both align with the goal for all dairy farms to have a Farm Environment Plan by 2025. Now that this plan has been created it's the plan owner's responsibility to ensure it is put into action and kept up to date as actions are completed or conditions on farm change. Tiaki Sustainable Dairying is here to help with that implementation and ongoing management through our team of Sustainable Dairying Advisors who can be contacted via the details below.

PHONE: 0800 65 65 68

EMAIL: sustainable.dairying@fonterra.com

CONTENTS:

FARM DETAILS

FARM NAME — **Woldwide 1 & 2**

SUPPLIER NUMBER — **32650 & 32651**

PLAN OWNER — **Albert De Wolde**

+64 27 2272537
dewolde@farmside.co.nz

FARM ADDRESS — **HUNDRED LINE RD, Winton**

LOCATION

REGIONAL COUNCIL — **Southland**

PLAN LAST EDITED DATE — 31 July 2019

POINTS OF NOTE

FARM OVERVIEW MAP

The map below presents the land on which the farming operations covered in this document occur and identifies some key points of interest. More detailed maps looking at specific environmental management topics are contained throughout the document.

- Accord Defined Stock Excluded Waterway
- Accord Defined Stock Not Excluded Waterway
- Non-Accord Defined Stock Excluded Waterway
- Non-Accord Defined Stock Not Excluded Waterway
- Farm Boundary
- Compliant Crossing
- Non-Compliant Crossing
- Non-Compliant Non-Regular Crossing
- Dispensation Crossing
- Dairy Shed

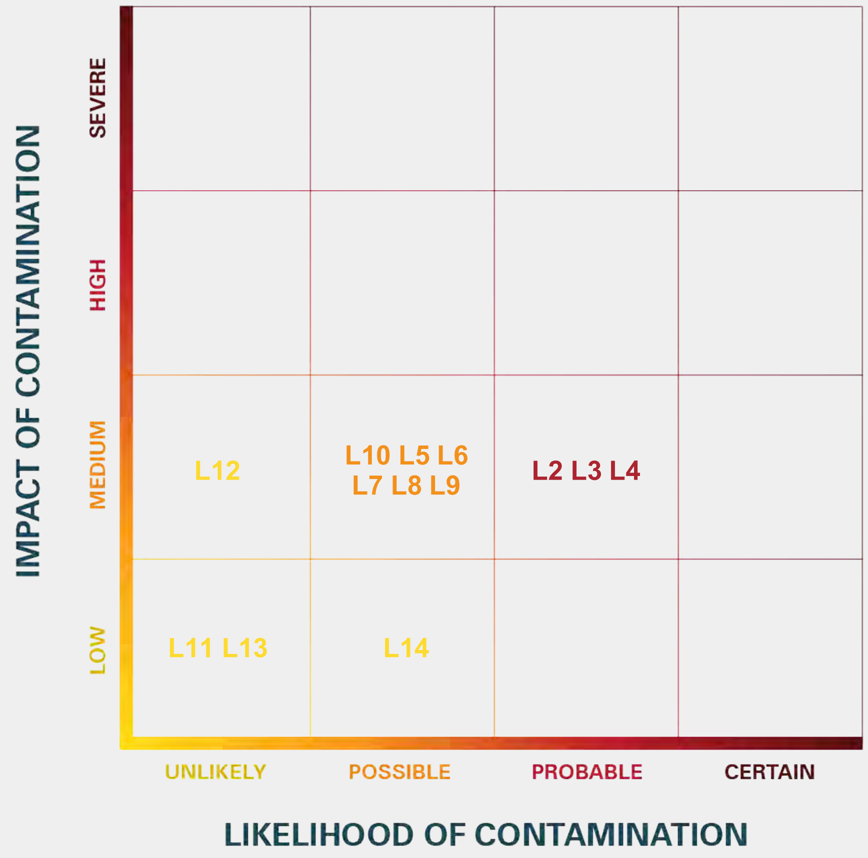
SUMMARY OF OPEN ACTIONS

This table includes all open or ongoing actions that have been agreed as part of this Farm Environment Plan. They are organized by their target due date. Where an action has been identified as especially important an additional (Flag) icon may have been added.

CATEGORY	FEATURE TYPE & NAME	ACTION REQUIRED	TARGET DATE
L2	Race Maintenance & Management - Lane Adjacent Waterway (West of Wintering Barn)	Establish Vegetated Riparian Margin (Beside Barn)	**1st August 2020**
L3	Critical Source Area - Critical Source Area (Paddocks 14-15)	Increase riparian buffer (triangle paddock)	**1st August 2020**
L3	Critical Source Area - Critical Source Area (Paddocks 14-15)	Protect Critical Source Area (Paddocks 14-15)	**1st August 2020**
L4	Race Maintenance & Management - Central Lane (between WOL and WTL)	Reduction in Use of Central Dairy Lane	**New Consent**
L4	Race Maintenance & Management - Central Lane (between WOL and WTL)	Slope Lane and Extend Riparian Buffer-Central Lane	**1st August 2020**
L5	Race Maintenance & Management - Lane Beside Waterway (Paddocks 18 & 19)	Extend Riparian Margin & Slope Lane	**1st February 2021**
L6	Culvert Management	Build up sides of culvert (South of Paddock 34)	**1st February 2021**
L7	Critical Source Area - Main Culvert (South of Wintering Barn)	Install Kerb - Main Culvert South Wintering Barn	**1st February 2021**
L8	Overland Flow Path - Overland Flow Path (Paddock 15)	Move Temporary Lane (Paddock 15)	**1st February 2021**
L9	Overland Flow Path - Critical Source Area (Paddock Marcel #1)	Extend Riparian Margin (Marcel #1)	**1st February 2021**
L10	Race Maintenance & Management - Lane Adjacent Waterway (Paddock 34)	Modify Lane beside Creek (Paddock 34)	**1st February 2021**
L11	Overland Flow Path - Overland Flow Path (Paddock 34)	Extend Riparian Margin (Paddock 34)	**1st August 2021**
L12	Critical Source Area - Culvert - Woldwide Two Dairy Shed	Build up Culvert Sides (Beside WTL Dairy Shed)	**1st August 2021**
L13	Critical Source Area - Culvert (Paddock Marcel #9)	Raise sides of culvert (Marcel #9)	**1st August 2021**
L14	Overland Flow Path - Critical Source Area (Paddock 21)	Extend Riparian Buffer (Paddock 21)	**1st August 2021**

UNDERSTANDING THE RISKS ON YOUR FARM

This section provides some context to help understand the relative impact and likelihood of environmental risks that have been identified on your farm. The chart on this page together with the map on the following page can be useful when thinking about what environmental risk areas on your farm need the most focus.



HOW ARE RISK RATINGS MEASURED?

The issues plotted on the chart above have been done so based upon two measures that are assigned to a specific area of your farm where an environmental risk has been identified. 1. Impact of contamination (on the vertical axis, or the first dial) is a measure of the potential scale or significance of contaminants that may be lost from this area of your farm. It's about quantifying how bad could the outcome for the environment be; 2. Likelihood of contamination (on the horizontal axis, or the second dial) is about the chance of the contamination actually occurring from that area of your farm. It takes into account things like how far the area might be from waterways as well as the slope or aspect of the area; When combined together the two measures also give an overall 'risk rating'. The measures and the combined rating are presented for each risk area along with other descriptive information about the risk area on the subsequent pages of this document.

Example:

RISK RATING

The map below shows the location of the risk areas identified on your farm. The Risk Rating presented here is a combined measure of the impact and likelihood of contamination occurring from each risk area.

LOW MEDIUM HIGH SEVERE

L2 Race Maintenance & Management - Lane Adjacent Waterway (West of Wintering Barn)

L3 Critical Source Area - Critical Source Area (Paddocks 14-15)

L4 Race Maintenance & Management - Central Lane (between WOL and WTL)

L5 Race Maintenance & Management - Lane beside Waterway (Paddocks 18 & 19)

L6 Culvert Management

L7 Critical Source Area - Main Culvert (South of Wintering Barn)

L8 Overland Flow Path - Overland Flow Path (Paddock 15)

L9 Overland Flow Path - Critical Source Area (Paddock Marcel #1)

L10 Race Maintenance & Management - Lane Adjacent Waterway (Paddock 34)

L11 Overland Flow Path - Overland Flow Path (Paddock 34)

L12 Critical Source Area - Culvert - Woldwide Two Dairy Shed

L13 Critical Source Area - Culvert (Paddock Marcel#9)

L14 Overland Flow Path - Critical Source Area (Paddock 21)

L1 Phosphorus Loss Overview

DESCRIPTION:

The overall property comprised of Woldwide One and Woldwide Two (as proposed) has three waterways passing through it and two tributaries to these waterways. The topography of the farm is flat, resulting in very few critical source areas that would facilitate the overland flow of contaminants into adjacent waterways. The main areas likely to be responsible for phosphorus losses are laneways that run adjacent to waterways and waterway crossing points (culverts).

Overseer is not spatially explicit and is unable to take into account landscape features. It assumes a hydrological connection exists to second order streams and that there is a transport mechanism to get phosphorus to those streams. The model will over estimate phosphorus loss if a significant portion of the block is hydrologically isolated from a second order stream (Gray, 2016).

The initiation and transport of phosphorus from the landscape requires conditions conducive to either overland or subsurface flow. In many situations, P loss to the stream is dominated by overland flow since soil will sorb most phosphorus from subsurface flow, unless, as with mole-pipe drainage, there is a direct conduit to the stream (McDowell et al. 2001). In general, more P is lost from soils with increasing slope, largely as particulate phosphorus.

Critical source areas are included in the model in general terms as the model was calibrated against catchment studies where losses from critical source areas would have occurred (Gray, 2016). On this basis, protecting critical source areas is a mitigation that needs to be applied outside of Overseer and will reduce phosphorus losses further from those modelled.

The estimated reductions in phosphorus referenced in this report are derived from the following calculations and research:

Phosphorus Loss – Culverts
There will be a reduction in phosphorus loss from mitigations applied around culverts but there is no robust research information to base an estimate on. On this basis estimated reductions in phosphorus have been referenced as >0 Kg/P.

Phosphorus Loss – Lanes
Overseer automatically estimates that there will be phosphorus loss from lanes to waterways. It assumes that all excreted phosphorus ends up as dung and that 30% of the phosphorus deposited on lanes is lost to water with the remaining 70% expected to remain on the lane or return to the adjacent paddock. This is a significant assumption and a major component of modelled phosphorus loss, reported as part of "other sources" in the Overseer phosphorus report.

Table 1.4 The fate of minerals ingested by a lactating dairy cow (ingesting 15.5 kg DM/day) (adapted from During 1984).

Element	Consumption	Percentage in			
	Kg /week	Faeces	Urine	Milk	Retained
N	5.1	26	53	17	4
P	0.4	66	-	26	8
K	2.9	11	81	5	3
Mg	0.2	80	12	3	5
Ca	0.4	77	3	11	9
Na	0.4	30	56	8	6

(Fertiliser and Lime Research Centre, 2014)

From Table 1.4 above, a cow eating 15.5 kg/DM/day will consume approximately 0.4kg of phosphorus per week, of which 66% is excreted in dung. For a cow with a 290 day lactation (assume not walking on lanes outside of the milking season) this equates to 10.9 kg/P/cow/yr. Cows are conservatively walking on the farm lanes for 1 hour per day as they move to and from the dairy shed. This means 4% (1 hour is 4% of a day) of phosphorus excreted is deposited on a lane. Overseer assumes 30% of this phosphorus is then lost to water via run-off.

((10.9 x 1500 cows) x 0.04) x 0.3 = 196 kg/P/yr lost to water from dairy lanes.

In total there are 10.8km of lanes on the farm of which 1.5km are adjacent to waterways and present a risk of contaminant runoff. This represents 14% of the lanes on the farm and proportionally 28kg of the total phosphorus losses from lanes. In reality this figure is likely to be higher as many of the other lanes on the property have no hydraulic connection to waterways. On this basis, lanes beside waterways are likely to make up a much larger proportion of the total phosphorus losses from the dairy lanes on the farm.

Assuming the conservative figure of 28 kg/yr of phosphorus loss from lanes adjacent waterways and the actions contained in this plan are carried out (improved vegetative buffer strips and lane management) then phosphorus losses from these areas are estimated to reduce by 40% (conservatively based on the lower end of the range of 38-59% of the data summarised in Figure 2 below). The exception to this is at site L12 where the use of the main cow lane is to be reduced significantly (by at least 50%) due to the changes in paddock layouts if consent is granted. This is in addition to the management and vegetation buffer improvements. At this site a 60% reduction phosphorus reduction factor has been used.

Overall phosphorus loss from lanes is estimated to reduce by 13.1kg/P/yr as outlined in the Table 1 below:

Site and Lane Length (m)	% of Total Lanes	P Loss (kg)	Mitigations (% Reduction)	Reduction in P Loss (kg)
L5 – 207	1.9	3.7	40	1.5
L2 – 241	2.2	4.3	40	1.7
L10 – 356	3.3	6.5	40	2.6
L4 – 553	5	9.8	60	5.9
L8 - 190	1.8	3.5	40	1.4
				13.1

Table 1 – Phosphorus Loss – Lanes

Phosphorus Loss – Critical Source Areas

Overseer predicts 101kg of phosphorus will be lost to water from paddocks (effective area of 478.9ha). Assuming phosphorus loss occurs evenly over the effective area of the farm, then critical source areas and their associated catchments would account for 2.5% of the phosphorus loss from blocks on the property. This equated to 2.5kg of phosphorus.

Assuming a 50% reduction in phosphorus loss occurs through the implementation of wider, vegetated riparian buffers (at locations where critical source areas enter waterways) and better management of critical source areas then a further reduction of 1.2kg of phosphorus is estimated to occur beyond that modelled in Overseer. See Table 2 below.

Site and Catchment Area	% of Total Catchment	P Loss (kg)	Mitigations (% Reduction)	Reduction in P Loss (kg)
L11 – 0.6ha	0.13	0.13	50	0.06
L3 – 0.7ha	0.15	0.14	50	0.07
L14 – 2.7ha	0.56	0.57	50	0.29
L9 – 7.5ha	1.57	1.9	50	0.79
				1.2

Table 2 – Phosphorus Loss – Critical Source Areas

The 50% reduction is based on research that shows management of critical source areas and vegetated buffers can reduce phosphorus loss by 38-59% (Figure 1). A midpoint reduction figure of 50% has been used to account for the likelihood of more phosphorus loss occurring in critical source areas than the rest of the farm and as such, more potential for phosphorus loss reductions.

It is acknowledged by McDowell et al, 2005 in the original design of the Overseer sub-model that, in some areas, 90% of phosphorus loss may come from only 10% of the catchment area (Sharpley et al, 1999). McDowell states that defining and isolating critical source areas, combined with adaptive management over the farm is the best approach to decreasing phosphorus loss.

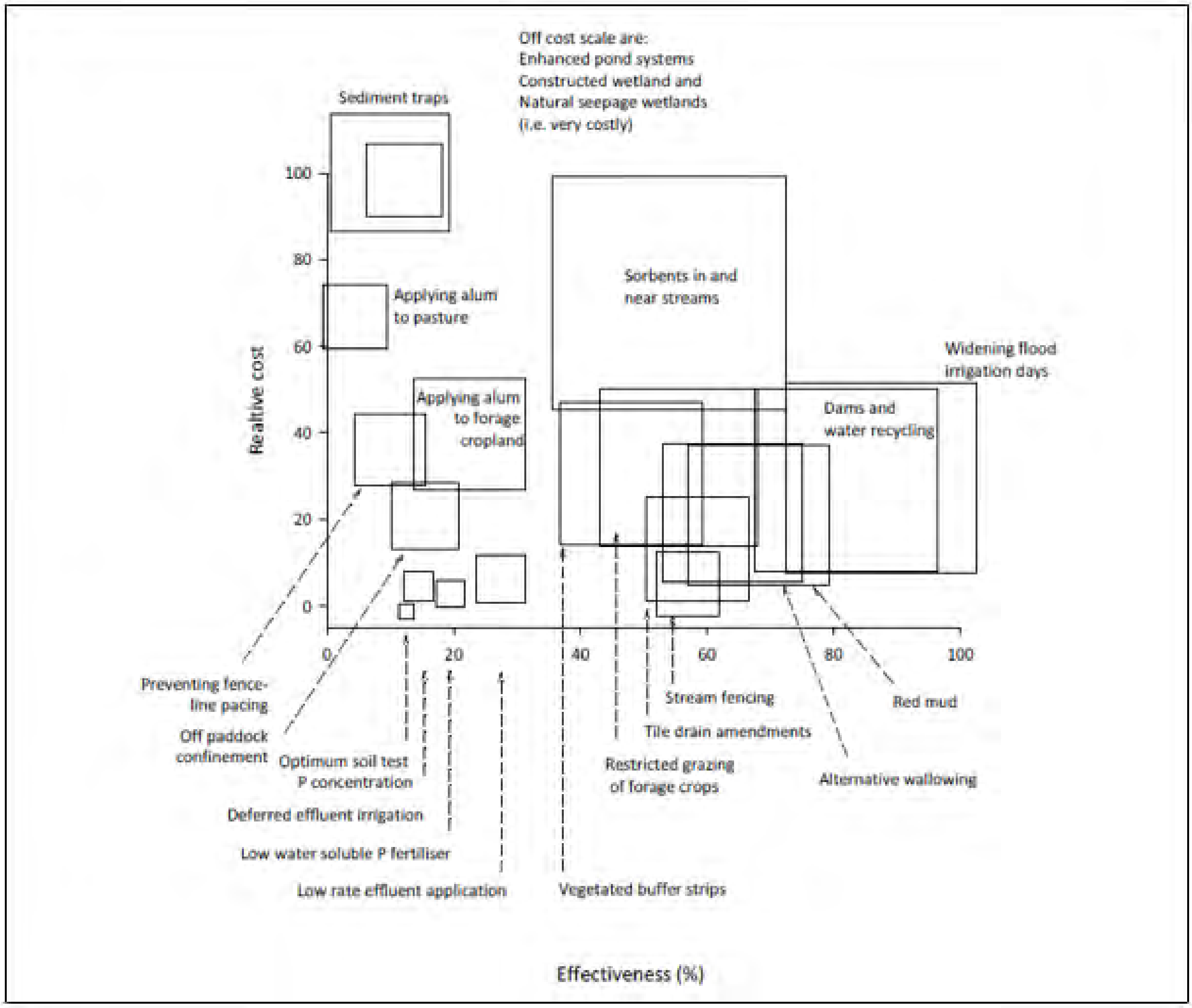


Figure 1 - Cost and effectiveness of strategies to mitigate phosphorus losses (McDowell et al, 2013)

Based on the topography of the property, it is likely that significantly more phosphorus will be lost through a small number of critical source areas rather than evenly over the property. On this basis, the estimated phosphorus loss from critical source areas is likely to be underestimated and thus the overall reductions achieved from implementing riparian buffers and better management of critical source areas.

References:

Fertiliser and Lime Research Centre. (2014). *Sustainable Nutrient Management Introductory Notes and Mastery Test*. Massey University.

Gray, C.W., Wheeler, D.M. and McDowell, R. (2016). *Review of the phosphorus loss submodel in OVERSEER®.* Report prepared for OVERSEER® owners under AgResearch core funding contract A21231(A). AgResearch. Report RE500/2015/050.

McDowell, R; Monaghan, R and Wheeler, D. (2005). *Modelling phosphorus losses from pastoral farming systems in New Zealand*, New Zealand Journal of Agricultural Research, 48:1, 131-141.

McDowell, RW; Sharpley, AN; Beegle, D and Weld J. (2001). *Comparing phosphorus management strategies at the watershed scale*. Journal of Soil and Water Conservation 56: 306-315.

McDowell, R; Wilcock, B and Hamilton, D. (2013). *Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters.* Report prepared for MfE. AgResearch. Report RE500/2013/066.

Sharpley, AN; Gburek, WJ; Folmar G and Pionke, HB. (1999). *Sources of phosphorus exported from an agricultural watershed in Pennsylvania*. Agricultural Water Management 41: 77-89.

LAND MANAGEMENT

L2

Race Maintenance & Management

Lane Adjacent Waterway (West of Wintering Barn)

IMPACT OF CONTAMINATION  +  LIKELIHOOD OF CONTAMINATION = HIGH RISK RATING

DESCRIPTION:

Main lane to the west of the Woldwide One wintering barn running adjacent to a waterway. There is 1-2m riparian buffer, which is wider to the north. Due to the location of farm infrastructure there is minimal opportunity to extend the riparian margin wider. There is minimal vegetation cover in the riparian margin to filter any run-off.

It is recommended this area be planted in low native grasses such as red tussock and carex secta (1m intervals) to filter any run-off and utilise the associated nutrients. As a minimum, the riparian buffer should be maintained in a healthy sward of rank grass. In addition to this, any areas of the lane that slope towards the waterway should be modified to slope in the opposite direction.

Estimated Reduction in Phosphorus: 1.7 Kg/P

GPS Co-ordinates: 1225117, 4889012

IMAGES:

OPEN ACTIONS:

Establish Vegetated Riparian Margin (Beside Barn)

The riparian margin between the main dairy lane and the waterway to the west of the Woldwide One wintering barn should be maintained in a healthy vegetative cover. It is recommended native carex secta and red tussock are planted (1m spacing's) in the riparian margin to filter run-off and utilise any associated nutrients. As a minimum the riparian margin should be maintained in a healthy sward of rank grass.

TARGET DATE: 1st August 2020

L3

Critical Source Area

Critical Source Area (Paddocks 14-15)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = HIGH RISK RATING

DESCRIPTION:

Low lying area at the eastern end of paddocks 14 and 15 on either side of the dairy lane. At times this area holds water which subsequently enters the creek at either end of the CSA. The area is partly fenced off but is still grazed.

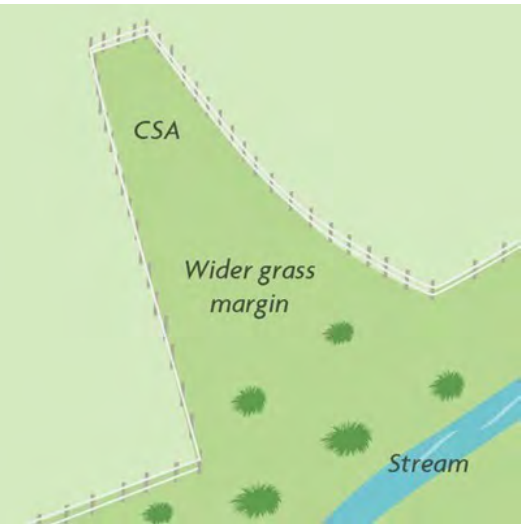
Being one of the few critical source areas on the farm means this area is likely to have a disproportionately high loss of sediment and phosphorus compared to other areas of the farm.

It is recommended that the riparian margin where the gully enters the adjacent waterway should be extended and maintained in rank grass (or planted in native grasses such as carex secta or red tussock) to filter any overland flow that may occur under normal rainfall conditions.

Estimated Reduction in Phosphorus: 0.07 Kg/P

GPS Co-ordinates: 1224779, 4889616

IMAGES:



OPEN ACTIONS:

Increase riparian buffer (triangle paddock)
The riparian margin where the gully (Critical Source Area) enters the waterway should be extended and maintained in rank grass (or planted in native grasses such as carex secta or red tussock) to filter any overland flow that may occur under normal rainfall conditions. See photo above.
TARGET DATE: 1st August 2020

LAND MANAGEMENT

L4

Race Maintenance & Management

Central Lane (between WOL and WTL)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = HIGH RISK RATING

DESCRIPTION:

Main dairy lane running between Woldwide One and Woldwide Two. Currently this is used frequently by stock from Woldwide Two to access paddocks to the south, south east and south west of the dairy shed. Changes in the layout of the farms will result in a number of these paddocks being accessed by different lanes. This will significantly reduce the frequency of stock movements along this section of the central lane (minimum of 50% reduction in stock movements) and the corresponding amount of dung (and associated phosphorus) deposited on the lane. In addition to the reduction in lane usage the lane should be sloped away from the adjoining waterway and the riparian buffer extended by 1m and maintained in rank grass (or planted in native grasses such as carex secta or red tussock).

Estimated Reduction in Phosphorus: 9.8 Kg/P

GPS Co-ordinates: 1225043, 4889449

IMAGES:

OPEN ACTIONS:

Reduction in Use of Central Dairy Lane

The reduction in use of the central dairy lane between Woldwide One and Woldwide Two will result in a significant reduction in stock movements along this section of laneway and a subsequent reduction in dung (phosphorus) deposited on the lane.

TARGET DATE: New Consent Issued

Slope Lane and Extend Riparian Buffer-Central Lane

The lane should be sloped away from the adjoining waterway and the riparian buffer extended by 1m and maintained in rank grass (or planted in native grasses such as carex secta or red tussock).

TARGET DATE: 1st August 2020

LAND MANAGEMENT

L5

Race Maintenance & Management

Lane beside Waterway (Paddocks 18 & 19)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

DESCRIPTION:

Main dairy lane running adjacent to a waterway. There is a small riparian buffer but this is not well vegetated and provides minimal opportunity for filtering contaminants off the lane. The lane is relatively wide in this area and as such it is recommended the fence be moved out 1m and a rank grass (or native plants such carex secta and red tussock) be established to assist in filtering any run-off.

In a number of places the lane does slope away from the adjacent waterway but during upcoming lane maintenance the entire lane should be sloped away from the creek.

Estimated Reduction in Phosphorus: 1.5 Kg/P

GPS Co-ordinates: 1225522, 4888560

IMAGES:

OPEN ACTIONS:

Extend Riparian Margin & Slope Lane
Extend the riparian margin by a minimum of 1m and establish a good sward of rank grass (or plant native grass such as carex secta and/or red tussock) to assist with filtering run-off from the lane. In addition to this slope the lane away from the waterway.
TARGET DATE: **1st February 2021**

L6 Culvert Management

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

DESCRIPTION:

Culvert crossing the waterway to the south of paddock 34. The culvert has no raised sides which allows any runoff to flow off the side into the underlying water. Building up the sides of the culvert and directing run-off back into the paddock or at a minimum into a grass riparian area will assist with filtering sediment and associated phosphorus.

Estimated Reduction in Phosphorus: >0 Kg

GPS Co-ordinates: 1225572, 4888488

IMAGES:

OPEN ACTIONS:

Build up sides of culvert (South of Paddock 34)

Build up the sides of the culvert crossing the waterway to the south of paddock 34. This will prevent the direct deposition of sediment and associated phosphorus into the underlying waterway and allow for filtering via a grass buffer.

TARGET DATE: 1st February 2021

LAND MANAGEMENT

L7

Critical Source Area

Main Culvert (South of Wintering Barn)

IMPACT OF CONTAMINATION  +  LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

DESCRIPTION:

The main lane culvert to the south of the wintering barn on Woldwide One. A kerb should be installed on the sides of the concrete lane going over the culvert to prevent direct run-off into the underlying waterway. The kerb should direct run-off back into the adjacent paddocks. On the western side of the culvert a triangle could be fenced off and left in rank grass.

Estimated Reduction in Phosphorus: >0 Kg/P

GPS Co-ordinates: 1225140, 4888897

IMAGES:

OPEN ACTIONS:

Install Kerb - Main Culvert South Wintering Barn
Install a kerb on the concrete lane at the point it goes over the main culvert. This should direct run-off into the adjacent paddock.
TARGET DATE: **1st February 2021**

LAND MANAGEMENT

L8

Overland Flow Path

Overland Flow Path (Paddock 15)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

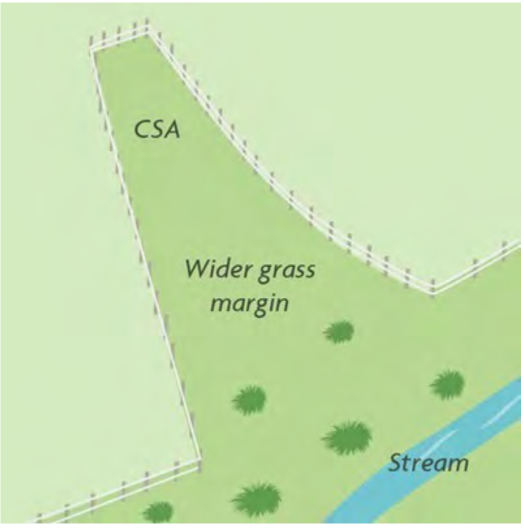
DESCRIPTION:

Fenced off strip at the southern end of paddock 15. Area used as an unformed lane to reach paddock 35. There is an overland flow path down to the south west corner of paddock 15 where run-off can exit into the adjacent waterway. The proximity of the unformed lane to the adjacent waterway also results in a high risk of run-off directly into the creek. The temporary lane should be moved 2-3m back from the waterway when in use and the resulting area left as rank grass to filter any run-off. The riparian buffer at the south west corner of paddock 15 should be extended and maintained in rank grass (or planted in native grasses such as carex secta, red tussock and toetoe).

Estimated Reduction in Phosphorus: 1.4 Kg/P

GPS Co-ordinates: 1225270, 4888883

IMAGES:



OPEN ACTIONS:

Move Temporary Lane (Paddock 15)
Move the temporary lane so it is 2-3m back from the waterway. Leave the resulting area in rank grass to filter any run-off. The riparian buffer at the low point at the south west corner of paddock 15 should be extended and maintained in rank grass (or planted in native grasses such as carex secta, red tussock and toetoe).
TARGET DATE: **1st February 2021**

LAND MANAGEMENT

L9

Overland Flow Path

Critical Source Area (Paddock Marcel #1)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

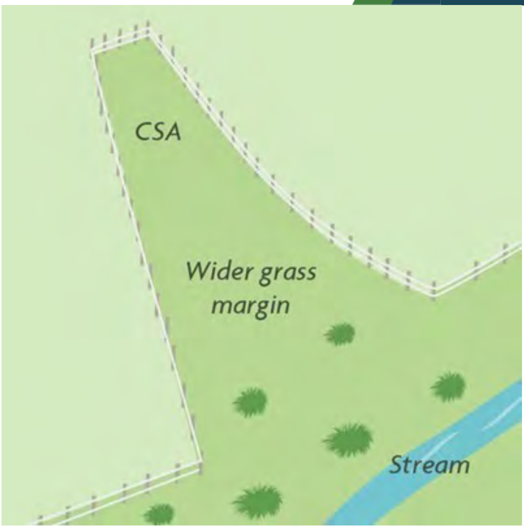
DESCRIPTION:

Swale/low area running through Marcel paddock 1. Overland flow will be concentrated in this area following heavy rain and make its way down into the adjacent waterway. The riparian margin should be increased where the swale enters the adjoining waterway and maintained in rank grass or planted in native grasses such as red tussock, carex secta or toetoe.

Estimated Reduction in Phosphorus: 0.79 Kg/P

GPS Co-ordinates: 1225180, 4890863

IMAGES:



OPEN ACTIONS:

Extend Riparian Margin (Marcel #1)
Extend the riparian margin in Marcel Paddock 1 where the critical source area enters the adjoining waterway. This area should be left in rank grass or planted in native grasses such as carex secta, red tussock or toetoe.
TARGET DATE: 1st February 2021

L10

Race Maintenance & Management

Lane Adjacent Waterway (Paddock 34)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = MEDIUM RISK RATING

DESCRIPTION:

Dairy lane on the boundary of Woldwide One and Woldwide Two, south of paddock 34. The lane is lined on the southern side with a row of tall gum trees, which will impact on the ability of the lane to dry out. There is a 1-1.5m riparian buffer between the lane and the creek, which is maintained in rank grass. Some re-contouring of the lane could occur to ensure it slopes away from the waterway along its full length. In addition to this the large gum trees could be removed and replaced with low growing native plantings such as flax, toetoe and red tussock. This will still provide stock shelter, aesthetic and biodiversity outcomes but not impact on the drying out of the lane.

Estimated Reduction in Phosphorus: 2.6 Kg/P

GPS Co-ordinates: 1225279, 4889150

IMAGES:

OPEN ACTIONS:

Modify Lane beside Creek (Paddock 34)
Re-contour the dairy lane at the southern end of paddock 34 (between Woldwide One and Woldwide Two) so it slopes away from the dairy lane. In addition to this the gum trees could be removed to prevent shading of the lane, allowing it to dry out (reducing the likelihood of water ponding and running off). This area could be replanted in low natives such as flax, toetoe and red tussock to maintain biodiversity and aesthetic values.
TARGET DATE: 1st February 2021

LAND MANAGEMENT

L11

Overland Flow Path

Overland Flow Path (Paddock 34)

IMPACT OF CONTAMINATION  +  LIKELIHOOD OF CONTAMINATION = LOW RISK RATING

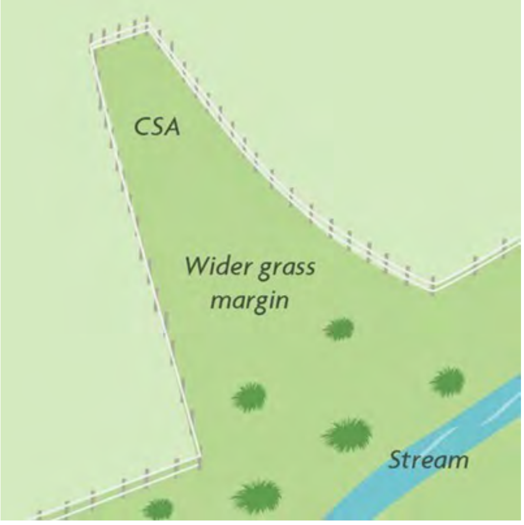
DESCRIPTION:

Small gully/swale running through paddock 34. In heavy rainfall events this will collect rainwater and associated contaminants from the surrounding land and direct them down to the waterway. Extending the riparian buffer and maintaining it in rank grass (or plant with native grasses such as Carex Secta or Red Tussock) in the location where the swale enters the creek will assist with filtering sediment and associated phosphorus.

Estimated Reduction in Phosphorus: 0.06 Kg/P

GPS Co-ordinates: 1225520, 4888729

IMAGES:



OPEN ACTIONS:

Extend Riparian Margin (Paddock 34)
Extend the riparian margin where the small swale in paddock 34 enters the adjacent waterway. Maintain this area in rank grass or plant in native grass species such as red tussock or carex secta.
TARGET DATE: **1st August 2021**

LAND MANAGEMENT

L12

Critical Source Area

Culvert - Woldwide Two Dairy Shed

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = LOW RISK RATING

DESCRIPTION:

Main culvert to the west of the dairy shed at Woldwide Two. The culvert could be improved to reduce the risk of contaminants off the lane flowing into the underlying waterway by building up the sides of the culvert and creating a wider buffer on the north side of the culvert where there is un-utilised space. Run-off should be directed off the culvert into adjacent paddocks (where possible) or as a minimum into a grassed riparian area.

Estimated Reduction in Phosphorus: >0 Kg/P

GPS Co-ordinates: 1224995, 4889689

IMAGES:

OPEN ACTIONS:

Build up Culvert Sides (Beside Woldwide Two Dairy Shed)
Build up the sides of culvert and create a wider riparian buffer on the north side of the culvert where there is un-utilised space. Direct run-off into adjacent paddocks where possible or as a minimum into a vegetated riparian margin.
TARGET DATE: **1st August 2021**

L13

Critical Source Area

Culvert (Paddock Marcel#9)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = LOW RISK RATING

DESCRIPTION:

Lane culvert into Marcel Paddock #9. The culvert is in good condition along with the lane overlying it. The sides of the culvert should be raised to prevent contaminants off the lane running directly into the underlying waterway. Run-off should be directed out into the adjacent paddocks.

Estimated Reduction in Phosphorus: >0 Kg/P

GPS Co-ordinates: 1225248, 4890530

IMAGES:

OPEN ACTIONS:

Raise sides of culvert (Marcel #9)

Raise the sides of the culvert to prevent contaminants off the lane running directly into the underlying waterway. Run-off should be directed out into the adjacent paddocks.

TARGET DATE: 1st August 2021

LAND MANAGEMENT

L14

Overland Flow Path

Critical Source Area (Paddock 21)

IMPACT OF CONTAMINATION + LIKELIHOOD OF CONTAMINATION = LOW RISK RATING

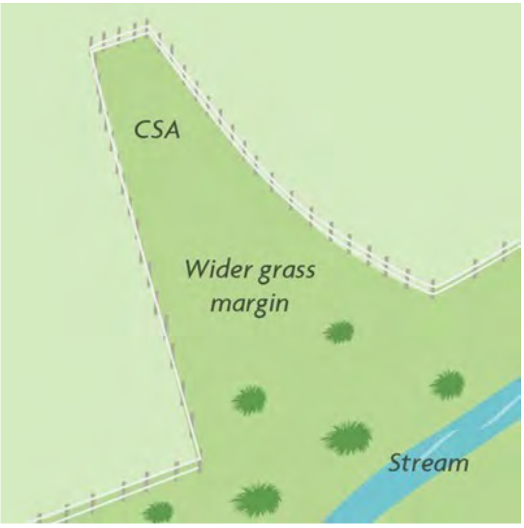
DESCRIPTION:

Shallow swale through paddock 21 that slopes down to the adjacent waterway. The swale will be a conduit for overland flow off the surrounding paddock during heavy rainfall events. Due to the flat topography of the farm and the small number of critical source areas, small swales as identified in paddock 21 are likely to carry a disproportionately high level of contaminants compared to the rest of the farm. On this basis having a wider riparian buffer where the swale enters the adjoining waterway and maintaining the buffer in rank grass or native grasses such as carex secta or red tussock will filter contaminants and reduce losses to surface waterways.

Estimated Reduction in Phosphorus: 0.29 Kg/P

GPS Co-ordinates: 1224876, 4889610

IMAGES:



OPEN ACTIONS:

Extend Riparian Buffer (Paddock 21)
Extend the riparian margin in the location where the low area through paddock 21 enters the adjoining waterway. This should be maintained in rank grass or planted in native grasses such as Carex Secta, Red Tussock or Toetoe.
TARGET DATE: **1st August 2021**

Executive Summary

This analysis has been prepared as part of a land use consent application to increase the number of dairy cows on Woldwide One Limited (WOL) and Woldwide Two Limited (WTL), while increasing the number of cows wintered off paddock in animal housing and removing the in paddock winter grazing of both mature mixed age cows and young stock. The overall objectives of the changes are to remove on-paddock winter grazing from the property, which has a high environmental impact and can negatively impact cow condition, and improve farm profitability by grazing additional dairy cows on the land previously used for winter grazing and silage production.

The properties are located in the Heddon Bush area of Southland and are comprised of 502ha of land currently comprised of two dairy platforms and a support block. The farm is predominately flat and sits within the Central Plains (77%) and Oxidising (23%) Physiographic Zones.

The nutrient budgets have been developed using Overseer FM 6.3.1 and the “Overseer Best Practice Data Input Standards, March 2018”. Four pre-expansion nutrient budgets (2013/14 – 2016/17) and a proposed post-expansion nutrient budget have been completed to inform the land use consent application to increase dairy cow numbers.

Modelled results from the 5 scenarios are presented below:

	13/14*	14/15	15/16	16/17	Average
Total N Loss (kg)	19005	23024	19024	20653	20427
N Loss/ha (kg)	40 (15)	46	38	41	41
Total P Loss (kg)	346	375	362	358	360
P Loss/ha (kg)	0.7 (0.2)	0.7	0.7	0.7	0.7
Pasture Grown Kg/DM/ha/yr (Dairy Platforms)	14,759	15,258	17,773	15,646	15,109

*See Section 7.1 & 10.1 for the makeup of these results

	Proposed	% Change From Pre-Expansion Average
Total N Loss (kg)	18932	-7.3
N Loss/ha (kg)	38	-
Total P Loss (kg)	352 (338)*	-2.2 (-6.1)
P loss/ha (kg)	0.7	-
Pasture Grown Kg/DM/ha/yr	15,513	-

*Additional P reductions calculated outside of Overseer (See Phosphorus Mitigation Plan)

Using Overseer, combined nutrient budgets have been developed for WOL, WTL and the Support Block, comparing the nutrient loss of the pre-expansion farm systems against the proposed farm system. Overseer has predicted that the nitrogen and phosphorus loss will decrease

Key drivers for the reduction in nitrogen loss are:

- Removal of winter and summer crop
- Removal of cows wintered outside on crop or grass
- Expansion of the size and use of the wintering barn facilities
- More efficient use of nitrogen fertiliser

Key drivers for the reduction in phosphorus loss are:

- Decrease in winter crop area
- Maintaining Olsen P at a target level of 30
- Expansion in the size and use of the wintering barn facilities (less wintering)

A supplementary section has been added to this report outlining the current and proposed nutrient budgets for the Horner Block (HB). The HB is a 160ha piece of land to the south west of WOL that is used for producing silage (cut and carry). HB receives wintering barn slurry from WOL, WTL and Woldwide 3 Limited.

Table of Contents

1.0 Farm Goals (Abe De Wolde)

Sustainability (environmental, economic and social) has been at the core of all we do at Woldwide Farming group. To us these principles flow out of a desire to be good stewards and they are all interlinked as shown in the picture below. (Please feel free to visit our website www.woldwide.nz to read the full story)

We were the first to build free stall barns in Southland to reduce outside crop wintering and we were the first (and only) ones to feed fresh grass to our cows in winter to reduce silage making losses and runoff. In 2013 we were supreme winners of the 2013 Southland Ballance Farm Environment Awards.

Ever since we came to New Zealand we have been trying to improve the sustainability of our farms with a long decision-making horizon and an innovative mind-set.

The proposed changes to the farms will enable us to take the next step on this journey; this plan will enable us to reduce fodder beet wintering further and we will be able to use our support land for fresh grass harvesting in winter rather than having to winter graze 1000 head of young stock on our lighter, high N loss soils. The utilisation of cow housing enables nutrients to be contained over winter and used to grow more grass and produce more food when the soil temperature rises and grass starts to grow again in the spring.

2.0 Proposal Overview

This analysis has been prepared as part of a proposal to increase the number of dairy cows on Woldwide One Limited (WOL) and Woldwide Two Limited (WTL), while increasing the number of cows wintered off paddock in animal housing and removing the in paddock winter grazing of both mature mixed age cows and young stock. The overall objectives of the changes are to remove on-paddock winter grazing from the property, which has a high environmental impact and can negatively impact cow condition, and improve farm profitability by grazing additional dairy cows on the land previously used for winter grazing and silage production.

The current effective land area of WOL and WTL is 388ha with total consented cow numbers of 1340. It is proposed to increase the land area of WOL and WTL to 502ha (479ha effective) by utilising the areas currently known as SH96 and Marcel Block to the north of WTL. In order to effectively utilise this land as part of the dairy platform it is proposed to increase total cow numbers by 160 to 1500.

At an operational level the property is currently split into two separate dairy farms and a support block (SH96 & Marcel). The dairy farms have individual discharge permits associated with them and the SH96 and Marcel Blocks have land use consent for dairying farming of cows that was granted in October 2017. Single land use, discharge and waters consent are being applied for to cover the overall expansion of both properties. This provides operational flexibility for the applicant and also allows a holistic assessment of environmental effects and proposed mitigations to be carried out.

Modelling has been carried out using Overseer FM Version 6.3.1 based on the property as a whole, however at a block level the pre-expansion budgets are broken down into the three farming enterprises to reflect the different fertiliser, feed and cropping regimes. The proposed budget does not individualise the farming enterprises as the entire property will be run as a dairy platform with WOL and WTL having the same size wintering facilities and similar land areas. The pre-expansion average losses have been derived by modelling the actual lawful use of the land (not consented maximums) from August 2013 through to July 2017 and comparing those losses to the proposed long term use of the land going forward.

Evidence of milk production has been obtained from Fonterra Co-Operative Group Ltd; fertiliser information from Ravensdown and Ballance (unless indicated otherwise); and cow numbers, concentrates fed and silage eaten and made on the dairy platforms from Agri-Business Consultants Ltd. Information has also been sort and provided directly from the property owner, Mr De Wolde.

Modelling pertaining to the Horner Block (HB), which is not directly related to WOL or WTL and is not proposed to be converted to dairy use has been included in a supplementary section to this report. Under the pSWLP, Environment Southland originally advised the Horner Block formed part of the landholding connected to WOL and WTL and therefore any farming activities on that land would need to be authorised by a land use consent. A legal opinion provided to the Council in October 2018 reversed this decision, however the HB supplementary section is still included for reference.

3.0 Property Overview

The 502ha of land is located across three soil types (farm scale soil mapping provided by Scandrett Rural Ltd – Appendix 1) comprised of Drummond (~348ha), Braxton (~105ha) and Glenelg (~49ha) soils. The farm is predominately flat and sits within the Central Plains (77%) and Oxidising (23%) Physiographic Zones (PZ).

The predominant risk to water quality within the PZ located on the property are contaminant losses (predominately nitrogen) to underlying groundwater. Within the Oxidising Zone this occurs via the movement of nutrient laden soil water during the late autumn and winter drainage period, into underlying aquifers. Within the Central Plains PZ the clay rich soils have shrink and swell properties, thus in dry conditions they are prone to cracking, which allows contaminants to bypass the soil matrix and move into underlying aquifers or into subsurface drains and subsequently into surface water. This can occur if dairy effluent is not well managed or during the first rainfall events following dry conditions. During wetter conditions Braxton soils are also prone to losses to surface water via artificial drainage due to their poor drainage characteristics (swelling) when wet.

Key infrastructure on the property, which has been included as a mitigation for nutrient loss within the Overseer modelling are the farms two effluent storage ponds, which allow for the deferred irrigation of farm dairy and wintering barn effluent; the use of low depth irrigation and the two 625 stall wintering barns (currently 900 stalls available across both WOL and WTL).

4.0 Key Applicable Regulations

The Decisions Version of the Proposed Southland Water and Land Plan (pSWLP) was notified by Environment Southland on the 4th April 2018.

Policy direction for the expansion of an existing dairy farm is provided for under Policy 5 (Central Plains), Policy 10 (Oxidising) and Policy 16 (Farming activities that affect water quality), of the pSWLP.

Policies 5 and 10 both require decision makers to generally not grant resource consents for additional dairy farming of cows where contaminant losses will increase as a result of the proposed activity. These policies also require the implementation of good management practices to manage the adverse effects on water quality and for these to be considered when assessing resource consent applications or developing farm environment plans.

Policy 16 in its current form requires the following:

- In the interim period, prior to the development of freshwater objectives under the Fresh Water Management Unit Process, applications to further intensify existing dairy farming of cows will generally not be granted where:
  - (i) The adverse effects, including cumulatively, on ground and surface water cannot be avoided or mitigated; or
  - (ii) Existing water quality is already degraded to the point of being over allocated; or
  - (iii) Water quality does not met the Appendix E Water Quality Standards or bed sediments do not meet the Appendix C ANZECC sediment guidelines.

Rule 20(d)(ii) of the pSWLP seek to give effect to these policies by requiring an assessment that shows that the annual amount of nitrogen, phosphorus, sediment and microbiological contaminants discharged from the landholding will be no greater than that which was lawfully discharged annually on average for the five years prior to the application being made. If this can be shown then the proposed expanded dairy farm is a restricted discretionary activity.

Rule 20(e) applies if the criteria above cannot be met, resulting in the proposed expanded dairy farm being a discretionary activity. The consent application will need to show how Policies 5, 10 and 16 will be given effect to.

Pre-expansion Overseer modelling has only been able to be carried out for 4 of the years prior to this application being made as at times cow numbers for the 2017/18 season exceeded the maximum number allowed under the farms discharge permit. This was largely as a result of having extra stock reared in anticipation of obtaining resource consent last year, which never eventuated. While modelling the 2017/18 season is possible it is deemed to be inappropriate as it could inflate the farms current nutrient loss averages. Modelling will be undertaken for 2017/18 if required.

Despite being a discretionary activity the Overseer modelling presented in this report shows that total modelled nitrogen and phosphorus losses from the increase in cow numbers are fully mitigated. There is a 7% modelled decrease in total nitrogen losses and a 2% reduction in modelled phosphorus losses compared to the pre-expansion 4 year average losses.

5.0 Overseer Version and Protocols

The nutrient budgets have been developed using Overseer FM 6.3.1 and the "Overseer Best Practice Data Input Standards, March 2018". No deviations have been made from the protocol.

Overseer Assumptions

- Long term annual average model - the model uses annual average input and produces annual average outputs
- Near equilibrium conditions -model assumes that that the farm is at a state where there is minimal change each year
- Actual and reasonable inputs - it is assumed that input data is reasonable and a reflection of the actual farm system. If any parameter changes, it is assumed that all other parameters affected will also be changed.
- Good management practices are followed - Overseer assumes the property is managed is line with accepted industry good management practice.

6.0 Overseer Limitations

Key limitations of the Overseer model are:

- Overseer does not predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving water body.
- Overseer uses long term average climate data and therefore doesn't account for climatic extremes.
- Overseer does not calculate the impacts of a conversion process, rather it predicts the long-term annual average nutrient budgets for the changed land use.
- Overseer is not spatially explicit beyond the level of defined blocks

- Not all management practices or activities that have an impact on nutrient losses are captured in the Overseer model

Further information on Overseer can be found in the following reports:

Technical Description of OVERSEER for Regional Councils, September 2015

Review of the phosphorus loss submodel in OVERSEER®, September 2016

7.0 Pre-Expansion Land Use

Four pre-expansion nutrient budgets have been produced covering the period from August 2013 to July 2017. An overview of each of the pre-expansion files is provided below with full details of the inputs used contained within Section 9.

All files have the following common input factors:

a) Dairy Platform Soil Test Results – Soil test result from 2016 have been used across all pre-expansion files. This represents a mid-point for the four files. Due to the annual fluctuations in soil test results and the fact WOL and WTL generally have higher Olsen P levels (reflected in the 2016 tests) this was deemed to be appropriate and avoided the complexity of multiple blocks having to be created to reflect different soil test results from different paddocks each year.

b) Support Block/Crop Soil Tests –Only sporadic soil test data is available for the support block so Overseer default values have been used. These default values provided a good representation of the fertility goals that were trying to be achieved on the support block.

c) Wintering Barn Use – The wintering barn is used from May – August in each of the pre-expansion files. In May the hours the barn is used for has been limited to 12 to reflect cows are generally only in the barn for half of May. In August, 1 hour of outside grazing has been entered to reflect some cows may periodically go outside if conditions are suitable. In June and July 900 cows are housed inside with numbers gradually falling over August as cows start springing.

d) Calving Date – A mean calving date of the 20th August and a drying off date of 15th June has been used for the pre-expansion files. This reflects the typical calving and drying off pattern over this time period.

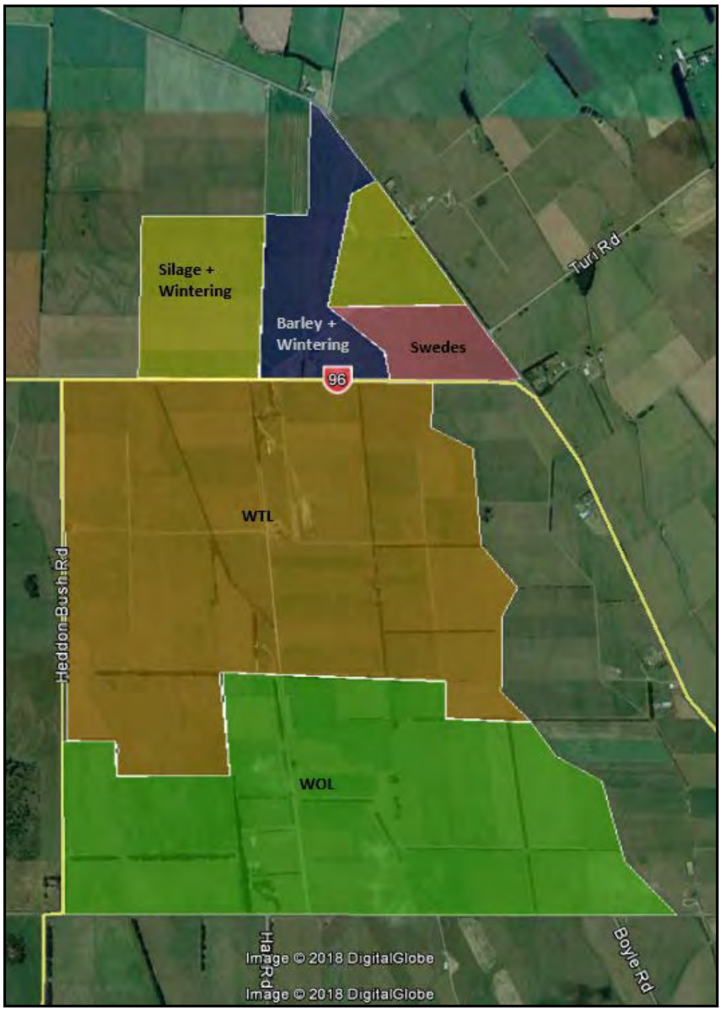
e) Tile Drains – On Drummond and Glenelg soils there are minimal tile drains and thus no tile drainage has been included in the model for these soil types. For the Braxton soils an estimate of 30% tile drainage has been used.

f) Wintering Barn Slurry –52m^3 of slurry per hectare has been used for the pre-expansion modelling of the silage areas that receive barn slurry. Barn slurry has been entered as exported in the wintering pad tab and is re-imported as a fertiliser at a block level. It was applied in three applications (17.3m^3/ha/application) and had the following nutrient classification, as outlined in the 2011 AgResearch report: Characterising dairy manures and slurries – Case Study 15.

Nitrogen = 3.2kg
Phosphorus = 0.8kg
Potassium = 4.4kg
Sulphur = 0.4kg
(Per 1000L of slurry)

g) Support Block = SH96 & Marcel Blocks

7.1 <u>August 2013 – July 2014</u>



In the 2013/14 season the farming enterprises occupied a smaller land area than what is under the control of Woldwide Group from 2014/15 onwards. The total farm size was 464ha (441ha effective) with WOL occupying 155ha and WTL 202ha. Peak cow numbers were 496 on WOL and 632 on WTL. On the support block to the north of WTL, Barley was sown with a tetraploid annual ryegrass on 26ha of land. This was harvested into cereal silage in late January with an additional cut of grass silage taken in April. Approximately 750 R1's grazed this area (along with the grass silage blocks) over winter. In addition to the Barley, 14ha of swedes were grown and used to winter 420 mixed age cows. The remaining 43.5ha of the support block was used for silage production (~15T/DM/ha), spreading of wintering barn/dairy effluent and the winter grazing of R1's on grass.

Milk production for the season was 250281kg/MS from WOL and 341434kg/MS from WTL, or an average of 524kg/MS/cow across the two properties. In order to achieve this level of production cows were fed 644kg silage per cow (not including in the wintering barn) as well as molasses, barley and palm kernel in the dairy shed (see Section 9.3 for quantities). The wintering barns were used from May through to August (900 cows) with an additional 1000T of silage fed in these facilities over this time period.

Fertiliser during the 13/14 season was purchased from Ravensdown and fertiliser inputs into Overseer have been based on fertiliser purchase records and spreading/fertiliser information provided directly from Ravensdown for the 30ha of the support block that forms part of WTL from 2014/15 onwards. Fertiliser for the pasture component of the summer turnip crop is based on WTL Non-Effluent (Drum_4a.1) block, which is the largest block the turnips rotate through. This methodology is also used for summer turnip crops in modelling of future years. In addition to the Ravensdown fertiliser inputs for the support block "cut and carry silage/young stock winter grazing" this area also received three applications of wintering barn effluent (17m^3/ha/application).

In order to account for the additional 38ha that is not part of the Woldwide Group in 2013/14 but is included from 2014/15 onwards and is part of the area subject to the land use consent for expanded dairying, a conservative nitrogen loss figure of 15kg/ha/yr has been used for this area of land (represents an average nitrogen loss figure from a sheep farm on lighter soils). For phosphorus, 0.2kg/ha/yr has been used as a conservative loss to water figure (including phosphorus losses from other sources). These are accounted for separately in the table below (Est 38ha).

	13/14 Land Area	**Est 38ha**	**Total**	**13/14 per ha**	**Est 38ha per ha**
Nitrogen Loss (kg/N)	18435	570	19005	40	15
Phosphorus Loss (Kg/P)	338	8	346	0.7	0.2
Pasture Production (Dairy Platform – kg/DM)				14,759	

7.2 <u>August 2014 – July 2015</u>

In the 2014/15 season an additional 38ha of support land was purchased to bring the overall size of the properties to 502ha. WTL expanded to take over 30ha of the support block, which resulted in WTL increasing in size from 202ha to 232ha. In addition to this, peak cow numbers on WTL increased from 632 in 2013/14 to 727. No changes were made to the area covered by WOL nor did any significant change in cow numbers occur (495 peak milked). On the support block to the north of WTL, Kale was grown on 30ha of land and facilitated the wintering of approximately 640 mixed age cows over June and July. In addition to the Kale, 10ha of fodder beet was grown and used to winter 430 mixed age cows. The remaining 51ha of the support block was used for silage production (~15T/DM/ha), spreading of wintering barn/dairy effluent and the winter grazing of approximately 875 R1's on grass.

Milk production for the season was 246072kg/MS from WOL and 372124kg/MS from WTL, or an average of 506kg/MS/cow across the two properties. In order to achieve this level of production cows were fed 487kg silage per cow (not including in the wintering barn) as well as molasses, barley and palm kernel in the dairy shed (see Section 9.3 for quantities). The wintering barns were used from May through to August (900 cows) with an additional 1000T of silage fed in these facilities over this time period.

Fertiliser during the 14/15 season was sourced from Balance Agri Nutrients and was applied according to the fertiliser plan produced by Latoya Grant (Balance Fertiliser Rep). Fertiliser records for the Kale crop were not available and thus standard recommendations have been used (based on information published by Ravensdown). Fertiliser inputs for the support block "cut and carry silage/young stock winter grazing" were not available and have been based on the 15/16 fertiliser records for the same land use. This area also received three applications of wintering barn effluent (17m^3/ha/application). Fodder beet fertiliser recommendations are based on the Balance fertiliser recommendations for fodder beet on Woldwide Three.

	Total	**Per/ha**
Nitrogen Loss (kg/N)	23024	46
Phosphorus Loss (Kg/P)	375	0.7
Pasture Production (Dairy Platform – kg/DM)		15258

7.3 August 2015 – July 2016

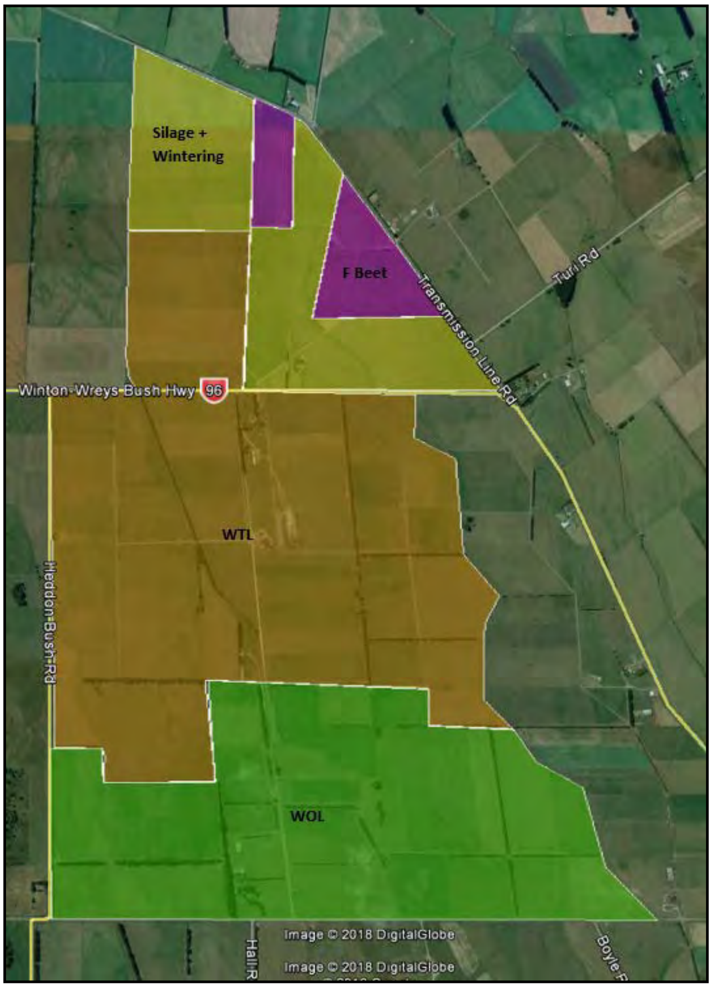
In the 2015/16 season no changes were made to the overall size of the properties (502ha) or the land area occupied by WTL or WOL. Peak cow numbers on WOL increased by ten cows to 505 but numbers on WTL decreased by 19 to 708 cows compared to the in 2014/15 season. On the support block to the north of WTL, fodder beet was grown on 22ha of land and facilitated the wintering of approximately 1100 mixed age cows over June and July. The remaining 69ha of the support block was used for silage production (~15T/DM/ha), spreading of wintering barn/dairy effluent and the winter grazing of approximately 745 R1's on grass.

Milk production for the season was 265277kg/MS from WOL and 361346kg/MS from WTL, or an average of 517kg/MS/cow across the two properties. In order to achieve this level of production cows were fed 510kg silage per cow (not including in the wintering barn) as well as molasses, barley and palm kernel in the dairy shed (see Section 9.3 for quantities). The wintering barns were used from May through to August (900 cows) with an additional 950T of silage fed in these facilities over this time period.

Fertiliser during the 15/16 season was sourced from Ravensdown and fertiliser inputs into Overseer have been based on fertiliser purchase records with reference to the fertiliser plan for the 15/16 season. Fodder beet is spread over two separate soil types and fertiliser use is based on the records for Marcel paddocks 2-5 where the majority of the crop was grown (SH96 paddock 6 where the rest of the fodder beet was grown had an almost identical fertiliser record). Fertiliser inputs for the support block "cut and carry silage/young stock winter grazing" have been based on the 15/16 fertiliser records for this area from Ravensdown and also received three applications of wintering barn effluent (17m^3/ha/application).

	Total	Per/ha
Nitrogen Loss (kg/N)	19024	38
Phosphorus Loss (Kg/P)	362	0.7
Pasture Production (Dairy Platform – kg/DM)		14773

7.4 August 2016 – July 2017



In the 2016/17 season no changes were made to the overall size of the properties (502ha) or the land area occupied by WTL or WOL. Peak cow numbers on WOL decreased by seven cows to 497 and numbers on WTL increased by one to 709 cows compared to the in 2015/16 season. Summer Turnips stopped being grown on the property for the first time. On the support block to the north of WTL, fodder beet was grown on 22.5ha of land and facilitated the wintering of approximately 1130 mixed age cows over June and July. The remaining 68.5ha of the support block was used for silage production (~17T/DM/ha) and the spreading of wintering barn/dairy effluent. No winter grazing of young stock occurred off the silage blocks as fresh grass was cut in winter and feed directly in the wintering barn (entered as additional silage within Overseer).

Milk production for the season was 287774kg/MS from WOL and 387618kg/MS from WTL, or an average of 560kg/MS/cow across the two properties. In order to achieve this level of production cows were fed 710kg silage per cow (not including in the wintering barn) as well as molasses, barley and palm kernel in the dairy shed (see Section 9.3 for quantities). The wintering barns were used from May through to August (900 cows) with an additional 1000T of silage fed in these facilities over this time period.

Fertiliser during the 16/17 season was sourced from Ravensdown and fertiliser inputs into Overseer have been based on fertiliser purchase records with reference to the fertiliser plan for the 16/17 season. Fodder beet is spread over two separate soil types and fertiliser use is based on the records for Marcel paddocks 2-5 where the majority of the crop was grown (SH96 paddock 6 where the rest of the fodder beet was grown had an almost identical fertiliser record). Fertiliser inputs for the support block "cut and carry silage blocks" have been based on the 16/17 fertiliser records for this area from Ravensdown and also received three applications of wintering barn effluent ($17m^3$/ha/application).

It should be noted that the SH96 "cut and carry silage block" paddocks 2 and 3 (10ha) didn't receive the last two fertiliser applications unlike the rest of the block. This was deemed minor in the overall modelling scenario and didn't justify the complexity of adding another block to the Overseer file.

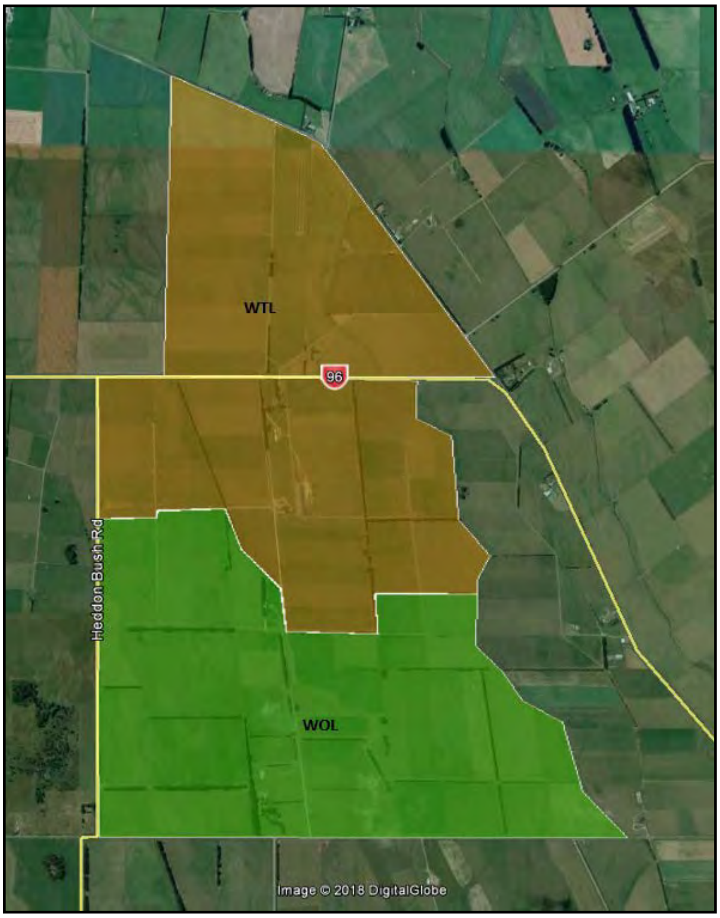
	Total	Per/ha
Nitrogen Loss (kg/N)	20653	41
Phosphorus Loss (Kg/P)	358	0.7
Pasture Production (Dairy Platform – kg/DM)		15909

8.0 Proposed Land Use

In the proposed scenario there are no changes to the overall size of the property (502ha) but the dairy platform (incorporating WOL and WTL) is expanded to cover the entire property (support land removed). Peak cow numbers are increased to 1500 cows (currently consented for 1340) to make use of the additional land being brought into the dairy platforms. A key change/mitigation in the proposed scenario is the removal of all in paddock winter grazing and the expansion of the wintering barn facilities to accommodate 1250 cows (currently 900).

Milk production is based on an average of 560kg/MS/cow or 840000kg/MS/yr. In order to achieve this level of production cows are fed 700kg silage per cow (not including in the wintering barn) as well as molasses, barley and palm kernel in the dairy shed (see Section 9.3 for quantities). The use of the wintering barns will be extended and used to a varying degree from April through to September. During this period, 1400T of silage is proposed be fed in these facilities along with fresh grass.

Fertiliser usage is based on the 16/17 season fertiliser records sourced from Ravensdown with some modifications to account for a single application of barn effluent on 185ha of Drummond soil and additional phosphorus fertiliser to ensure Olsen P levels can be maintained at 30. In addition to this, a slight reduction in nitrogen fertiliser usage (when compared to average usage in the pre expansion nutrient budgets) has been made to better align with pasture production being achieved and the expanded use of farm dairy effluent.



Soil test results have been based on maintaining an Olsen P levels of 30, which is the long term goal objective and reflects a level where near maximum pasture production is achieved.

Tile drainage on Drummond and Glenelg soils is minimal and thus no tile drainage has been included in the model for these soil types. For the Braxton soils an estimate of 30% tile drainage has been used.

	Total	**Per/ha**
Nitrogen Loss (kg/N)	18932	38
Phosphorus Loss (Kg/P)	352	0.7
Pasture Production (Dairy Platform – kg/DM)		15513

9.0 Modelling Inputs

To construct the nutrient budgets the following input data has been used;

9.1 *Blocks*

The farm has been split into the following pastoral (effluent and non-effluent), fodder crops (rotating), crop blocks and cut and carry blocks:

Block Name	Soil Type	13/14	14/15	15/16	16/17	Proposed
WOL Effluent	Drum_2a.1	30	30	30	30	
WOL Non Effluent	Brax_4a.1	47.5	47.5	47.5	47.5	
WOL Non Effluent	Drum_2a.1	78.4	78.4	78.4	78.4	
WTL Effluent	Drum_2a.1	45	45	45	45	
WTL Non Effluent	Brax_4a.1	53	53	53	53	
WTL Non Effluent	Drum_2a.1	104	134	134	134	
Effluent Block	Drum_2a.1					120
Non-Effluent	Brax_4a.1					100.5
Non-Effluent	Drum_2a.1					25.4
Non-Effluent	Glene_4a.1					48
Barn Slurry	Drum_2a.1					185
Swedes	Drum_2a.1	2				
Swedes	Glene_4a.1	12				
Barley + Silage + WGYS	Drum_2a.1	19				
Barley + Silage + WGYS	Glene_4a.1	7				
Silage + WGYS + Barn Eff	Drum_2a.1	31.5	21.5			
Silage + WGYS + Barn Eff	Glene_4a.1	12	29.2			
SH 96 Silage+WGYS+Barn Eff	Drum_2a.1			28		
SH 96 Silage+WGYS+Barn Eff	Glene_4a.1			12		
Marcel Silage+WGYS+Barn Eff	Drum_2a.1			11		
Marcel Silage+WGYS+Barn Eff	Glene_4a.1			18		
SH96 Cut & Carry	Drum_2a.1				28	
SH96 Cut & Carry	Glene_4a.1				12	
Marcel Cut & Carry	Drum_2a.1				11	
Marcel Cut & Carry	Glene_4a.1				17.5	
Fodder Beet	Drum_2a.1		10	4	4	
Fodder Beet	Glene_4a.1			18	18.5	
Kale	Drum_2a.1		11.4			
Kale	Glene_4a.1		18.5			
Effective Farm Area		**441.4**	**478.5**	**478.9**	**478.9**	**478.9**
Non productive		22.6	23.5	23.1	23.1	23.1
Total Farm Area		**464**	**502**	**502**	**502**	**502**
Summer Turnips	Rotating	15.8	14	14.5		

- Soil areas were obtained from soils mapping provided by Dairy Green Ltd (refer to Appendix 1).
- Soil settings were obtained from SMap for all soil types.

9.2 Climate Data

- Location setting = Southland
- Climate station tool used for block climate data
  - 1002mm of rainfall
  - 9.8°C mean annual temperature
  - 731-1450mm daily rainfall pattern. Low variation.
  - 711mm mean annual PET

9.3 Farm System Inputs

Description	13/14	14/15	15/16	16/17	Proposed
Milk Solids Production	591,715 kg/MS	618,196 kg/MS	626,623 kg/MS	675,392 kg/MS	840,000 kg/MS
Median Calving Date	20th August	20th August	20th August	20th August	20th August
Drying Off Date	15th June	15th June	15th June	15th June	15th June
Cows on Farm (Generated from Peak Cow Numbers)	Friesian July – 900 Aug – 1189 Sep – 1128 Oct – 1128 Nov – 1128 Dec – 1128 Jan – 1060 Feb – 1060 Mar – 1060 Apr – 981 May – 913 Jun – 900 11 Bulls Dec-Feb	Friesian July – 900 Aug – 1285 Sep – 1222 Oct – 1222 Nov – 1222 Dec – 1222 Jan – 1149 Feb – 1149 Mar – 1149 Apr – 1063 May – 990 Jun – 900 12 Bulls Dec-Feb	Friesian July – 900 Aug – 1281 Sep – 1213 Oct – 1213 Nov – 1213 Dec – 1213 Jan – 1140 Feb – 1140 Mar – 1140 Apr – 1055 May – 982 Jun – 900 12 Bulls Dec-Feb	Friesian July – 900 Aug – 1249 Sep – 1206 Oct – 1206 Nov – 1206 Dec – 1206 Jan – 1174 Feb – 1174 Mar – 1174 Apr – 1049 May – 977 Jun – 900 12 Bulls Dec-Feb	Friesian July – 1250 Aug – 1500 Sep – 1500 Oct – 1500 Nov – 1500 Dec – 1500 Jan – 1410 Feb – 1410 Mar – 1410 Apr – 1305 May – 1215 Jun – 1250 15 Bulls Dec-Feb
Milking Shed Feeding	August to May	August to May	August to May	August to May	August to May
Dairy Replacements	Calves Aug – 88 Sep – 248 Oct – 248 R1's Jun – 750 Jul - 750	Calves Aug – 95 Sep – 269 Oct – 269 R1's Jun – 551 Jul - 551	Calves Aug – 95 Sep – 267 Oct – 267 R1's Jun – 745 Jul - 745	Calves Aug – 98 Sep – 275 Oct – 275 R1's Jun – 0 Jul - 0	Calves Aug – 220 Sep – 417 Oct – 417 R1's Jun – 0 Jul - 0
Dairy Cow Wintering	Mixed Age Jun – 420	Mixed Age Jun – 1070	Mixed Age Jun – 1100	Mixed Age Jun – 1130	Mixed Age Jun – 0

Description	**13/14**	**14/15**	**15/16**	**16/17**	**Proposed**
	Jul - 420	Jul - 1070	Jul - 1100	Jul - 1130	Jul – 0
Wintering Barn	Mth/Cows/Hr May - 900 - 12 Jun – 900 - 24 Jul – 900 – 24 Aug –535 – 23 Effluent – All Exported *(imported as a fertiliser at block level)*	Mth/Cows/Hr May - 900 - 12 Jun – 900 - 24 Jul – 900 – 24 Aug –578 – 23 Effluent – All Exported *(imported as a fertiliser at block level)*	Mth/Cows/Hr May - 900 - 12 Jun – 900 - 24 Jul – 900 – 24 Aug –576 – 23 Effluent – All Exported *(imported as a fertiliser at block level)*	Mth/Cows/Hr May - 900 - 12 Jun – 900 - 24 Jul – 900 – 24 Aug –562 – 23 Effluent – All Exported *(imported as a fertiliser at block level)*	Mth/Cows/Hr Apr – 326 - 2 May- 1250-14 Jun -1250 - 24 Jul -1250 – 24 Aug -750 – 23 Sep -150 - 24 Effluent – All Exported *(imported as a fertiliser at block level)*
Crop Area & Inputs	14ha Swedes 13T/DM/ha Conventional Cultivation November 270kg/ha Cropmaster 15 at sowing 160kg/ha Urea – Jan Grazed 24 hrs day Jun & Jul by mixed age cows. 15.8ha Sum Turnips 9T/DM/ha Conventional Cultivation November 240kg/ha Cropmaster DAP at sowing 100kg/ha Urea – Dec 100kg/ha Urea – Apr for pasture renewal	29.9ha Kale 12T/DM/ha Conventional Cultivation November 450kg/ha Superten & 70kg/ha Urea at sowing. 150kg/ha Urea – Dec 100kg/ha Urea – Feb 250kg/ha Pot Super – Oct for Pasture Renewal. Grazed 24 hrs day Jun & Jul by mixed age cows. 10ha Fodder Beet 25T/DM/ha Conventional Cultivation October 400kg /ha Cropzeal 16N at sowing 200kg/ha	22ha Fodder Beet 25T/DM/ha Conventional Cultivation October 160kg/ha Ammo36, 280 kg/ha Super, 120kg/ha Cropmaster15 & 150kg/ha Pot Chloride at sowing. 250kg/ha Pot Super – Sep for Pasture Renewal. Grazed 24hrs day by mixed age cows. 14.5ha Sum Turnips 8T/DM/ha 240kg/ha DAP at sowing 100kg/ha Urea – Nov 250kg/ha Pot Super – Oct for Pasture Renewal.	22.5ha Fodder Beet 25T/DM/ha Conventional Cultivation October 425kg/ha Cropmaster 15, 110kg/ha Pot Chloride at sowing. 160kg/ha Urea & 75kg/ha Pot Chloride – Dec 250kg/ha Pot Super – Sep for Pasture Renewal. Grazed 24hrs day by mixed age cows.	None

Description	13/14	14/15	15/16	16/17	Proposed
	Grazed 2hrs day Feb & Mar by dairy cows	Sustain 20K – Dec 100kg/ha Sustain 20K – Feb 250kg/ha Pot Super – Sep for Pasture Renewal. Grazed 24hrs day Jun & Jul by mixed age cows 14ha Sum Turnips Conventional Cultivation October 250kg/ha Cropzeal Boron Boost at sowing 150kg/ha Urea – Nov 250kg/ha Pot Super – Mar for Pasture Renewal. Grazed 2hrs day Jan & Feb by dairy cows.	Grazed 2hrs day Jan & Feb by dairy cows		
Silage/Barley Blocks & Inputs	Barley+Silage + WGYS – 26ha Barley under sown with annual ryegrass in October 251kg/N/ha, 101kg/P/ha & 139kg/K/ha	Silage+WGYS+ Barn Eff – 50.7ha 406kg/N/ha, 34kg/P/ha & 125kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha & 228kg/K/ha applied as	SH96 Silage + WGYS+ Barn Eff – 40ha 406kg/N/ha, 34kg/P/ha & 125kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha & 228kg/K/ha applied as	SH96 Silage + WGYS+ Barn Eff – 40ha 258kg/N/ha, 53kg/P/ha & 64kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha & 228kg/K/ha applied as	None

Description	13/14	14/15	15/16	16/17	Proposed
	applied as fertiliser 8T/ha of Cereal Silage & 5T/ha grass silage. All grass winter grazing Jun & Jul with R1's Silage+WGYS+ Barn Eff - 43.5ha 304kg/N/ha, 59kg/P/ha & 228kg/K/ha applied as fertiliser. 166kg/N/ha, 42kg/P/ha and 228kg/K/ha applied as wintering barn effluent. 15T/ha grass silage cut. All grass winter grazing Jun & Jul with R1's	wintering barn effluent. 15T/ha grass silage cut. All grass winter grazing Jun & Jul with R1's	wintering barn effluent. 15T/ha grass silage cut All grass winter grazing with Jun & Jul R1's Marcel Silage+ WGYS + Barn Eff – 29ha 267kg/N/ha, 70kg/P/ha & 142kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha & 228kg/K/ha applied as wintering barn effluent. 15T/ha grass silage cut All grass winter grazing Jun & Jul with R1's	wintering barn effluent. 17T/ha grass silage cut Marcel Silage+ Barn Eff – 28.5ha 440kg/N/ha, 89kg/P/ha & 167kg/K/ha applied as fertiliser 166kg/N/ha, 43kg/P/ha & 235kg/K/ha applied as wintering barn effluent. 17T/ha grass silage cut	
Supplements	Utilised (DM) 830T Barley Grain, 233T Molasses & 425T PKE fed in dairy shed 726T Silage (fed on dairy platform paddocks)	Utilised (DM) 845T Barley Grain, 148T Molasses & 524T PKE fed in dairy shed 595T Silage (fed on dairy platform paddocks)	Utilised (DM) 1092T Barley Grain, 92T Molasses & 600T PKE fed in dairy shed 619T Silage (fed on dairy platform paddocks)	Utilised (DM) 953T Barley Grain, 129T Molasses & 580T PKE fed in dairy shed 818T Silage (fed on dairy platform paddocks)	Utilised (DM) 1120T Barley Grain, 208T Molasses & 765T PKE fed in dairy shed 1000T Silage (fed on dairy platform paddocks)

Description	13/14	14/15	15/16	16/17	Proposed
	1000T Silage fed in wintering barn 168T Baleage fed on Swede Crop Made on Farm (DM) 51T Silage – to storage.	1000T Silage fed in wintering barn 300T Baleage fed on Kale & Fodder Beet Crop	950T Silage fed in wintering barn 240T Baleage fed on Fodder Beet Crop Made on Farm (DM) 77T Silage – to storage.	1000T Silage fed in wintering barn 252T Baleage fed on Fodder Beet Crop Made on Farm (DM) 38T Silage – to storage.	1400T Silage fed in wintering barn
Fertiliser	WOL Effluent 97kg/N/ha (split Aug-Mar) 25kg/P/ha 0kg/K/ha WOL Non-Effluent 189kg/N/ha (split Aug-Apr) 37kg/P/ha 18kg/K/ha WTL Effluent 147kg/N/ha (split Aug-Mar) 26kg/P/ha 0kg/K/ha WTL Non-Effluent 239kg/N/ha (split Aug-Apr) 39kg/P/ha 20kg/K/ha	WOL Effluent 140kg/N/ha (split Aug-Apr) 30kg/P/ha 0kg/K/ha WOL Non-Effluent 225kg/N/ha (split Aug-May) 46kg/P/ha 45kg/K/ha WTL Effluent 168kg/N/ha (split Aug-Apr) 30kg/P/ha 0kg/K/ha WTL Non-Effluent 225kg/N/ha (split Aug-May) 44kg/P/ha 30kg/K/ha	WOL Effluent 165kg/N/ha (split Aug-Mar) 32kg/P/ha 0kg/K/ha WOL Non-Effluent 203kg/N/ha (split Aug-Mar) 32kg/P/ha 24kg/K/ha WTL Effluent 156kg/N/ha (split Aug-Mar) 12kg/P/ha 0kg/K/ha WTL Non-Effluent 237kg/N/ha (split Aug-Mar) 19kg/P/ha 15kg/K/ha	WOL Effluent 165kg/N/ha (split Aug-Feb) 19kg/P/ha 0kg/K/ha WOL Non-Effluent 236kg/N/ha (split Aug-Apr) 20kg/P/ha 26kg/K/ha WTL Effluent 147kg/N/ha (split Aug-Mar) 14kg/P/ha 0kg/K/ha WTL Non-Effluent 241kg/N/ha (split Aug-Apr) 14kg/P/ha 0kg/K/ha	Effluent 139kg/N/ha (split Aug – Mar) 25kg/P/ha 0kg/K/ha Non-Effluent 209kg/N/ha (split Aug-Apr) 34kg/P/ha 28kg/K/ha Barn Slurry 173kg/N/ha (split Aug-Apr) 22kg/P/ha 0kg/K/ha 36kg/N/ha 9kg/P/ha 50kg/K/ha Applied as wintering barn effluent.
Effluent	Holding Pond Effluent applied at <12mm	Holding Pond Effluent applied at <12mm	Holding Pond Effluent applied at <12mm	Holding Pond Effluent applied at <12mm	Holding Pond Effluent applied at <12mm

Description	13/14	14/15	15/16	16/17	Proposed
	Wintering barn & pond solids exported as these are partly applied on land not covered in this nutrient budget. Where barn/pond effluent is applied on the support block this has been added under the fertiliser tab.	*Wintering barn & pond solids exported as these are partly applied on land not covered in this nutrient budget. Where barn/pond effluent is applied on the support block this has been added under the fertiliser tab.*	*Wintering barn & pond solids exported as these are partly applied on land not covered in this nutrient budget. Where barn/pond effluent is applied on the support block this has been added under the fertiliser tab.*	*Wintering barn & pond solids exported as these are partly applied on land not covered in this nutrient budget. Where barn/pond effluent is applied on the support block this has been added under the fertiliser tab.*	*Wintering barn & pond solids exported as these are partly applied on land not covered in this nutrient budget. Where barn/pond effluent is applied on the barn slurry block this has been added under the fertiliser tab.*

10.0 Modelling Results

10.1 Pre-Expansion Results

	13/14*	14/15	15/16	16/17	Average
Total N Loss (kg)	19005	23024	19024	20653	20427
N Loss/ha (kg)	40 (15)	46	38	41	41
N Concentration in Drainage (ppm)	7.3 - 12.9 (Pastoral) 19.5 - 27 (Crops) 5.8 – 12.5 (Silage/WGYS)	9.9 – 15.8 (Pastoral) 13.5 - 17.6 (Crops) 5.8 – 9.2 (Silage/WGYS)	7.3 – 14.3 (Pastoral) 13.1 - 18.8 (Crops) 3.9 – 9.5 (Silage/WGYS)	8.5 – 15.3 (Pastoral) 18.0 - 23.8 (Crops) 2.9 – 7.5 (Silage)	
Total P Loss (kg)	346	375	362	358	360
P Loss/ha (kg)	0.7 (0.2)	0.7	0.7	0.7	0.7
Pasture Grown Kg/DM/ha/yr (Dairy Platforms)	14,759	15,258	14,773	15,646	15,109

* 13/14 results include an estimate of losses from the 38ha of land that wasn't part of Woldwide Farms in 2013/14 but forms part of the property from 14/15 onwards and is part of the expanded dairy farming application. A conservative estimate of 15kg/N/ha and 0.2kg/P/ha has been used to estimate total losses – See Section 7.1 for further details.

10.2 *Post Expansion Results*

	Proposed Dairy Unit
Total N Loss (kg)	18932
N Loss/ha (kg)	38
N Concentration in Drainage (ppm)	Pastoral – 7.7 to 17.4 ppm
Total P Loss (kg)	352 (338)*
P loss/ha (kg)	0.7
Pasture Grown Kg/DM/ha/yr	15,513

*Additional reduction in P obtained outside of Overseer – See Phosphorus Mitigation Plan

11.0 Modelling Conclusions

Using Overseer, combined nutrient budgets have been developed for WOL, WTL and the Support Block, comparing the nutrient loss of the pre-expansion farm systems against the proposed farm system. Overseer has predicted that the nitrogen and phosphorus loss will decrease

Key drivers for the reduction in nitrogen loss are:

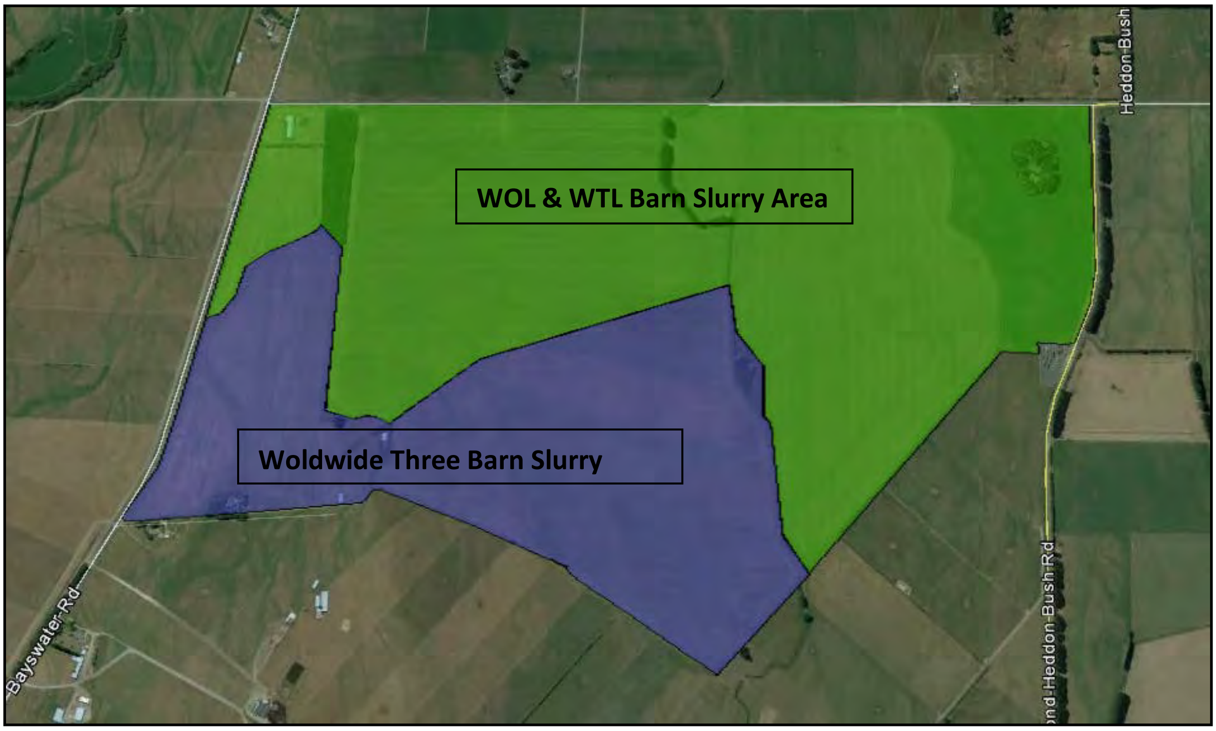
- Removal of winter and summer crop
- Removal of cows wintered outside on crop or grass
- Expansion of the size and use of the wintering barn facilities
- More efficient use of nitrogen fertiliser

Key drivers for the reduction in phosphorus loss are:

- Decrease in winter crop area
- Maintaining Olsen P at a target level of 30
- Expansion in the size and use of the wintering barn facilities (less wintering)

12.0 Supplementary Report – Horner Block

The Horner Block (HB) is a 160ha piece of land located to the south west of WOL. It forms part of Woldwide Farms Ltd, which is a transport, contracting, concentrate purchasing and silage production company. Wintering barn slurry is taken from WOL, WTL and Woldwide Three Ltd for the cost of the nutrients it contains and is subsequently spread on designated areas of the HB as partial fulfilment of the fertiliser requirements of the cut and carry operation. Approximately 17T/DM/ha of silage is produced off the HB, which is subsequently purchased by the dairy farms in the Woldwide Group and other customers.



Due to the definition of “landholding” in the pSWLP, Environment Southland originally concluded that the HB is part of the same landholding as WOL and WTL and therefore needs to form part of the farming land use consent application activated by the increase in cow numbers on WOL and WTL. A subsequent legal opinion (October 2018) reversed this decision, however this supplementary report has still be included for reference.

The effective area of land associated with WOL and WTL barn slurry is approximately 97ha with an additional 56.5ha associated with Woldwide Three Ltd. Over the last 5 years the HB has been used for the production of cut and carry silage and the wintering of mixed age cows and young stock on grass and a range of crops. Accurate records of the crop areas and cow numbers are not available thus a current nutrient budget has been produced based on 2017-18 cut and carry operation.

The current nutrient budget represents a conservative approach to modelling the existing nitrogen and phosphorus losses on the HB. If a five year annual average was used (as outlined in Rule 20(d) of the pSWLP) winter grazing activities would also be captured, resulting in higher average nitrogen and phosphorus losses compared to a straight cut and carry operation.

Fertiliser inputs into the current nutrient budget are based on purchase records from Ravensdown for the 2017-18 season. In addition to the fertiliser purchased from Ravensdown, three applications of wintering barn slurry (17.3m^3/ha/application) were applied across the HB.

Fertiliser inputs into the proposed nutrient budget are also based on the 2017-18 purchase records from Ravensdown but a proportion of the purchased fertiliser has been replaced by wintering barn slurry on the WOL and WTL section of the HB. Five applications of wintering barn slurry are proposed to be applied (15.2m^3/ha/application) totalling 7372m^3.

Soil test results have been based on maintaining an Olsen P levels of 30, which is the long term goal objective and reflects a level where near maximum pasture production is achieved.

	Total Current	Total Proposed	Per/ha Current	Per/ha Proposed	% Change
Nitrogen Loss (kg/N)	3155	3107	20	19	-1.5
Phosphorus Loss (Kg/P)	24	22	0.1	0.1	-8
Pasture Production (kg/DM)	17000		17000		

12.1 *Modelling Inputs – Horner Block*

To construct the nutrient budgets the following input data has been used;

12.1.1 Blocks

The HB has been split into the following cut and carry blocks:

Block Name	Soil Type	Current	Proposed
Horner WW1&2	Brax_4a.1	62	62
Horner WW1&2	Drum_2a.1	30	30
Horner WW1&2	Waiau_3a.1	5	5
Horner WW3	Brax_4a.1	13	13
Horner WW3	Drum_2a.1	25	25
Horner WW3	Glene_4a.1	4	4
Horner WW3	Waiau_3a.1	14.5	14.5
Effective Farm Area		**153.5**	**153.5**
Non productive		6.5	6.5
Total Farm Area		**160**	**160**

- Soil areas were obtained from Smap/Environment Southland.
- Soil settings were obtained from SMap for all soil types.

12.1.2 Climate Data

- Location setting = Southland
- Climate station tool used for block climate data

- 1002mm of rainfall
- 9.8°C mean annual temperature
- 731-1450mm daily rainfall pattern. Low variation.
- 711mm mean annual PET

12.1.3 Farm System Inputs

Description	Current	Proposed
Cut & Carry Block Inputs	<u>Grass Silage – 153.5ha</u> 17T/ha grass silage cut (DM) 293kg/N/ha, 21kg/P/ha & 68kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha and 228kg/K/ha applied as wintering barn effluent.	<u>Grass Silage – 97ha (WOL & WTL Slurry Area)</u> 17T/ha grass silage cut (DM) 207kg/N/ha, 10kg/P/ha & 0kg/K/ha applied as fertiliser 243kg/N/ha, 61kg/P/ha and 334kg/K/ha applied as wintering barn effluent. <u>Grass Silage – 56.5ha (Woldwide Three Ltd Slurry Area)</u> 17T/ha grass silage cut (DM) 293kg/N/ha, 21kg/P/ha & 68kg/K/ha applied as fertiliser 166kg/N/ha, 42kg/P/ha and 228kg/K/ha applied as wintering barn effluent.

Appendix 1 – Soil Survey/Farm Map

APPENDIX

Woldwide One Soils

The following photographs and comments refer to various paddocks across Woldwide One using paddock numbers provided on a farm plan as at January 2017.

Holes were dug on the 7 February 2017 to check the depth of topsoil, stone content and drainage properties. The topsoil and subsoil were checked for texture using field methods and for the drainage properties mottling was taken as an indication of impeded drainage.

The profile at each site was compared to the Topoclimate South soil map to determine if the soils were true to type as described in the Topoclimate soil information sheets.

It was found the Topoclimate maps were not particularly accurate with soil profiles generally better than stated. In places the soils were an intergrade between two types. The Braxton and Pukemutu soils are less extensive than shown.

Prior to Topoclimate maps being produced most of the block were depicted as being of the Drummond soil type in DSIR Soil Bureau Bulletin 27. Makarewa soils were shown to cover the west end of the farm. Makarewa soils are inherently poorly drained. Topoclimate has redefined the area covered by the Makarewa type as being a Braxton or Pukemutu soil type, both of which are poorly drained. Topoclimate has also extended the area of poorly drained soil to cover approximately 90% of Woldwide One.
I believe shallow to moderately deep Drummond soils cover much of the area shown as the Braxton type, other than for the west end of the block.

WOLDWIDE ONE

Paddock 23

Topoclimate suggests a Glenelg soil type for this area. However, there was no stone in the topsoil and there was a well developed subsoil. The subsoil was free draining with no mottling to the bottom of the subsoil level at 0.5 m. This profile is more characteristic of a Drummond soil type. The sample site was on a broad ridge. The paddock had recently been cultivated and the profile was reported as being uniform to plough depth across it, i.e. no stones in the topsoil.

Paddock 24

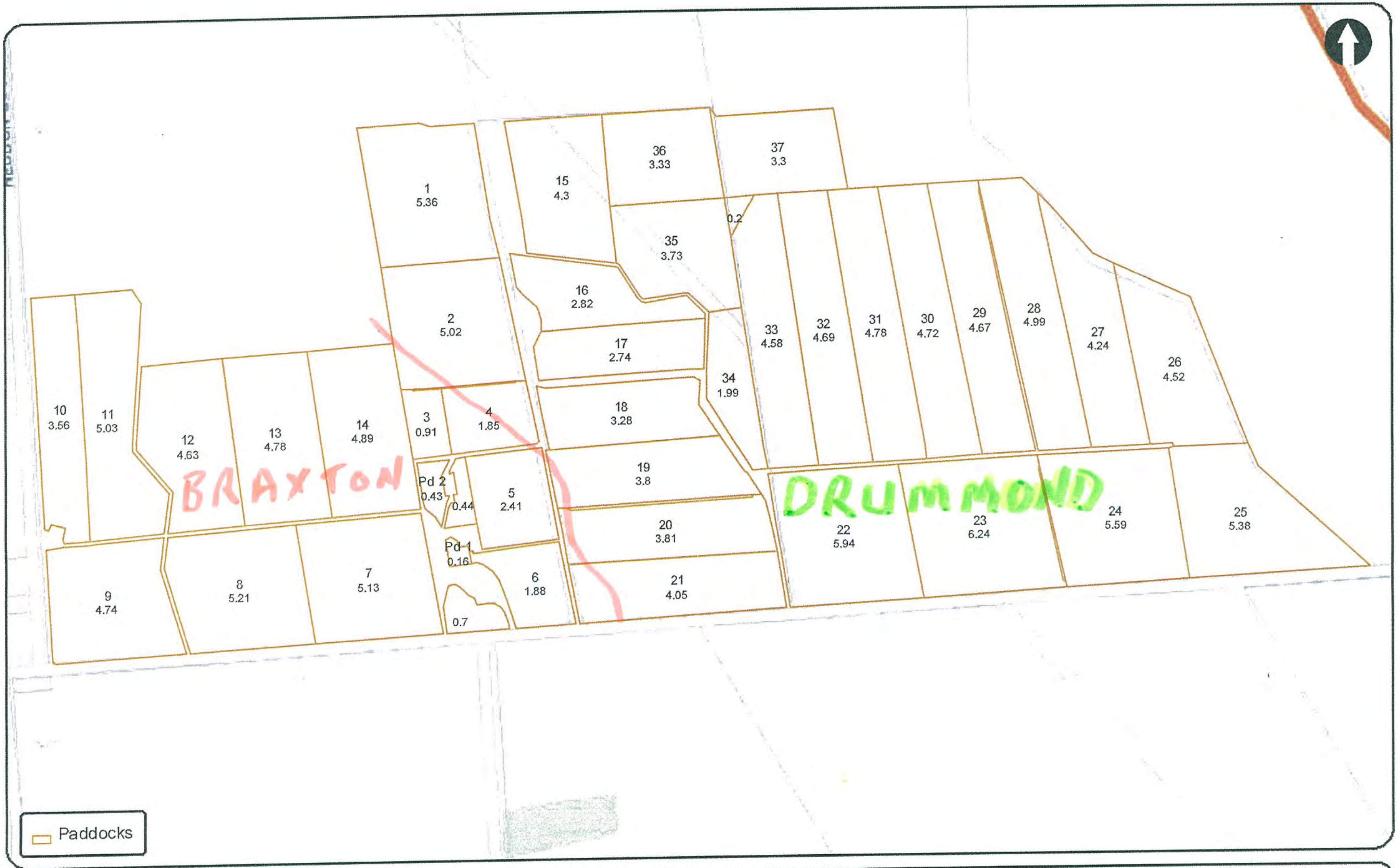
Topoclimate suggests a Glenelg soil type for this paddock. There was 250 mm depth of soil to stone. The profile was better than a typical Glenelg soil which has stone throughout all horizons. The south west corner where this hole was dug is the lightest part of the paddock.

Paddock 21

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The profile was 250 mm depth of topsoil, no mottles present, well structured, overlying a heavier textured subsoil. There were some mottles present in the subsoil and no stone with 0.5 m of the surface. This profile is tending towards the Braxton soil type. The sample site was in a slight hollow and would be expected to have a wetter profile compared to the higher adjoining ground.

Paddock 7

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The topsoil depth was 200 mm, overlying a 50 mm thick intergrade layer overlying a heavy and mottled subsoil. This profile showed poorer drainage than the profile in paddock 21 and is more characteristic of a Braxton soil type.



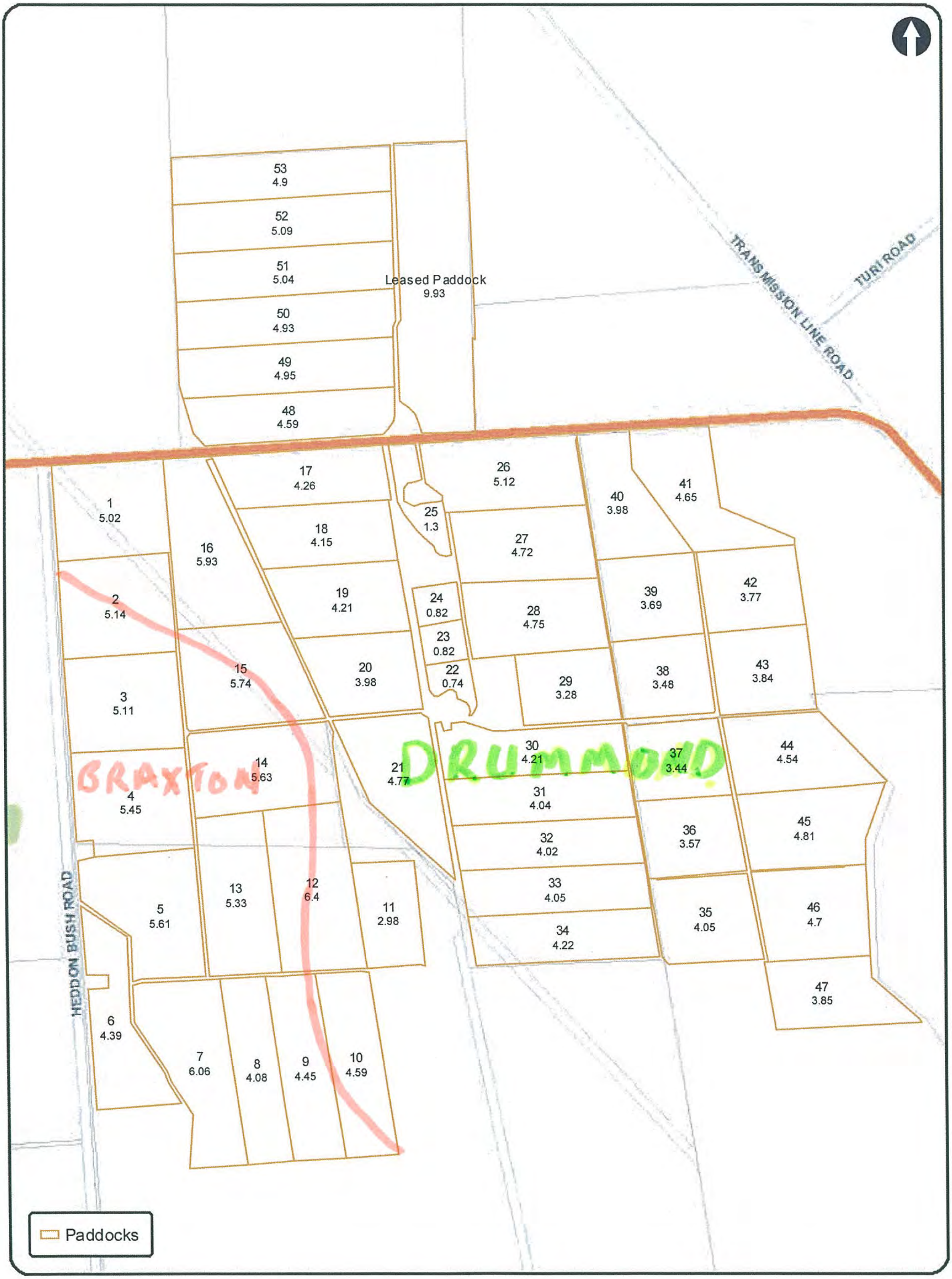
My Ravensdown Smart Maps
www.myravensdown.co.nz
Note: Areas are in hectares
Copyright Ravensdown

Woldwide One Ltd

0 55 110 220 330 440 Metres

ravensdown

08 October 2015



My Ravensdown Smart Maps

www.myravensdown.co.nz

Note: Areas are in hectares

Copyright Ravensdown

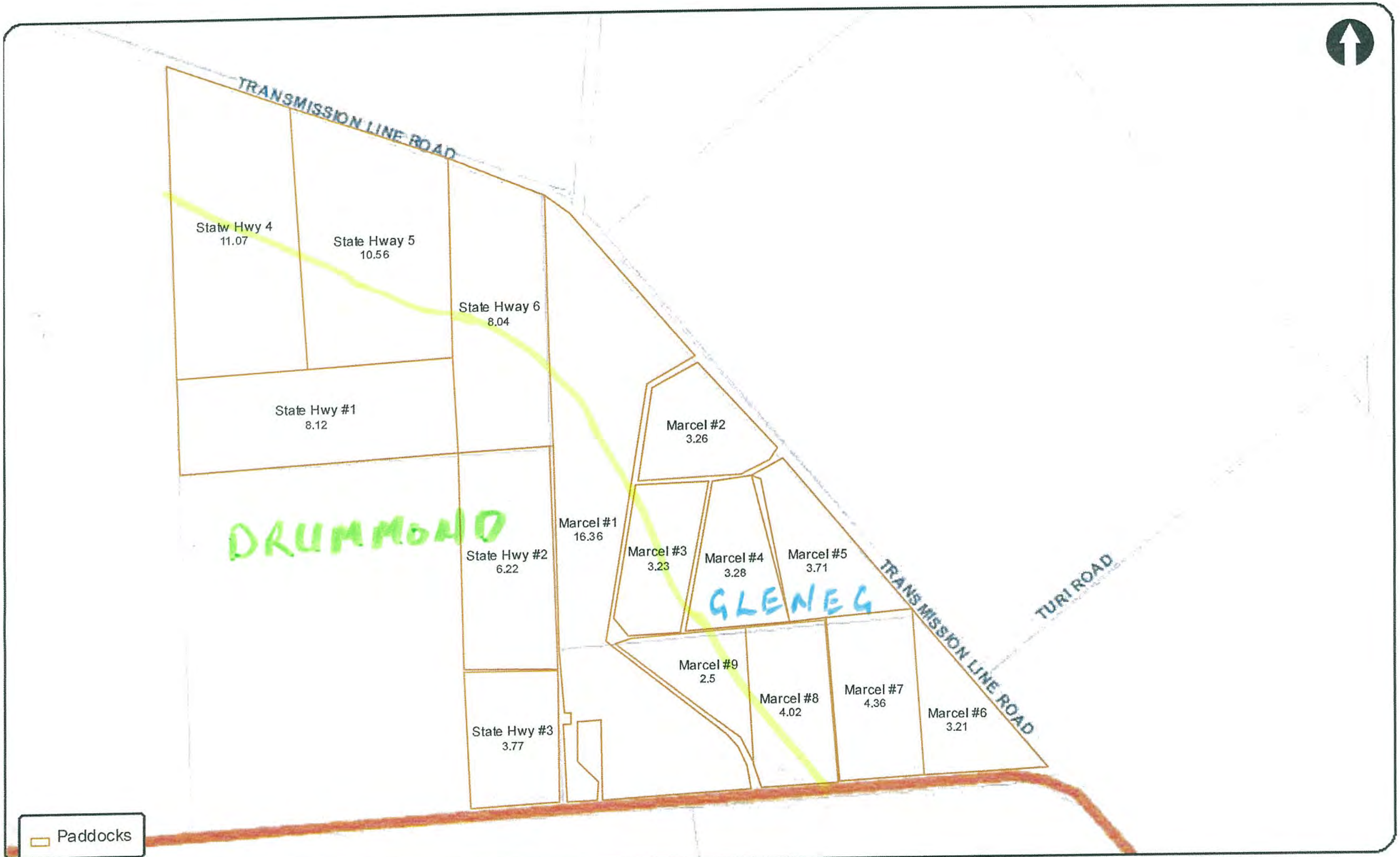
Woldwide Two

0 50 100 200 300 400 500 Metres

ravensdown

New Zealand imagery is provided by CoreLogic NZ Ltd under Creative Commons Attribution 3.0 NZ

12 October 2015



My Ravensdown Smart Maps
www.myravensdown.co.nz
Note: Areas are in hectares

Highway 96 Support

ravensdown

12 October 2015

Appendix 2 – Nutrient Budgets & Block Reports

P loss categories

Woldwide One & Two Ltd

1354 Hundred Line Rd, Dunearn 9783, New Zeal...

OverseerFM

Year ending 2014

Analysis type	Year end
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:52AM
Model version	6.3.1

Farm details

N: 18435 N/ha: 40 P: 338 P/ha: 0.7 GHG/ha: 16757 NCE: 63%

Total area	464 ha
Productive block area	441.40 ha
Nitrogen conversion efficiency (NCE)	63%
N Surplus	126 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Silage + WG YS + Barn Eff (Drum_2a.1)	Pasture	31.5	669	21	126	6	0.2
Silage + WG YS + Barn Eff (Glene_4a.1)	Pasture	12	481	40	138	2	0.1
WOL Effluent (Drum_2a.1)	Pasture	30	1260	44	273	7	0.2
WOL Non Effluent (Brax_4a.1)	Pasture	47.5	1134	25	185	28	0.6
WOL Non Effluent (Drum_2a.1)	Pasture	78.4	2649	35	190	16	0.2
WTL Effluent (Drum_2a.1)	Pasture	45	2073	48	291	10	0.2
WTL Non Effluent (Brax_4a.1)	Pasture	53	1455	29	203	29	0.6
WTL Non Effluent (Drum_2a.1)	Pasture	104	4053	41	209	21	0.2
Barley + Silage +WGYS (Drum_4a.1)	Crop	19	882	46	-56	6	0.3
Barley + Silage +WGYS (Glene_4a.1)	Crop	7	406	58	-55	1	0.2
Swedes (Drum_2a.1)	Crop	2	161	81	267	1	0.3
Swedes (Glen_4a.1)	Crop	12	1432	119	265	3	0.2
Summer Turnips	Fodder crop	15.8	1172	74	159	5	0.3
Other sources	Other	-	608	-	-	205	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	18,435	40
Phosphorus	338	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	217	45	55	45	77	0	1
Irrigation	0	0	0	0	0	0	0
Supplements	64	13	42	10	8	7	3
Rain/clover fixation	58	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	40	0.7	17	61	75	4	15
As product	97	16	23	5	21	2	7
Transfer	0	0	0	0	0	0	0
Effluent exported	55	8	52	6	13	5	3
To atmosphere	77	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	77	12	5	-10	1	1	0
Inorganic mineral	0	5	-15	0	5	-3	-4
Inorganic soil pool	13	19	46	0	-21	8	12

Woldwide One & Two Ltd

1354 Hundred Line Rd, Dunearn 9783, New Zeal...

OverseerFM

Year ending 2015

Analysis type	Year end
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:52AM
Model version	6.3.1

Farm details

N: 23024 N/ha: 46 P: 375 P/ha: 0.7 GHG/ha: 16366 NCE: 54%

Total area	502 ha
Productive block area	478.50 ha
Nitrogen conversion efficiency (NCE)	54%
N Surplus	164 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
WOL Effluent (Drum_2a.1)	Pasture	30	1539	53	302	7	0.2
WOL Non Effluent (Brax_4a.1)	Pasture	47.5	1561	34	206	28	0.6
WOL Non Effluent (Drum_2a.1)	Pasture	78.4	3481	46	212	17	0.2
WTL Effluent (Drum_2a.1)	Pasture	45	2555	59	311	13	0.3
WTL Non Effluent (Brax_4a.1)	Pasture	53	1742	34	206	29	0.6
WTL Non Effluent (Drum_2a.1)	Pasture	134	5949	46	212	27	0.2
Silage + WG YS + Barn Eff (Drum_2a.1)	Pasture	21.5	463	22	145	3	0.1
Silage + WG YS + Barn Eff (Glene_4a.1)	Pasture	29.2	1115	38	155	3	0.1
Kale (Drum_2a.1)	Crop	11.4	683	60	219	4	0.3
Kale (Glen_4a.1)	Crop	18.5	1529	83	219	4	0.2
Fodder Beet (Drum_2a.1)	Crop	10	704	70	181	4	0.4
Summer Turnips	Fodder crop	14	1028	73	126	5	0.3
Other sources	Other	-	675	-	-	230	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	23,024	46
Phosphorus	375	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	232	45	61	62	95	0	1
Irrigation	0	0	0	0	0	0	0
Supplements	67	14	40	10	7	7	3
Rain/clover fixation	58	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	46	0.7	18	75	79	4	15
As product	94	16	23	5	21	2	6
Transfer	0	0	0	0	0	0	0
Effluent exported	55	8	51	6	13	5	3
To atmosphere	79	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	104	13	4	-9	1	1	0
Inorganic mineral	0	5	-15	0	-2	-3	-4
Inorganic soil pool	13	22	70	0	3	9	13

Woldwide One & Two Ltd

1354 Hundred Line Rd, Dunearn 9783, New Zeal...

OverseerFM

Year ending 2016

Analysis type	Year end
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:53AM
Model version	6.3.1

Farm details

N: 19024 N/ha: 38 P: 362 P/ha: 0.7 GHG/ha: 16914 NCE: 58%

Total area	502 ha
Productive block area	478.90 ha
Nitrogen conversion efficiency (NCE)	58%
N Surplus	152 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
WOL Effluent (Drum_2a.1)	Pasture	30	1538	53	308	7	0.2
WOL Non Effluent (Brax_4a.1)	Pasture	47.5	1138	25	195	27	0.6
WOL Non Effluent (Drum_2a.1)	Pasture	78.4	2769	37	201	16	0.2
WTL Effluent (Drum_2a.1)	Pasture	45	2266	52	301	12	0.3
WTL Non Effluent (Brax_4a.1)	Pasture	53	1297	25	201	26	0.5
WTL Non Effluent (Drum_2a.1)	Pasture	134	4822	37	208	25	0.2
SH 96 Silage + WG YS + Barn Eff (Drum_2a.1)	Pasture	28	611	22	147	4	0.1
SH 96 Silage + WG YS + Barn Eff (Glene_4a.1)	Pasture	12	472	39	157	1	0.1
Marcel Silage + WG YS + Barn Eff (Drum_2a.1)	Pasture	11	157	14	96	2	0.2
Marcel Silage + WG YS + Barn Eff (Glen_4a.1)	Pasture	18	503	28	103	2	0.1
Fodder Beet (Glen_4a.1)	Crop	18	1553	86	155	5	0.3
Fodder Beet (Drum_2a.1)	Crop	4	226	56	155	2	0.4
Summer Turnips	Fodder crop	14.5	1017	70	87	5	0.3
Other sources	Other	-	656	-	-	228	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	19,024	38
Phosphorus	362	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	235	34	66	41	54	2	1
Irrigation	0	0	0	0	0	0	0
Supplements	78	16	39	10	6	7	3
Rain/clover fixation	52	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	38	0.7	17	54	72	4	15
As product	96	16	23	5	21	2	7
Transfer	0	0	0	0	0	0	0
Effluent exported	54	8	50	6	13	5	3
To atmosphere	76	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	104	13	4	-8	1	1	0
Inorganic mineral	0	5	-20	0	-2	-3	-4
Inorganic soil pool	11	10	59	0	-36	10	12

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1354 Hundred Line Rd, Dunearn 9783, New Zeal...

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Year ending 2017

Analysis type	Year end
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:53AM
Model version	6.3.1

Farm details

N: 20653 N/ha: 41 P: 358 P/ha: 0.7 GHG/ha: 17194 NCE: 59%

Total area	502 ha
Productive block area	478.90 ha
Nitrogen conversion efficiency (NCE)	59%
N Surplus	151 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
WOL Effluent (Drum_2a.1)	Pasture	30	1710	57	310	7	0.2
WOL Non Effluent (Brax_4a.1)	Pasture	47.5	1377	29	207	25	0.5
WOL Non Effluent (Drum_2a.1)	Pasture	78.4	3306	42	213	14	0.2
WTL Effluent (Drum_2a.1)	Pasture	45	2462	55	303	12	0.3
WTL Non Effluent (Brax_4a.1)	Pasture	53	1592	30	207	25	0.5
WTL Non Effluent (Drum_2a.1)	Pasture	134	5871	44	214	23	0.2
SH96 Cut&Carry (Glen_4a.1)	Cut and carry	12	144	12	70	1	0.1
SH96 Cut&Carry (Drum_2a.1)	Cut and carry	28	329	12	69	3	0.1
Marcel Cut&Carry (Glen_4a.1)	Cut and carry	17.5	518	30	145	2	0.1
Marcel Cut&Carry (Drum_2a.1)	Cut and carry	11	306	28	157	2	0.2
Fodder Beet (Glen_4a.1)	Crop	18.5	2022	109	221	5	0.3
Fodder Beet (Drum_2a.1)	Crop	4	307	77	221	2	0.4
Other sources	Other	-	708	-	-	237	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	20,653	41
Phosphorus	358	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	246	30	59	36	32	5	2
Irrigation	0	0	0	0	0	0	0
Supplements	72	15	40	10	7	7	3
Rain/clover fixation	53	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	41	0.7	18	53	79	3	15
As product	103	17	25	6	23	2	7
Transfer	0	0	0	0	0	0	0
Effluent exported	56	9	51	6	13	5	3
To atmosphere	81	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	116	14	4	-10	1	1	0
Inorganic mineral	0	6	-22	0	-2	-3	-4
Inorganic soil pool	0	3	45	0	-66	12	13

Woldwide One & Two Ltd
1354 Hundred Line Rd, Dunearn 9783, New Zeal...

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Woldwide One & Two Ltd - Proposed Final

Analysis type	Predictive
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:53AM
Model version	6.3.1

Farm details

N: 18932 N/ha: 38 P: 352 P/ha: 0.7 GHG/ha: 18287 NCE: 44%

Total area	502 ha
Productive block area	478.90 ha
Nitrogen conversion efficiency (NCE)	44%
N Surplus	259 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Effluent Blocks (Drum_2a.1)	Pasture	120	5355	45	276	22	0.2
Non Effluent (Brax_4a.1)	Pasture	100.5	2639	26	200	44	0.4
Non-Effluent (Drum_2a.1)	Pasture	25.4	944	37	205	4	0.1
Non-Effluent (Glen_4a.1)	Pasture	48	3464	72	221	5	0.1
Barn Slurry (Drum_2a.1)	Pasture	185	5719	31	161	26	0.1
Other sources	Other	-	811	-	-	251	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	18,932	38
Phosphorus	352	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	183	30	28	68	58	2	0
Irrigation	0	0	0	0	0	0	0
Supplements	203	28	147	21	27	16	9
Rain/clover fixation	80	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	38	0.7	11	84	49	4	15
As product	125	21	30	7	27	3	9
Transfer	0	0	0	0	0	0	0
Effluent exported	82	10	74	8	15	7	3
To atmosphere	86	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	135	14	20	-4	4	2	1
Inorganic mineral	0	4	-17	0	-2	-3	-4
Inorganic soil pool	0	8	60	0	-5	11	12

Woldwide One & Two Ltd
1354 Hundred Line Rd, Dunearn 9783, New Zeal...

OverseerFM

Horner Block Current

Analysis type	Scenario
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:54AM
Model version	6.3.1

Farm details

N: 3155 N/ha: 20 P: 24 P/ha: 0.1 GHG/ha: 4009 NCE: 85%

Total area	160 ha
Productive block area	153.50 ha
Nitrogen conversion efficiency (NCE)	85%
N Surplus	73 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Horner WW1&2 (Brax_4a.1)	Cut and carry	62	995	16	73	11	0.2
Horner WW1&2 (Drum_2a.1)	Cut and carry	30	719	24	77	2	0.1
Horner WW1&2 (Waiau_3a.1)	Cut and carry	5	132	26	85	1	0.2
Horner WW3 (Brax_4a.1)	Cut and carry	13	209	16	73	2	0.2
Horner WW3 (Drum_2a.1)	Cut and carry	25	599	24	77	2	0.1
Horner WW3 (Glene_4a.1)	Cut and carry	4	103	26	79	0	0.1
Horner WW3 (Waiau_3a.1)	Cut and carry	14.5	383	26	86	3	0.2
Other sources	Other	-	14	-	-	1	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	3,155	20
Phosphorus	24	0.1

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	441	60	284	47	528	5	2
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	46	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	20	0.1	10	40	58	5	14
As product	0	0	0	0	0	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	19	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	34	17	0	-22	0	0	0
Inorganic mineral	0	3	-27	0	171	-2	-5
Inorganic soil pool	0	-5	-40	0	215	-14	0

Woldwide One & Two Ltd
1354 Hundred Line Rd, Dunearn 9783, New Zeal...

OverseerFM

Horner Block Proposed

Analysis type	Scenario
Is publication	No
Application version	2.6.0.5
Printed date	28 Jul, 2019, 8:54AM
Model version	6.3.1

Farm details

N: 3107 N/ha: 19 P: 22 P/ha: 0.1 GHG/ha: 3467 NCE: 85%

Total area	160 ha
Productive block area	153.50 ha
Nitrogen conversion efficiency (NCE)	85%
N Surplus	74 kg/ha
Region	Southland

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Horner WW1&2 (Brax_4a.1)	Cut and carry	62	1006	16	74	10	0.2
Horner WW1&2 (Drum_2a.1)	Cut and carry	30	662	22	78	2	0.1
Horner WW1&2 (Waiau_3a.1)	Cut and carry	5	131	26	85	1	0.2
Horner WW3 (Brax_4a.1)	Cut and carry	13	209	16	73	2	0.2
Horner WW3 (Drum_2a.1)	Cut and carry	25	599	24	77	2	0.1
Horner WW3 (Glene_4a.1)	Cut and carry	4	103	26	79	0	0.1
Horner WW3 (Waiau_3a.1)	Cut and carry	14.5	383	26	86	3	0.2
Other sources	Other	-	14	-	-	1	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	3,107	19
Phosphorus	22	0.1

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	435	65	293	46	528	5	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	44	0	2	5	3	6	26

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	19	0.1	8	39	58	5	14
As product	0	0	0	0	0	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	16	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	38	17	0	-22	0	0	0
Inorganic mineral	0	3	-25	0	171	-2	-5
Inorganic soil pool	0	0	-16	0	215	-15	-1

Appendix 3 – Nutrient Budget Evidence

Agri-Business Consultants
Annual Reviews.

2013/14 Farm Review

Woldwide Group

	Average	Top Farm	WWF1	WWF 2	WWF3	Mayfiled
Final Production (kgMS)	13333212	325649	250281	341434	506021	427164
Effective Milking Area (ha)	9450.86	187.5	155	202	286	253
Stock Numbers/Weights						
Cows Wintered	29940	693	525	664	982	813
Cows at Peak	28619	673	496	632	950	794
Change Winter-Peak (%)	4.4%	2.9%	5.5%	4.8%	3.3%	2.3%
SR Wintered	3.17	3.7	3.4	3.3	3.4	3.2
SR at Peak	3.03	3.6	3.20	3.13	3.32	3.14
June 2012 Weights	474	480.0	540.0	540.0	510.0	520.0
LW/ha	1436	1722.9	1728.0	1689.5	1694.1	1631.9
KgMS/KGLW	0.98	1.01	0.93	1.00	1.04	1.03
KgLW/TDM Consumed	85.7	83.2	103.3	99.0	92.7	87.4
Herd BW	102.9	102.0	118.0	115.0	131.0	123.0
Production						
KgMS/ha	1411	1737	1615	1690	1769	1688
KgMS/cows at peak	466	484	505	540	533	538
KgMS/cow wintered	445	470	477	514	515	525
Mating						
Empties	2973	58	56	73	66	65
Empty % of peak numbers	10.5%	8.6%	11.3%	11.6%	6.9%	8.2%
Mating Interval (Weeks)	11.3	11.4	12	11.6	11.3	11.6
Wasteage - Loss + empties	14.3%	11.3%	16.2%	15.8%	10.0%	10.3%
Feed						
Silage at start	5343873	88160	142320	175780	174700	102700
+ silage bought	15777449	248420	655000	792000	1100000	205000
+ silage made	3174770	39380	15620	35420	53240	70400
- silage at end	15609412	115980	498292	591372	872232	147000
= silage fed	8686680	259980	314648	411828	455708	231100
Silage fed per cow	304	386	634	652	480	291
Silage per KgMS	0.7	0.8	1.3	1.2	0.9	0.5
Nitrogen Applied (kgN/ha)	179	200	151.6	175.2	158.7	194.2
Nitrogen Response @ 10:1	16963455	375000	234980	353904	453882	491326
Concentrates Bought						
Molasis t	1640	27.4	108	125	171	135.5
Barley	6258	319.5	340	490	891	449.6
Palm Kernt	7733	0	164	261	363	340.5
Concentrates fed per cow	546	434	1044	1179	1276	995
Concentrates per KgMS	1.17	0.90	2.07	2.18	2.40	1.85
Total Bought Milking Feed kgDM	38106535	848345	1035988	1440042	2015410	1371861
Total Bought Feed /cow	1332	1261	2089	2279	2121	1728
Total Bought Feed/kgMS	2.9	2.6	4.1	4.2	4.0	3.2
Feed Required For Milk Production @ 12kgDM/kgMS	159998544	3907788	3003372	4097208	6072252	5125968
Feed Required For Drystock	949590	0	0	0	0	0
Less Bought In Feed	38106535	848345	1035988	1440042	2015410	1371861
Leaves Pasture Utilised	122841599	3059443	1967384	2657166	4056842	3754107
Utilised Pasture/ha	**12998**	**16317**	**12693**	**13154**	**14185**	**14838**
Utilised Pasture/kgMS	9.21	9.39	7.86	7.78	8.02	8.79

Financial Analysis/hectare	Average	Top Farm	WWF1	WWF 2	WWF3	Mayfiled
Income — Milk @ $8.40/kgMS	$11,934.66	$14,589.08	$13,563.62	$14,198.25	$14,862.16	$14,182.52
Adj. for cull cows @ $1000	-$0.42	$114.08	-$62.61	-$48.36	$149.79	$128.86
Total	$11,934.24	$14,703.16	$13,501.01	$14,149.88	$15,011.94	$14,311.38
Variable Feed Costs						
Silage — Bought Off @ 32c	$536.92	$423.97	$1,352.26	$1,254.65	$1,230.77	$259.29
Made On @ 10c	$33.04	$21.00	$10.08	$17.53	$18.62	$27.83
Fed Out @ 5c	$47.38	$69.33	$101.50	$101.94	$79.67	$45.67
Change in inventory	-$339.41	-$47.48	-$734.91	-$658.36	-$780.46	-$56.03
Concentrates @ ?c	$572.07	$865.90	$1,572.05	$1,712.31	$2,026.98	$1,385.88
Nitrogen @ 17c	$313.28	$390.00	$257.72	$297.84	$269.79	$330.14
Less feed fed to drystock @ 16c	-$14.53	$0.00	$0.00	$0.00	$0.00	$0.00
Total Feed Costs	$1,148.74	$1,722.73	$2,558.70	$2,725.91	$2,845.37	$1,992.78
Net Margin	**$10,785.50**	**$12,980.43**	**$10,942.31**	**$11,423.97**	**$12,166.57**	**$12,318.60**

2014/15 Farm Review

	Average	Top Farm	WWF1	WWF 2	WWF3	Mayfiled
Final Production (kgMS)	5224056	312099	246072	372124	472332	402148
Effective Milking Area (ha)	3887.28	225.5	155	232	286	253
Stock Numbers/Weights						
Cows Wintered	12467	726	525	760	1000	810
Cows at Peak	11856	700	495	727	962	780
Change Winter-Peak (%)	4.9%	3.6%	5.7%	4.3%	3.8%	3.7%
SR Wintered	3.21	3.2	3.4	3.3	3.5	3.2
SR at Peak	3.05	3.1	3.19	3.13	3.36	3.08
June 2015 Weights	488	520.0	540.0	540.0	520.0	520.0
LW/ha	1487	1614.2	1724.5	1692.2	1749.1	1603.2
KgMS/KGLW	0.90	0.86	0.92	0.95	0.94	0.99
KgLW/TDM Consumed	99.0	93.7	104.6	103.5	101.0	95.0
Herd BW	105.6	109.0	99.0	99.0	110.0	111.0
Production						
KgMS/ha	1344	1384	1588	1604	1652	1590
KgMS/cows at peak	441	446	497	512	491	516
KgMS/cow wintered	419	430	469	490	472	496
Mating						
Empties	1172	83	51	72	75	56
Empty % of peak numbers	9.9%	11.9%	10.3%	9.9%	7.8%	7.2%
Mating Interval (Weeks)	11.0	10.9	11.6	11.6	11.4	11
Wasteage - Loss + empties	14.3%	15.0%	15.4%	13.8%	11.3%	10.6%
Feed						
Silage at start	2893650	130400	142320	199000	266000	146500
+ silage bought	5131040	205000	572000	724000	750000	251000
+ silage made	426730	15250	0	0	0	0
- silage at end	4090750	159210	526000	516000	607000	151000
= silage fed	4360670	191440	188320	407000	409000	246500
Silage fed per cow	368	273	380	560	425	316
Silage per KgMS	0.8	0.6	0.8	1.1	0.9	0.6
Nitrogen Applied (kgN/ha)	187	196.5	183.9	179.4	180.55	173
Nitrogen Response @ 10:1	7279890	443107.5	285045	416208	516373	437690
Concentrates Bought						
Molasis t	591	117	50.16	98.12	68.98	25.02
Barley	3187	0	333.43	511.29	658.41	527.62
Palm Kern t	4134	36.7	251.94	272.38	408.86	407.32
Concentrates fed per cow	667	173	1107	1036	1018	1069
Concentrates per KgMS	1.51	0.39	2.23	2.02	2.07	2.07
Total Bought Milking Feed kgDM	19126450	724827.5	1021146.5	1576536.5	1904730.5	1518020
Total Bought Feed /cow	1613	1035	2063	2169	1980	1946
Total Bought Feed/kgMS	3.7	2.3	4.1	4.2	4.0	3.8
Feed Required For Milk Production @ 12kgDM/kgMS	62688672	3745188	2952864	4465488	5667984	4825776
Feed Required For Drystock	0	0	0	0	0	0
Less Bought In Feed	19126450	724827.5	1021146.5	1576536.5	1904730.5	1518020
Leaves Pasture Utilised	43562222	3020360.5	1931717.5	2888951.5	3763253.5	3307756
Utilised Pasture/ha	**11206**	**13394**	**12463**	**12452**	**13158**	**13074**
Utilised Pasture/kgMS	8.34	9.68	7.85	7.76	7.97	8.23

Financial Analysis/hectare	Average	Top Farm	WWF1	WWF 2	WWF3	Mayfiled
Income — Milk @ $4.40/kgMS	$6,022.52	$6,089.74	$7,144.03	$7,217.92	$7,431.80	$7,152.83
Adj. for cull cows @ $1000	-$6.02	-$22.92	-$38.17	$15.92	$104.96	$117.96
Total	$6,016.51	$6,066.81	$7,105.86	$7,233.84	$7,536.75	$7,270.79
Variable Feed Costs						
Silage — Bought Off @ 32c	$435.48	$290.91	$1,180.90	$998.62	$839.16	$317.47
Made On @ 10c	$10.59	$6.76	$0.00	$0.00	$0.00	$0.00
Fed Out @ 5c	$56.14	$42.45	$60.75	$87.72	$71.50	$48.72
Change in inventory	-$110.10	-$40.88	-$792.11	-$437.24	-$381.54	-$5.69
Concentrates @ ?c	$732.33	$235.58	$1,613.43	$1,545.75	$1,597.98	$1,493.43
Nitrogen @ 17c	$318.37	$334.05	$312.63	$304.98	$306.94	$294.10
Less feed fed to drystock @ 16c	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Feed Costs	$1,442.81	$868.87	$2,375.60	$2,499.83	$2,434.04	$2,148.02
Net Margin	**$4,573.70**	**$5,197.95**	**$4,730.26**	**$4,734.02**	**$5,102.71**	**$5,122.77**

2015/16 Farm Review

Woldewide Farms

	Average	Top Farm	WWF1	WWF 2	WWF3	WWF4	WWF5
Final Production (kgMS)	15594890	323306	265277	361346	462933	374617	231267
Effective Milking Area (ha)	12125.59	224	155	232	286	253	164
Stock Numbers/Weights							
Cows Wintered	38866	723	525	756	976	800	527
Cows at Peak	36737	704	505	708	957	757	500
Change Winter-Peak (%)	5.5%	2.6%	3.8%	6.3%	1.9%	5.4%	5.1%
SR Wintered	3.2	3.2	3.4	3.3	3.4	3.2	3.2
SR at Peak	3.03	3.1	3.26	3.05	3.35	2.99	3.0
June 2015 Weights	469.3	520.0	550.0	550.0	525.0	540.0	530.0
LW/ha	1421.7	1634.3	1791.9	1678.4	1756.7	1615.7	1615.9
KgMS/KGLW	0.90	0.88	0.96	0.93	0.92	0.92	0.87
KgLW/TDM Consumed	93.1	84.9	106.3	109.0	107.6	99.4	92.2
Herd BW	108.9	116.0	95.0	96.0	108.0	115.0	87.0
Production							
KgMS/ha	1286	1443	1711	1558	1619	1481	1410
KgMS/cows at peak	425	459	525	510	484	495	463
KgMS/cow wintered	401	447	505	478	474	468	439
Mating							
Empties	4489	109	69	102	84	93	104
Empty % of peak numbers	12.5%	15.5%	13.7%	14.4%	8.8%	12.3%	20.8%
Mating Interval (Weeks)	10.4	10	11.6	11.6	11.4	11	9.7
Wasteage - Loss + empties	17.0%	17.7%	17.0%	19.8%	10.6%	17.0%	24.9%
Feed							
Silage at start	7713240	69840	171000	100000	84000	75000	150000
+ silage bought	16438599	705780	585000	808000	995000	138000	167750
+ silage made	4065620	103000	11730	64860	79120	148000	223560
- silage at end	16806289	845680	508730	613000	800000	265000	470430
= silage fed	11411170	32940	259000	359860	358120	96000	70880
Silage fed per cow	311	47	513	508	374	127	142
Silage per KgMS	0.7	0.1	1.0	1.0	0.8	0.3	0.3
Nitrogen Applied (kgN/ha)	199.1	197.7	211.6	227.8	201.7	233.4	226.4
Nitrogen Response @ 10:1	24145058.6	442848	327980	528496	576862	590502	371296
Concentrates Bought							
Molasis t	862.14	55	24.5	67	0	27	50
Barley	4507.68	0	408.58	683.39	957.8	625.98	405.47
Palm Kern t	12375	132.9	295.58	304.3	504.76	434	167.6
Concentrates fed per cow	483	228	1251	1278	1325	1246	1066
Concentrates per KgMS	1.14	0.50	2.38	2.50	2.74	2.52	2.30
Total Bought Milking Feed kgDM	49235448.6	430648	1195210	1663637.5	2045156	1333435	528045.5
Total Bought Feed /cow	1340	612	2367	2350	2137	1761	1056
Total Bought Feed/kgMS	3.2	1.3	4.5	4.6	4.4	3.6	2.3
Feed Required For Milk Production @ 12kgDM/kgMS	187138680	3879672	3183324	4336152	5555196	4495404	2775204
Feed Required For Drystock	994100	0	0	0	0	0	0
Less Bought In Feed	49235448.6	430648	1195210	1663637.5	2045156	1333435	528045.5
Leaves Pasture Utilised	138897331	3449024	1988114	2672514.5	3510040	3161969	2247158.5
Utilised Pasture/ha	11455	15397	12827	11519	12273	12498	13702
Utilised Pasture/kgMS	8.91	10.67	7.49	7.40	7.58	8.44	9.72

Financial Analysis/hectare							
Income — Milk @ $3.90/kgMS	$5,120.67	$5,628.99	$6,674.71	$6,074.35	$6,312.72	$5,774.73	$5,499.64
Adj. for cull cows @ $1000	-$4.36	-$17.46	$7.14	-$87.27	$225.57	$5.16	-$247.26
Total	$5,116.31	$5,611.53	$6,681.85	$5,987.08	$6,538.29	$5,779.89	$5,252.38
Variable Feed Costs							
Silage — Bought Off @ 30c	$413.43	$945.24	$1,132.26	$1,044.83	$1,043.71	$163.64	$306.86
Made On @ 12c	$38.99	$55.18	$9.08	$33.55	$33.20	$70.20	$163.58
Fed Out @ 5c	$48.33	$7.35	$83.55	$77.56	$62.61	$18.97	$21.61
Change in inventory	-$235.62	-$1,108.34	-$697.25	-$707.59	-$801.12	-$240.32	-$625.23
Concentrates @ ?c	$448.12	$230.91	$1,760.24	$1,817.35	$2,007.09	$1,619.16	$1,530.32
Nitrogen @ 15.2c	$302.67	$300.50	$321.63	$346.26	$306.58	$354.77	$344.13
Less feed fed to drystock @ 16c	-$15.83	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Feed Costs	$1,000.09	$430.84	$2,609.51	$2,611.95	$2,652.06	$1,986.42	$1,741.27
Net Margin	$4,116.21	$5,180.69	$4,072.34	$3,375.13	$3,886.23	$3,793.47	$3,511.12

2016/17 Farm Review

Woldewide Farms

	Average	Top Farm	WWF1	WWF 2	WWF3	WWF4	WWF5	Average
Final Production (kgMS)	18518916	239300	287774	387618	499695	432338	267414	1874839
	0							
Effective Milking Area (ha)	13615.02	138.5	155	232	286	253	170	1096
	0							
Stock Numbers/Weights	0							
Cows Wintered	42716	433	517	752	966	803	539	3577
Cows at Peak	40842	428	497	709	931	775	526	3438
Change Winter-Peak (%)	4.4%	1.2%	3.9%	5.7%	3.6%	3.5%	2.4%	3.9%
SR Wintered	3.1	3.1	3.3	3.2	3.4	3.2	3.2	3.3
SR at Peak	3.00	3.1	3.21	3.06	3.26	3.06	3.1	3.1
June 2017 Weights	476.4	530.0	550.0	550.0	525.0	540.0	530.0	539.0
LW/ha	1429.1	1637.8	1763.5	1680.8	1709.0	1654.2	1639.9	1690.8
KgMS/KGLW	0.95	1.05	1.05	0.99	1.02	1.03	0.96	1.01
KgLW/TDM Consumed	88.9	82.9	96.4	103.3	99.5	94.7	101.5	99.1
Herd BW	68.8		46.0	38.0	55.0	70.0	36.0	49.0
Production	83.3		51	54	70	88	42	61.0
KgMS/ha	1360	1728	1857	1671	1747	1709	1573	1711
KgMS/cows at peak	453	559	579	547	537	558	508	545
KgMS/cow wintered	434	553	557	515	517	538	496	524
Mating								
Empties	5435	52	66	110	78	82	68	404
Empty % of peak numbers	13.4%	12.1%	13.3%	15.5%	8.4%	10.6%	12.9%	11.8%
Mating Interval (Weeks)	10.5	10	12.4	12.4	12.4	12.4	12.4	12.4
Wasteage - Loss + empties	17.1%	13.2%	16.6%	20.3%	11.7%	13.7%	15.0%	15.2%
Feed								
Silage at start	11643549	90850	90000	150000	293000	265000	150000	948000
+ silage bought	15938955	69000	618600	859200	1161400	276000	392700	3307900
+ silage made	5458844	80040	0	38200	0	15000	0	53200
- silage at end	18634761	133400	390000	510000	900000	151000	275000	2226000
= silage fed	14406587	106490	318600	537400	554400	405000	267700	2083100
Silage fed per cow	353	249	641	758	595	523	509	606
Silage per KgMS	0.8	0.4	1.1	1.4	1.1	0.9	1.0	1.1
Nitrogen Applied (kgN/ha)	198.3	197	202	209	203	203	190	201.4
Nitrogen Response @ 10:1	27003713	272845	313100	484880	580580	513590	323000	2207344
Concentrates Bought								
Molasis t	1003.98	0	25	104	20	24	47	220
Barley	6202.52	326	419	534	676	579	398	2606
Palm Kernt t	11707	172	252	328	567	362	154	1663
Concentrates fed per cow	463	1009	1211	1167	1181	1079	974	1128
Concentrates per KgMS	1.02	1.80	2.09	2.13	2.20	1.93	1.92	2.07
Total Bought Milking Feed kgDM	54864786	651155	1233400	1772980	2234880	1724540	1102850	8060844
Total Bought Feed /cow	1343	1521	2482	2501	2401	2225	2097	2345
Total Bought Feed/kgMS	3.0	2.7	4.3	4.6	4.5	4.0	4.1	4.3
Feed Required For Milk Production @ 12kgDM/kgMS	222226992	2871600	3453288	4651416	5996340	5188056	3208968	22498068
Feed Required For Drystock	619300	0	0	0	0	0	0	0
Less Bought In Feed	54864786	651155	1233400	1772980	2234880	1724540	1102850	8060844
Leaves Pasture Utilised	167981506	2220445	2219888	2878436	3761460	3463516	2106118	14437224
Utilised Pasture/ha	12338	16032	14322	12407	13152	13690	12389	13173
Utilised Pasture/kgMS	9.07	9.28	7.71	7.43	7.53	8.01	7.88	7.70
Financial Analysis/hectare								
Income Milk @ $6.15/kgMS	$8,510.04	$10,625.96	$11,418.13	$10,275.22	$10,745.19	$10,509.40	$9,674.09	$10,520.31
Adj. for cull cows @ $1000	$0.44	$123.39	$15.89	-$104.86	$182.83	$108.30	$66.04	$63.00
Total	$8,510.49	$10,749.34	$11,434.02	$10,170.36	$10,928.02	$10,617.70	$9,740.13	$10,583.31
Variable Feed Costs								
Silage Bought Off @ 30c	$373.41	$149.46	$1,197.29	$1,111.03	$1,218.25	$327.27	$693.00	$905.45
Made On @ 12c	$45.48	$69.35	$0.00	$19.76	$0.00	$7.11	$0.00	$5.82
Fed Out @ 5c	$54.31	$38.44	$102.77	$115.82	$96.92	$80.04	$78.74	$95.03
Change in inventory	-$172.00	-$98.31	-$619.35	-$496.55	-$679.16	$144.19	-$235.29	-$373.14
Concentrates @ ?c	$397.27	$1,179.75	$1,454.23	$1,349.81	$1,373.76	$1,229.32	$1,192.63	$1,318.63
Nitrogen @ 15.2c	$287.59	$285.65	$292.90	$303.05	$294.35	$294.35	$275.50	$292.03
Less feed fed to drystock @ 16c	-$6.60	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Feed Costs	$979.45	$1,624.34	$2,427.84	$2,402.92	$2,304.12	$2,082.28	$2,004.57	$2,243.83
Net Margin	$7,531.04	$9,125.01	$9,006.18	$7,767.44	$8,623.90	$8,535.41	$7,735.56	$8,339.48

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2013/2014

Name	2013/2014	Reference Period Status	Past
Farm	32650		

Farm Metrics

Total Hectares	170	Dairy Hectares	155
Peak Cows		KgMS	250,281
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	246		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:44 AM	Last Modified By	integration, 29/06/2018 5:11 PM

Farm Season History

29/06/2018 10:21 AM

User **integration**
Action **Changed Average**

13/04/2018 7:44 PM

User **integration**
Action **Changed**

2/09/2016 1:34 PM

User **integration**
Action **Changed**

11/03/2016 5:44 AM

User **integration**
Action **Created.**

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2013/2014

Name	2013/2014	Reference Period Status	Past
Farm	32651		

Farm Metrics

Total Hectares	205	Dairy Hectares	202
Peak Cows		KgMS	341,434
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	299		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:43 AM	Last Modified By	integration, 1/08/2018 11:45 AM

Farm Season History

29/06/2018 10:21 AM

User **integration**
Action **Changed Average SCC from**

13/04/2018 7:44 PM

User **integration**
Action **Changed**

2/09/2016 1:34 PM

User **integration**
Action **Changed**

11/03/2016 5:43 AM

User **integration**
Action **Created.**

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2014/2015

Name	2014/2015	Reference Period Status	Past
Farm	32650		

Farm Metrics

Total Hectares	170	Dairy Hectares	155
Peak Cows		KgMS	246,071
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	256		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:44 AM	Last Modified By	integration, 29/06/2018 5:11 PM

Farm Season History

13/04/2018 4:57 PM

User **integration**
Action

2/09/2016 1:29 PM

User **integration**
Action **Changed**

11/03/2016 5:44 AM

User **integration**
Action **Created.**

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2014/2015

Name	2014/2015	Reference Period Status	Past
Farm	32651		

Farm Metrics

Total Hectares	235	Dairy Hectares	232
Peak Cows		KgMS	372,124
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	257		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:43 AM	Last Modified By	integration, 1/08/2018 11:45 AM

Farm Season History

13/04/2018 4:57 PM

User **integration**
Action **Changed**

2/09/2016 1:29 PM

User **integration**
Action **Changed**

11/03/2016 5:43 AM

User **integration**
Action **Created.**

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2015/2016

Name	2015/2016	**Reference Period Status**	Past
Farm	32650		

Farm Metrics

Total Hectares	170	**Dairy Hectares**	155
Peak Cows		**KgMS**	265,277
Supplementary Feed Used		**Cows Grazed Off Farm**	
Fodder Crops Grown		**Nitrogen Fertiliser Used**	
Supplied Days	264		

Milk Quality

Average SCC		**Grade Free Award Eligibility**	
Demerit Days		**Achievement Award Eligibility**	
Demerit Points			

Submission Details

Submission Source		**Sustainable Dairy Records**	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:44 AM	**Last Modified By**	integration, 29/06/2018 5:11 PM

Farm Season History

13/04/2018 1:45 PM

User **integration**
Action **Changed**

2/09/2016 12:45 PM

User **integration**
Action **Changed**

10/06/2016 3:35 PM

User **integration**
Action **Changed**

11/03/2016 5:44 AM

User **integration**
Action **Created.**

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2015/2016

Name	2015/2016	Reference Period Status	Past
Farm	32651		

Farm Metrics

Total Hectares	235	Dairy Hectares	232
Peak Cows		KgMS	361,346
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	261		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:43 AM	Last Modified By	integration, 1/08/2018 11:45 AM

Farm Season History

13/04/2018 1:45 PM

User **integration**
Action **Changed**

2/09/2016 12:45 PM

User **integration**
Action **Changed**

6/06/2016 7:07 PM

User **integration**
Action **Changed**

11/03/2016 5:43 AM

User **integration**
Action **Created.**

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2016/2017

Name	2016/2017	**Reference Period Status**	Past
Farm	32650		

Farm Metrics

Total Hectares	170	**Dairy Hectares**	155
Peak Cows		**KgMS**	287,773
Supplementary Feed Used		**Cows Grazed Off Farm**	
Fodder Crops Grown		**Nitrogen Fertiliser Used**	
Supplied Days	273		

Milk Quality

Average SCC		**Grade Free Award Eligibility**	
Demerit Days		**Achievement Award Eligibility**	
Demerit Points			

Submission Details

Submission Source		**Sustainable Dairy Records**	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:44 AM	**Last Modified By**	integration, 29/06/2018 5:11 PM

Farm Season History

13/04/2018 10:27 AM

User **integration**
Action **Changed**

6/06/2017 1:08 PM

User **integration**
Action **Changed**

8/08/2016 12:35 PM

User **Rika West**
Action **Changed**

11/03/2016 5:44 AM

User **integration**
Action **Created.**

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2016/2017

Name	2016/2017	Reference Period Status	Past
Farm	32651		

Farm Metrics

Total Hectares	235	Dairy Hectares	232
Peak Cows		KgMS	387,617
Supplementary Feed Used		Cows Grazed Off Farm	
Fodder Crops Grown		Nitrogen Fertiliser Used	
Supplied Days	271		

Milk Quality

Average SCC		Grade Free Award Eligibility	
Demerit Days		Achievement Award Eligibility	
Demerit Points			

Submission Details

Submission Source		Sustainable Dairy Records	
		Submission Type	

System Information

Created By	integration, 11/03/2016 5:43 AM	Last Modified By	integration, 1/08/2018 11:45 AM

Farm Season History

13/04/2018 10:27 AM

User **integration**
Action **Changed**

6/06/2017 1:08 PM

User **integration**
Action **Changed**

9/11/2016 8:52 AM

User **integration**
Action **Changed**

11/03/2016 5:43 AM

User **integration**
Action **Created.**

				Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
60848385	**DE WOLDE GROUP HOLDING ACCOUNT**				**34.622**	**59.803**	**44.586**	**67.289**	**65.693**	**287.691**	**19.161**	**40.050**	**19.400**	**5.830**	**644.125**
60842384	WOLDWIDE ONE LTD - DE WOLDE A & J J	0001110	SODIUM MOLYBDATE BAGS 25KG	2015-16			0.015								**0.015**
		0001210	BORATE 46 GRANULAR	2013-14						0.090					**0.090**
				2015-16				0.083							**0.083**
		0002510	SELENIUM SELPRILL DOUBLE 2%SE	2013-14	0.076										**0.076**
				2015-16		0.040	0.035			0.006					**0.081**
				2016-17					0.006		0.003				**0.009**
				2017-18		0.092									**0.092**
		0300000	AGLIME	2013-14				3.005		55.824	1.360				**60.189**
				2017-18						59.559					**59.559**
		1000000	SUPERPHOSPHATE BULK	2013-14	22.547			3.005							**25.552**
				2015-16		12.024	10.330	12.246	7.457	5.887					**47.944**
				2016-17					12.516	18.607	2.633				**33.756**
				2017-18					5.693	79.069					**84.762**
		1890000	SULPHUR SUPER 30 BULK	2013-14						8.676					**8.676**
		2000000	POTASSIUM CHLORIDE GRAN BULK	2013-14						4.338					**4.338**
				2015-16				3.394	1.864	0.655					**5.913**
				2016-17					2.158	4.017	0.293				**6.468**
				2017-18					0.633	7.454					**8.087**
		3000000	CROPMASTER DAP BULK	2013-14						13.792	0.085				**13.877**
				2015-16				1.583							**1.583**
		4000000	GRANULAR AMMONIUM SULP BULK	2016-17		7.120									**7.120**
				2017-18		8.733									**8.733**
		4050000	PASTORAL AMMONIUM SULPHATE	2013-14						2.335	0.255				**2.590**
		4300000	UREA BULK	2013-14	11.999		6.000	7.120	4.650	3.100		7.870	7.460	3.350	**51.549**
				2015-16		8.016	18.106	2.730	3.370	5.743	6.850	5.850			**50.665**
				2016-17		10.680	7.200	5.690	8.530		7.682	6.260	6.440		**52.482**
				2017-18		13.098	2.900	22.630	12.875			20.070	5.500	2.480	**79.553**
		4340000	FLEXI-N	2015-16				5.803	3.500						**9.303**
				2016-17					2.441	6.626					**9.067**
				2017-18						11.913					**11.913**
		Total			**34.622**	**59.803**	**44.586**	**67.289**	**65.693**	**287.691**	**19.161**	**40.050**	**19.400**	**5.830**	**644.125**

Parent	Parent Total		2013-14	2015-16	2016-17	2017-18	Total
60848385	DE WOLDE GROUP HOLDING ACCOUNT		**166.937**	**115.587**	**108.902**	**252.699**	**644.125**
	0001110	SODIUM MOLYBDATE BAGS 25KG		0.015			**0.015**
	0001210	BORATE 46 GRANULAR	0.090	0.083			**0.173**
	0002510	SELENIUM SELPRILL DOUBLE 2%SE	0.076	0.081	0.009	0.092	**0.258**
	0300000	AGLIME	60.189			59.559	**119.748**
	1000000	SUPERPHOSPHATE BULK	25.552	47.944	33.756	84.762	**192.014**
	1890000	SULPHUR SUPER 30 BULK	8.676				**8.676**
	2000000	POTASSIUM CHLORIDE GRAN BULK	4.338	5.913	6.468	8.087	**24.806**
	3000000	CROPMASTER DAP BULK	13.877	1.583			**15.460**
	4000000	GRANULAR AMMONIUM SULP BULK			7.120	8.733	**15.853**
	4050000	PASTORAL AMMONIUM SULPHATE	2.590				**2.590**
	4300000	UREA BULK	51.549	50.665	52.482	79.553	**234.249**
	4340000	FLEXI-N		9.303	9.067	11.913	**30.283**
	Total		**166.937**	**115.587**	**108.902**	**252.699**	**644.125**

				Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
60848385 DE WOLDE GROUP HOLDING ACCOUNT					**45.612**	**90.677**	**43.282**	**79.720**	**68.036**	**337.372**	**50.340**	**58.900**	**28.660**	**6.250**	**808.849**
	60842385 WOLDWIDE TWO LTD - DE WOLDE A & J J	0001110	SODIUM MOLYBDATE BAGS 25KG	2015-16			0.022								**0.022**
		0001210	BORATE 46 GRANULAR	2013-14						0.135					**0.135**
				2015-16				0.100							**0.100**
		0002510	SELENIUM SELPRILL DOUBLE 2%SE	2013-14	0.100										**0.100**
				2015-16		0.080	0.015			0.007					**0.102**
				2016-17					0.003						**0.003**
				2017-18		0.103									**0.103**
		0300000	AGLIME	2013-14				4.365		73.545					**77.910**
				2017-18						44.745	1.323				**46.068**
		1000000	SUPERPHOSPHATE BULK	2013-14	29.657			4.365							**34.022**
				2015-16		23.731	4.503	1.520	7.720	6.925					**44.399**
				2016-17					8.788	26.858					**35.646**
				2017-18					5.198	82.230	1.387				**88.815**
		1890000	SULPHUR SUPER 30 BULK	2013-14						12.215					**12.215**
		2000000	POTASSIUM CHLORIDE GRAN BULK	2013-14						6.108					**6.108**
				2015-16				3.330	1.430	0.769					**5.529**
				2016-17					1.555	6.381					**7.936**
				2017-18					0.578	13.609	10.345				**24.532**
		3000000	CROPMASTER DAP BULK	2013-14						19.100					**19.100**
				2015-16				1.900							**1.900**
		4000000	GRANULAR AMMONIUM SULP BULK	2015-16				3.774	3.666	1.050					**8.490**
				2016-17		10.597									**10.597**
				2017-18		9.780									**9.780**
		4050000	PASTORAL AMMONIUM SULPHATE	2013-14						2.341					**2.341**
		4300000	UREA BULK	2013-14	15.855		8.000	10.250	6.260	4.150		12.470	8.380	5.010	**70.375**
				2015-16		15.821	16.122	11.766	6.969	12.789	13.200	12.060	2.000		**90.727**
				2016-17		15.895	10.520	13.670	9.365	2.310	11.380	10.970	9.650		**83.760**
				2017-18		14.670	4.100	20.180	12.035		12.440	23.400	8.630	1.240	**96.695**
		4340000	FLEXI-N	2015-16				4.500	2.680						**7.180**
				2016-17					1.789	8.721					**10.510**
				2017-18						13.384	0.265				**13.649**
		Total			**45.612**	**90.677**	**43.282**	**79.720**	**68.036**	**337.372**	**50.340**	**58.900**	**28.660**	**6.250**	**808.849**

Parent	Parent Total		2013-14	2015-16	2016-17	2017-18	Total
60848385	DE WOLDE GROUP HOLDING ACCOUNT		**222.306**	**158.449**	**148.452**	**279.642**	**808.849**
	0001110	SODIUM MOLYBDATE BAGS 25KG		0.022			**0.022**
	0001210	BORATE 46 GRANULAR	0.135	0.100			**0.235**
	0002510	SELENIUM SELPRILL DOUBLE 2%SE	0.100	0.102	0.003	0.103	**0.308**
	0300000	AGLIME	77.910			46.068	**123.978**
	1000000	SUPERPHOSPHATE BULK	34.022	44.399	35.646	88.815	**202.882**
	1890000	SULPHUR SUPER 30 BULK	12.215				**12.215**
	2000000	POTASSIUM CHLORIDE GRAN BULK	6.108	5.529	7.936	24.532	**44.105**
	3000000	CROPMASTER DAP BULK	19.100	1.900			**21.000**
	4000000	GRANULAR AMMONIUM SULP BULK		8.490	10.597	9.780	**28.867**
	4050000	PASTORAL AMMONIUM SULPHATE	2.341				**2.341**
	4300000	UREA BULK	70.375	90.727	83.760	96.695	**341.557**
	4340000	FLEXI-N		7.180	10.510	13.649	**31.339**
	Total		**222.306**	**158.449**	**148.452**	**279.642**	**808.849**

Ballance agri-nutrients

Fertiliser Recommendation

Prepared for (customer):	WOLDWIDE ONE LTD (Cust No: 3100992)		
Property:	Woldwide One Ltd (Prop No: 4077982)		
Recommendation:	WW 1 Annual 2014/15	**Representative:**	Latoya Grant
Date:	07/07/2014	**Phone:**	027 434-4423

Having considered all available data relevant to your property Ballance Agri-Nutrients recommends the following fertilliser to be applied.

Block: Non-Effluent **Area (Ha): 113** **Usage: Dairy**

Application	Kg/Ha	Product		N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
				(Kg nutrient / ha)													
14/15 WW 1 Spring N & P - Non eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	150.000 ✓	Superten									70						
	65.000 ✓	Nrich Urea									30						
Tot App Rate/Ha:	**215.000**	**Total tonnes:**	**24.295**	30	14	0	16	0	33	0	100		$404.67	$9,831.46	$0.00	$87.00	$9,831.46
14/15 WW 1 Nov - Maint. Non eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	450.000	Superten 10K ✓									100						
	1.000	Selenium N/A										2.22					
Tot App Rate/Ha:	**451.000**	**Total tonnes:**	**50.963**	0	32	45	38	0	79	0	100		$411.82	$20,987.58	$0.00	$185.73	$20,987.58
14/15 WW 1 Seasonal N - Non Eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	430.000	SustaiN									100						
Tot App Rate/Ha:	**430.000**	**Total tonnes:**	**48.590**	197	0	0	0	0	0	0	100		$666.00	$32,360.94	$0.00	$286.38	$32,360.94
		Block Analysis:		227	46	45	54	0	112	0	123.848 tonnes			$63,180.18			$63,179.98
		Maintenance:		0	0	0	0	0	0	0							

Block: Effluent **Area (Ha): 36** **Usage: Dairy**

Application	Kg/Ha	Product		N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
				(Kg nutrient / ha)													
14/15 WW1 Spring N - Eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	150.000	Superten									70						
	65.000	Nrich Urea									30						
Tot App Rate/Ha:	**215.000**	**Total tonnes:**	**7.740**	30	14	0	16	0	33	0	100		$404.67	$3,132.15	$0.00	$87.00	$3,132.15
14/15 WW1 Nov Maint - Eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	200.000	Sulphurgain 20S									100						
	1.000	Selenium										4.98					
Tot App Rate/Ha:	**201.000**	**Total tonnes:**	**7.236**	0	16	0	40	0	40	0	100		$373.29	$2,701.13	$0.00	$75.03	$2,701.13
14/15 WW1 Seasonal N - Eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	250.000	SustaiN									100						
Tot App Rate/Ha:	**250.000**	**Total tonnes:**	**9.000**	115	0	0	0	0	0	0	100		$666.00	$5,994.00	$0.00	$166.50	$5,994.00
		Block Analysis:		145	30	0	56	0	73	0	23.976	tonnes		$11,827.33			$11,827.27
		Maintenance:		0	0	0	0	0	0	0							

Block: Turnips **Area (Ha): 10** **Usage:**

Application	Kg/Ha	Product	N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
			(Kg nutrient / ha)													
2014/15 WW1 Turnips at sowing		**Merchant:** PGG Wrightson Otautau **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	250.000	Cropzeal Boron Boost								100						
	1.000	Selenium									3.98					
Tot App Rate/Ha:	**251.000**	**Total tonnes: 2.510**	41	49	0	0	0	0	0	100		$917.66	$2,303.33	$0.00	$230.33	$2,303.33
2014/15 WW1 Turnip side dressing		**Merchant:** PGG Wrightson Otautau **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	150.000	SustaiN								100						
Tot App Rate/Ha:	**150.000**	**Total tonnes: 1.500**	69	0	0	0	0	0	0	100		$666.00	$999.00	$0.00	$99.90	$999.00
		Block Analysis:	110	49	0	0	0	0	0	4.010 tonnes			$3,302.32			$3,302.33
		Maintenance:	0	0	0	0	0	0	0							

Recommendation Totals:	**151.83 tonnes**	**$78,309.83**	**$78,309.58**

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To minimise the risk of fluorosis, Ballance recommends that:

- Following application of P-fertiliser, pastures should not be grazed until at least 25 mm of rainfall has occurred, or sufficient time has elapsed so that no fertiliser residues are evident on the leaves of the pasture.
- P-fertiliser application should be staggered so that there is feed available to stock at all times that is not contaminated with fertiliser residues

Should you choose to disregard the above principals, the fertiliser application practice you undertake is done so at your own risk. Managing P-fertiliser applications based on the following principals will reduce the risk of fluorosis, however, Ballance does not recommend application outside of the conditions outlined above.

- Application of P-fertilisers containing lower levels of fluoride will reduce the risk of fluorosis. For example, RPR and Superphosphate have higher fluoride levels than DAP and Triple super.
- Well-granulated fertiliser products are less likely to adhere to plant leaves
- Avoid applying P-fertilisers when the pasture is damp (e.g. on a morning dew)
- Low application rates (<200 kg/ha) will reduce the risk of fluorosis
- Defer P-fertiliser applications away from early spring when stock have high feed demand and are under stress, and where pasture covers are low

Lime to go on Non-effluent only at 400kg/ha.

Ballance agri-nutrients

Fertiliser Recommendation

Prepared for (customer): WOLDWIDE TWO LTD (Cust No: 3100989)
Property: Woldwide Two Ltd (Prop No: 4077987)
Recommendation: WW 2 Annual 2014/15 **Representative:** Latoya Grant
Date: 07/07/2014 **Phone:** 027 434-4423

Having considered all available data relevant to your property Ballance Agri-Nutrients recommends the following fertilliser to be applied.

Block: Non-Effluent **Area (Ha): 207** **Usage: Dairy**

Application	Kg/Ha	Product		N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
				(Kg nutrient / ha)													
14/15 WW 2 Spring N and P - Non eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	150.000	Superten ✓									70						
	65.000	Nrich Urea ✓									30						
Tot App Rate/Ha:	**215.000**	**Total tonnes:**	**44.505**	30	14	0	16	0	33	0	100		$404.67	$18,009.84	$0.00	$87.00	$18,009.84
14/15 WW 2 Nov - Maint - Non eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	350.000	Sulphurgain 15S ✓									85						
	60.000	Muriate Of Potash ✓									15						
Tot App Rate/Ha:	**410.000**	**Total tonnes:**	**84.870**	0	30	30	52	0	74	0	100		$390.17	$33,113.73	$0.00	$159.97	$33,113.73
14/15 WW 2 Seasonal N - Non eff		**Merchant:**	PGG Wrightson Otautau								**Delivery Date:**						
		Store:	Winton Consignment Store								**Carrier:**						
											Spreader:						
	430.000	SustaiN									100						
Tot App Rate/Ha:	**430.000**	**Total tonnes:**	**89.010**	197	0	0	0	0	0	0	100		$666.00	$59,280.66	$0.00	$286.38	$59,280.66
		Block Analysis:		**227**	**44**	**30**	**68**	**0**	**107**	**0**	218.385 tonnes			$110,404.40			$110,404.23
		Maintenance:		0	0	0	0	0	0	0							

Block: Effluent Area (Ha): 26 Usage: D[illegible]y

Application	Kg/Ha	Product	N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
			(Kg nutrient / ha)													
14/15 WW 2 Spring N & P - Eff		Merchant: PGG Wrightson Otautau Store: Winton Consignment Store								Delivery Date: Carrier: Spreader:						
	150.000	Superten ✓								70						
	65.000	Nrich Urea ✓								30						
Tot App Rate/Ha:	215.000	Total tonnes: 5.590	30	14	0	16	0	33	0	100		$404.67	$2,262.11	$0.00	$87.00	$2,262.11
14/15 WW 2 Nov - Maint - Eff		Merchant: PGG Wrightson Otautau Store: Winton Consignment Store								Delivery Date: Carrier: Spreader:						
	200.000	Sulphurgain 20S ✓								100						
	1.000	Selenium									4.98					
Tot App Rate/Ha:	201.000	Total tonnes: 5.226	0	16	0	40	0	40	0	100		$373.29	$1,950.81	$0.00	$75.03	$1,950.81
14/15 WW 2 Seasonal N - Eff		Merchant: PGG Wrightson Otautau Store: Winton Consignment Store								Delivery Date: Carrier: Spreader:						
	300.000	SustaiN								100						
Tot App Rate/Ha:	300.000	Total tonnes: 7.800	138	0	0	0	0	0	0	100		$666.00	$5,194.80	$0.00	$199.80	$5,194.80
		Block Analysis:	168	30	0	56	0	73	0	18.616 tonnes			$9,407.76			$9,407.72
		Maintenance:	0	0	0	0	0	0	0							

Block: Turnips | **Area (Ha): 10** | **Usage:**

Application	Kg/Ha	Product			N	P	K	S	Mg	Ca	Na	% of Mix	Kg/T	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
					(Kg nutrient / ha)													
14/15 WW 2 Turnips - At sowing		Merchant:	PGG Wrightson Otautau									Delivery Date:						
		Store:	Winton Consignment Store									Carrier:						
												Spreader:						
	250.000	Cropzeal Boron Boost										100						
	1.000	Selenium											3.98					
Tot App Rate/Ha:	251.000	Total tonnes:	2.510		41	49	0	0	0	0	0	100		$917.66	$2,303.33	$0.00	$230.33	$2,303.33
14/15 WW 2 Turnips - Side		Merchant:	PGG Wrightson Otautau									Delivery Date:						
		Store:	Winton Consignment Store									Carrier:						
												Spreader:						
	150.000	SustaiN										100						
Tot App Rate/Ha:	150.000	Total tonnes:	1.500		69	0	0	0	0	0	0	100		$666.00	$999.00	$0.00	$99.90	$999.00
		Block Analysis:			110	49	0	0	0	0	0	4.010 tonnes			$3,302.32			$3,302.33
		Maintenance:			0	0	0	0	0	0	0							

Recommendation Totals:	241.01 tonnes	$123,114.48	$123,114.28

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Lime on Non-Effluent area only at 400kg/ha.

Block: Fodder Beet – Wolldwide 3 **Area (Ha): 3** **Usage:**

Application	Kg/Ha	Product	N	P	K	S	Mg	Ca	Na	% of Mix	Kg	$/Tonne (Prod)	Total $ (Prod)	Crt/Sprd ($/T)	$/Ha	Total $
						(Kg nutrient / ha)										
Base Dressing		**Merchant:** PGG Wrightson Otautau **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	400.000	Cropzeal 16N								76						
	100.000	Agriculture Coarse Salt 1200kg								19						
	25.000	Boron 15%									47.62					
Tot App Rate/Ha:	**525.000**	**Total tonnes: 1.575**	62	32	40	38	0	0	39	**95**		**$726.52**	**$1,144.27**	**$0.00**	**$381.42**	**$1,144.27**
Side Dressing - Jan		**Merchant:** PGG Wrightson Otautau **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	200.000	SustaiN 20K								100						
Tot App Rate/Ha:	**200.000**	**Total tonnes: 0.600**	55	0	40	0	0	0	0	**100**		**$706.00**	**$423.60**	**$0.00**	**$141.20**	**$423.60**
Side Dressing - Mar		**Merchant:** PGG Wrightson Otautau **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	100.000	SustaiN								100						
Tot App Rate/Ha:	**100.000**	**Total tonnes: 0.300**	46	0	0	0	0	0	0	**100**		**$684.00**	**$205.20**	**$0.00**	**$68.40**	**$205.20**
		Block Analysis:	**163**	**32**	**80**	**38**	**0**	**0**	**39**	**2.475 tonnes**			**$1,773.07**			**$1,773.07**
		Maintenance:	**0**	**0**	**0**	**0**	**0**	**0**	**0**							
		Recommendation Totals:								**268.18 tonnes**			**$139,650.23**			**$139,650.19**

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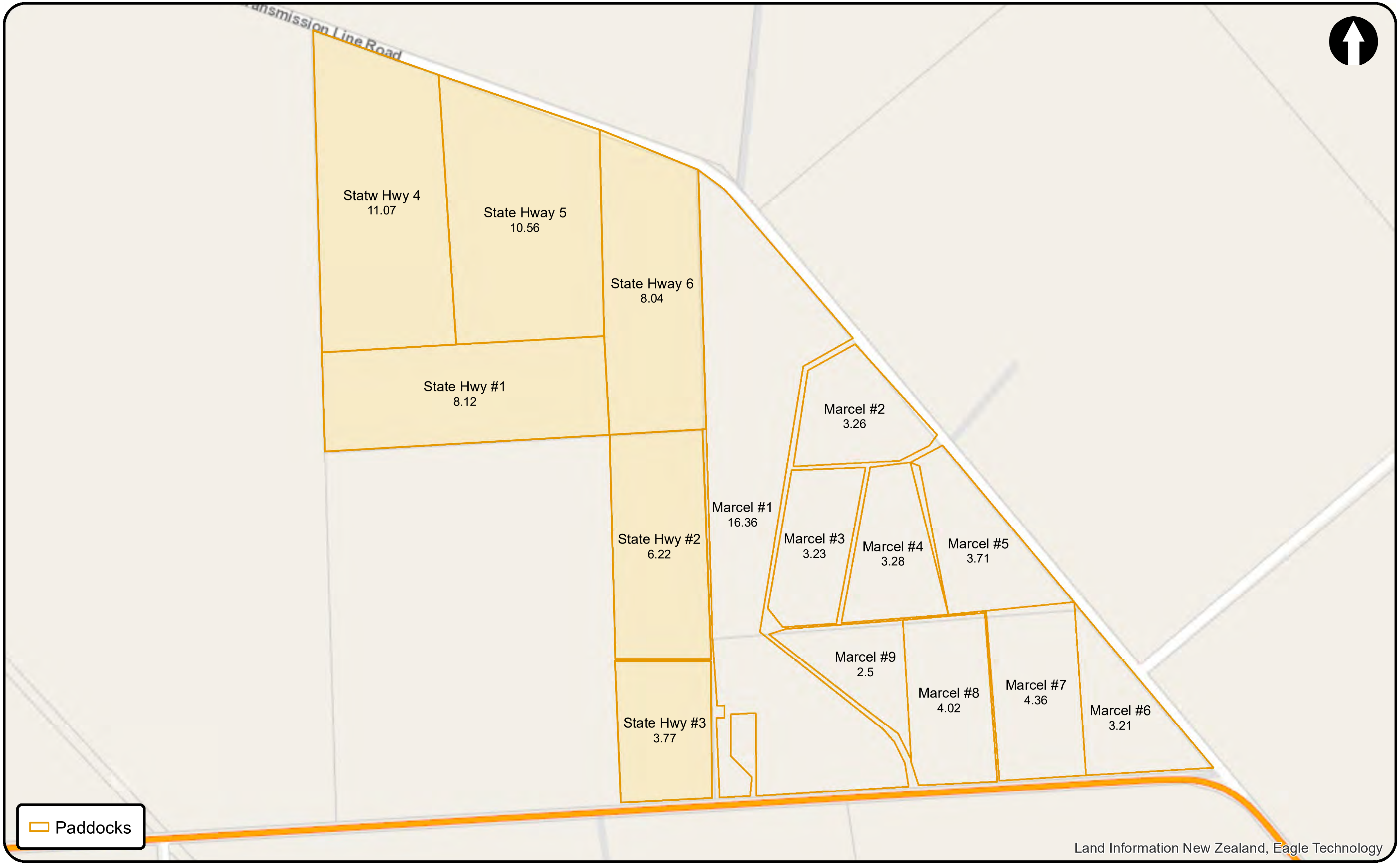
Maintenance Lime should be applied to the Non-effluent area only at 400kg/ha.



My Ravensdown Smart Maps
www.myravensdown.co.nz
Note: Areas are in hectares

SH96 map

0 55 110 220 330 440 Metres

ravensdown

28 May 2018

Nutrient summary report

WOLDWIDE FARM LTD - 60842383

Query range : 01 Jun 2013 to 28 May 2018

Name	Date	Area (ha)	Product	Rate (kg/ha or l/ha)	N kg/ha	P kg/ha	K kg/ha	S kg/ha	Ca kg/ha	Mg kg/ha
State Hway 5	01/04/2014	10.1	Urea	89	41	-	-	-	-	-
	02/09/2014	10.2	Non-Ravensdown product *	538	-	-	-	-	-	-
	18/09/2014	10.2	BAN-Urea	110	50	-	-	-	-	-
	29/10/2014	10.2	BAN-Urea	161	74	-	-	-	-	-
	30/12/2014	10.1	BAN-HIGH ANALYSIS *	213	-	-	-	-	-	-
	18/02/2015	10.2	NON-RAVENSDOWN PRODUCT *	108	-	-	-	-	-	-
	04/04/2015	10.2	BAN-Urea	80	37	-	-	-	-	-
	02/09/2015	10.1	Ammo 36 + Sel	150	53	-	-	14	-	-
	23/09/2015	10.1	Urea	156	72	-	-	-	-	-
	22/10/2015	9.9	POST SILAGE	377	71	9	51	11	20	9
	17/11/2015	10.1	UREA	79	36	-	-	-	-	-
	10/12/2015	10.1	CUT 2 DRESSING	670	66	9	51	11	131	8
	02/02/2016	10.2	UREA	160	74	-	-	-	-	-
	24/03/2016	10	20 POT SUP FLEXI-N	291	33	15	21	19	34	4
	31/08/2016	9.8	UREA	70	32	-	-	-	-	-
	18/10/2016	10	Marcel Post 1st cut	375	100	21	32	14	-	-
	07/12/2016	0.5	Marcel post 2nd Cut	315	76	20	30	13	-	-
	09/12/2016	10	SH96/Horner 2nd Post Cut	214	33	12	-	15	27	4

	30/01/2017	9.7	Gladfield Post 3rd Cut	240	49	22	33	1	-	-
	21/03/2017	9.8	Urea	106	49	-	-	-	-	-
	Area weighted total				**831**	**84**	**179**	**81**	**202**	**24**
State Hway 6	01/04/2014	7.4	Urea	90	41	-	-	-	-	-
	02/09/2014	7.7	Non-Ravensdown product *	543	-	-	-	-	-	-
	18/09/2014	7.8	BAN-Urea	112	52	-	-	-	-	-
	29/10/2014	7.6	BAN-Urea	158	73	-	-	-	-	-
	30/12/2014	7.6	BAN-HIGH ANALYSIS *	213	-	-	-	-	-	-
	18/02/2015	7.6	NON-RAVENSDOWN PRODUCT *	109	-	-	-	-	-	-
	04/04/2015	7.6	BAN-Urea	80	37	-	-	-	-	-
	27/10/2015	7.5	FODDER BEET	1336	-	24	-	29	438	-
	29/10/2015	7.7	FODDERBEET STARTER	682	17	12	70	9	-	-
	25/10/2016	7.7	WINTON FB BASE MIX 2016	614	62	39	92	34	-	1
	06/12/2016	7.7	4 - 6 WEEK DRESSING	252	75	-	38	-	-	-
	02/11/2017	7.8	WINTON FB BASE MIX 2017	632	64	40	95	35	-	1
	02/11/2017	7.5	AGLIME	1057	-	-	-	-	380	-
	Area weighted total				**402**	**110**	**284**	**102**	**765**	**2**
State Hwy #1	01/04/2014	7.8	Urea	88	41	-	-	-	-	-
	02/09/2014	7.9	Non-Ravensdown product *	511	-	-	-	-	-	-
	18/09/2014	8	BAN-Urea	101	47	-	-	-	-	-
	29/10/2014	8	BAN-Urea	158	73	-	-	-	-	-

	30/12/2014	7.9	BAN-HIGH ANALYSIS *	206	-	-	-	-	-	-
	18/02/2015	8	NON-RAVENSDOWN PRODUCT *	102	-	-	-	-	-	-
	04/04/2015	8	BAN-Urea	76	35	-	-	-	-	-
	02/09/2015	7.5	Ammo 36 + Sel	145	52	-	-	14	-	-
	23/09/2015	7.8	Urea	149	69	-	-	-	-	-
	22/10/2015	7.5	POST SILAGE	390	74	10	53	12	21	9
	17/11/2015	7.9	UREA	81	37	-	-	-	-	-
	10/12/2015	8	CUT 2 DRESSING	682	67	9	52	11	133	8
	02/02/2016	7.9	UREA	165	76	-	-	-	-	-
	24/03/2016	7.9	20 POT SUP FLEXI-N	284	32	15	21	18	33	4
	31/08/2016	7.9	UREA	70	32	-	-	-	-	-
	18/10/2016	7.8	Marcel Post 1st cut	368	98	21	31	13	-	-
	09/12/2016	7.9	SH96/Horner 2nd Post Cut	216	33	12	-	15	27	4
	30/01/2017	7.9	Gladfield Post 3rd Cut	224	46	20	30	1	-	-
	21/03/2017	7.9	Urea	103	48	-	-	-	-	-
	Area weighted total				**827**	**84**	**179**	**81**	**209**	**25**
State Hwy #2	05/08/2013	5.5	SMIX	302	62	15	-	18	34	-
	23/10/2013	6.1	Other Product *	1427	-	-	-	-	-	-
	23/10/2013	6.1	Other Product *	1427	-	-	-	-	-	-
	20/11/2013	6.1	Urea	320	147	-	-	-	-	-
	01/04/2014	6	EX BARLEY S.H.96	727	49	43	69	53	96	-
	18/09/2014	6.1	BAN-Urea	85	39	-	-	-	-	-
	05/11/2014	5.8	BAN-High Analysis *	657	-	-	-	-	-	-
	31/08/2016	5.7	UREA	70	32	-	-	-	-	-

	18/10/2016	6	Marcel Post 1st cut	354	94	20	30	13	-	-
	09/12/2016	5.9	SH96/Horner 2nd Post Cut	218	34	12	-	15	27	4
	Area weighted total				**438**	**86**	**96**	**94**	**149**	**4**
State Hwy #3	30/07/2013	3.5	Urea	132	61	-	-	-	-	-
	23/10/2013	3.6	Other Product *	1457	-	-	-	-	-	-
	23/10/2013	3.6	Other Product *	1457	-	-	-	-	-	-
	20/11/2013	3.5	Urea	331	152	-	-	-	-	-
	01/04/2014	3.5	EX BARLEY S.H.96	759	51	45	73	55	100	-
	18/09/2014	3.6	BAN-Urea	86	40	-	-	-	-	-
	05/11/2014	3.3	BAN-High Analysis *	676	-	-	-	-	-	-
	31/08/2016	3.2	UREA	73	33	-	-	-	-	-
	18/10/2016	3.2	Marcel Post 1st cut	426	113	24	36	16	-	-
	09/12/2016	3.2	SH96/Horner 2nd Post Cut	224	35	13	-	15	28	4
	Area weighted total				**439**	**73**	**98**	**78**	**117**	**4**
Statw Hwy 4	01/04/2014	10.6	Urea	86	40	-	-	-	-	-
	02/09/2014	10.7	Non-Ravensdown product *	512	-	-	-	-	-	-
	18/09/2014	10.8	BAN-Urea	103	48	-	-	-	-	-
	29/10/2014	10.9	BAN-Urea	155	71	-	-	-	-	-
	30/12/2014	10.8	BAN-HIGH ANALYSIS *	206	-	-	-	-	-	-
	18/02/2015	10.9	NON-RAVENSDOWN PRODUCT *	108	-	-	-	-	-	-
	04/04/2015	10.9	BAN-Urea	80	37	-	-	-	-	-
	02/09/2015	10.8	Ammo 36 + Sel	148	53	-	-	14	-	-
	23/09/2015	10.9	Urea	148	68	-	-	-	-	-
	22/10/2015	10.7	POST SILAGE	399	75	10	54	12	22	9

	17/11/2015	10.9	UREA	78	36	-	-	-	-	-
	10/12/2015	10.9	CUT 2 DRESSING	665	65	9	51	11	130	8
	02/02/2016	10.9	UREA	159	73	-	-	-	-	-
	24/03/2016	10.8	20 POT SUP FLEXI-N	275	31	14	20	18	32	4
	31/08/2016	10.7	UREA	66	30	-	-	-	-	-
	18/10/2016	10.9	Marcel Post 1st cut	361	96	20	31	13	-	-
	09/12/2016	10.8	SH96/Horner 2nd Post Cut	201	31	11	-	14	25	4
	30/01/2017	10.9	Gladfield Post 3rd Cut	240	49	22	33	1	-	-
	21/03/2017	10.9	Urea	101	47	-	-	-	-	-
	Area weighted total				**833**	**85**	**184**	**81**	**205**	**25**
Weighted average rate based on applied areas and rates for selected areas					**677**	**88**	**181**	**86**	**285**	**17**

Note: Total and average rates assume product applications cover effective area of paddock(s) selected.
This is dependent on positional accuracy of paddock boundaries

* The product that you have created, is missing nutrient values. This will affect any averages or totals in the Nutrient summary. Please go to the event concerned and add the nutrient values to the appropriate product.

Nutrient summary report

WOLDWIDE FARM LTD - 60842383

Query range : 01 Jun 2013 to 29 May 2018

Name	Date	Area (ha)	Product	Rate (kg/ha or l/ha)	N kg/ha	P kg/ha	K kg/ha	S kg/ha	Ca kg/ha	Mg kg/ha
Marcel #1	09/10/2013	15.5	Ag Lime *	1121	-	-	-	-	-	-
	21/10/2013	15.7	BARLEY STARTER	422	51	57	68	3	-	-
	20/11/2013	15.2	Urea	326	150	-	-	-	-	-
	01/04/2014	14.9	EX BARLEY S.H.96	746	50	44	71	54	99	-
	02/09/2014	15.5	Non-Ravensdown product *	566	-	-	-	-	-	-
	18/09/2014	15.6	BAN-Urea	109	50	-	-	-	-	-
	05/11/2014	14.9	BAN-High Analysis *	689	-	-	-	-	-	-
	14/10/2015	15.1	Cropmaster 15	402	60	40	40	31	-	-
	17/11/2015	15.3	UREA	230	106	-	-	-	-	-
	02/02/2016	15.2	UREA + 50% POT SUPER	492	75	15	82	18	33	-
	24/03/2016	15.7	20 POT SUP FLEXI-N	299	34	16	22	19	35	4
	19/08/2016	15.4	MARCEL	341	78	22	33	17	-	-
	30/08/2016	15	Urea/Potash	219	69	-	35	-	-	-
	18/10/2016	15.8	Marcel Post 1st cut	421	112	24	36	15	-	-
	07/12/2016	15.7	Marcel post 2nd Cut	367	89	23	35	15	-	-
	30/01/2017	15.5	Gladfield Post 3rd Cut	254	52	23	35	1	-	-
	21/03/2017	15.7	Urea	108	50	-	-	-	-	-
	27/09/2017	14.5	CROPMASTER DAP BULK	166	29	33	-	2	-	-

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	02/11/2017	6.3	WINTON FB BASE MIX 2017	651	65	42	98	36	-	1
	02/11/2017	6.2	AGLIME	1063	-	-	-	-	383	-
	Area weighted total				**1019**	**295**	**466**	**178**	**299**	**4**
Marcel #2	05/08/2013	2.9	SMIX	291	59	15	-	18	32	-
	18/10/2013	3	MARCEL 1ST CUT	559	103	20	56	25	45	-
	09/12/2013	3.2	MARCEL POST 2ND CUT	452	124	23	56	1	-	-
	23/01/2014	3.1	POST 3RD CUT	632	67	33	61	40	73	-
	17/03/2014	3	Urea	72	33	-	-	-	-	-
	02/09/2014	3.1	Non-Ravensdown product *	560	-	-	-	-	-	-
	18/09/2014	3.1	BAN-Urea	112	51	-	-	-	-	-
	29/10/2014	3.1	Ban-Urea	272	125	-	-	-	-	-
	30/12/2014	3.2	BAN-HIGH ANALYSIS *	229	-	-	-	-	-	-
	18/02/2015	3.1	NON-RAVENSDOWN PRODUCT *	110	-	-	-	-	-	-
	04/04/2015	3.1	BAN-Urea	84	39	-	-	-	-	-
	01/10/2015	2.7	jzw - AMM SE	152	54	-	-	15	-	-
	27/10/2015	3.1	FODDER BEET	1319	-	24	-	29	432	-
	29/10/2015	3.1	FODDERBEET STARTER	716	18	12	73	9	-	-
	25/10/2016	3.1	WINTON FB BASE MIX 2016	642	65	41	97	35	-	1
	06/12/2016	3.2	4 - 6 WEEK DRESSING	256	77	-	39	-	-	-
	30/04/2018	3.1	UREA BULK	78	36	-	-	-	-	-
	Area weighted total				**801**	**158**	**366**	**160**	**545**	**1**
Marcel #3	05/08/2013	3	SMIX	281	57	14	-	17	31	-

	18/10/2013	3	MARCEL 1ST CUT	541	99	19	54	24	43	-
	09/12/2013	3.2	MARCEL POST 2ND CUT	486	133	24	61	1	-	-
	23/01/2014	3.1	POST 3RD CUT	625	66	32	60	40	72	-
	17/03/2014	3.1	Urea	80	37	-	-	-	-	-
	02/09/2014	3.1	Non-Ravensdown product *	570	-	-	-	-	-	-
	18/09/2014	3	BAN-Urea	110	50	-	-	-	-	-
	29/10/2014	3.1	Ban-Urea	276	127	-	-	-	-	-
	30/12/2014	3.2	BAN-HIGH ANALYSIS *	243	-	-	-	-	-	-
	18/02/2015	3.1	NON-RAVENSDOWN PRODUCT *	105	-	-	-	-	-	-
	04/04/2015	3.1	BAN-Urea	91	42	-	-	-	-	-
	01/10/2015	3.1	jzw - AMM SE	169	60	-	-	16	-	-
	27/10/2015	3.1	FODDER BEET	1328	-	24	-	29	436	-
	29/10/2015	3.1	FODDERBEET STARTER	684	17	12	70	9	-	-
	25/10/2016	3.1	WINTON FB BASE MIX 2016	675	68	43	102	37	-	1
	06/12/2016	3.2	4 - 6 WEEK DRESSING	259	78	-	39	-	-	-
	30/04/2018	3.1	UREA BULK	78	36	-	-	-	-	-
	Area weighted total				**836**	**163**	**374**	**166**	**558**	**1**
Marcel #4	05/08/2013	3.2	SMIX	306	63	15	-	19	34	-
	18/10/2013	3.1	MARCEL 1ST CUT	563	103	20	56	25	45	-
	09/12/2013	3.3	MARCEL POST 2ND CUT	490	134	24	61	1	-	-
	23/01/2014	3.2	POST 3RD CUT	649	69	34	62	41	75	-
	17/03/2014	3.2	Urea	73	34	-	-	-	-	-

	02/09/2014	3.2	Non-Ravensdown product *	558	-	-	-	-	-	-
	18/09/2014	3.2	BAN-Urea	119	55	-	-	-	-	-
	29/10/2014	3.2	Ban-Urea	304	140	-	-	-	-	-
	30/12/2014	3.2	BAN-HIGH ANALYSIS *	227	-	-	-	-	-	-
	18/02/2015	3	NON-RAVENSDOWN PRODUCT *	122	-	-	-	-	-	-
	04/04/2015	3	BAN-Urea	94	43	-	-	-	-	-
	01/10/2015	2.8	jzw - AMM SE	168	60	-	-	16	-	-
	27/10/2015	3.2	FODDER BEET	1451	-	26	-	32	476	-
	29/10/2015	3.2	FODDERBEET STARTER	706	18	12	72	9	-	-
	25/10/2016	3.3	WINTON FB BASE MIX 2016	675	68	43	102	37	-	1
	06/12/2016	3.3	4 - 6 WEEK DRESSING	260	78	-	40	-	-	-
	30/04/2018	3.2	UREA BULK	75	35	-	-	-	-	-
	Area weighted total				**871**	**172**	**387**	**175**	**615**	**1**
Marcel #5	05/08/2013	3.4	SMIX	305	62	15	-	19	34	-
	18/10/2013	3.4	MARCEL 1ST CUT	595	109	21	59	26	48	-
	09/12/2013	3.5	MARCEL POST 2ND CUT	467	128	23	58	1	-	-
	23/01/2014	3.6	POST 3RD CUT	678	72	35	65	43	78	-
	17/03/2014	3.4	Urea	75	34	-	-	-	-	-
	02/09/2014	3.6	Non-Ravensdown product *	591	-	-	-	-	-	-
	18/09/2014	3.5	BAN-Urea	112	51	-	-	-	-	-
	29/10/2014	3.4	Ban-Urea	293	135	-	-	-	-	-

	30/12/2014	3.4	BAN-HIGH ANALYSIS *	232	-	-	-	-	-	-
	18/02/2015	3.4	NON-RAVENSDOWN PRODUCT *	110	-	-	-	-	-	-
	04/04/2015	3.5	BAN-Urea	82	38	-	-	-	-	-
	01/10/2015	3.4	jzw - AMM SE	150	53	-	-	14	-	-
	27/10/2015	3.4	FODDER BEET	1307	-	24	-	29	429	-
	29/10/2015	3.5	FODDERBEET STARTER	745	19	13	76	10	-	-
	25/10/2016	3.5	WINTON FB BASE MIX 2016	630	63	40	95	34	-	1
	06/12/2016	3.5	4 - 6 WEEK DRESSING	241	72	-	37	-	-	-
	30/04/2018	3.5	UREA BULK	78	36	-	-	-	-	-
	Area weighted total				**811**	**160**	**366**	**164**	**538**	**1**
Marcel #6	05/08/2013	2.9	SMIX	303	62	15	-	18	34	-
	06/11/2013	2.8	Cropmaster 15	273	41	27	27	21	-	-
	10/01/2014	3	Urea	169	78	-	-	-	-	-
	03/12/2014	3	Non-Ravensdown product *	332	-	-	-	-	-	-
	06/01/2015	3	BAN-Urea	201	92	-	-	-	-	-
	14/10/2015	3.1	Cropmaster 15	410	61	41	41	32	-	-
	17/11/2015	3.1	UREA	218	100	-	-	-	-	-
	02/02/2016	3.1	UREA + 50% POT SUPER	485	74	15	81	18	32	-
	24/03/2016	3	20 POT SUP FLEXI-N	294	33	15	21	19	34	4
	19/08/2016	2.9	MARCEL	344	79	22	33	17	-	-
	30/08/2016	2.9	Urea/Potash	203	64	-	32	-	-	-
	18/10/2016	3.1	Marcel Post 1st cut	448	119	25	38	16	-	-

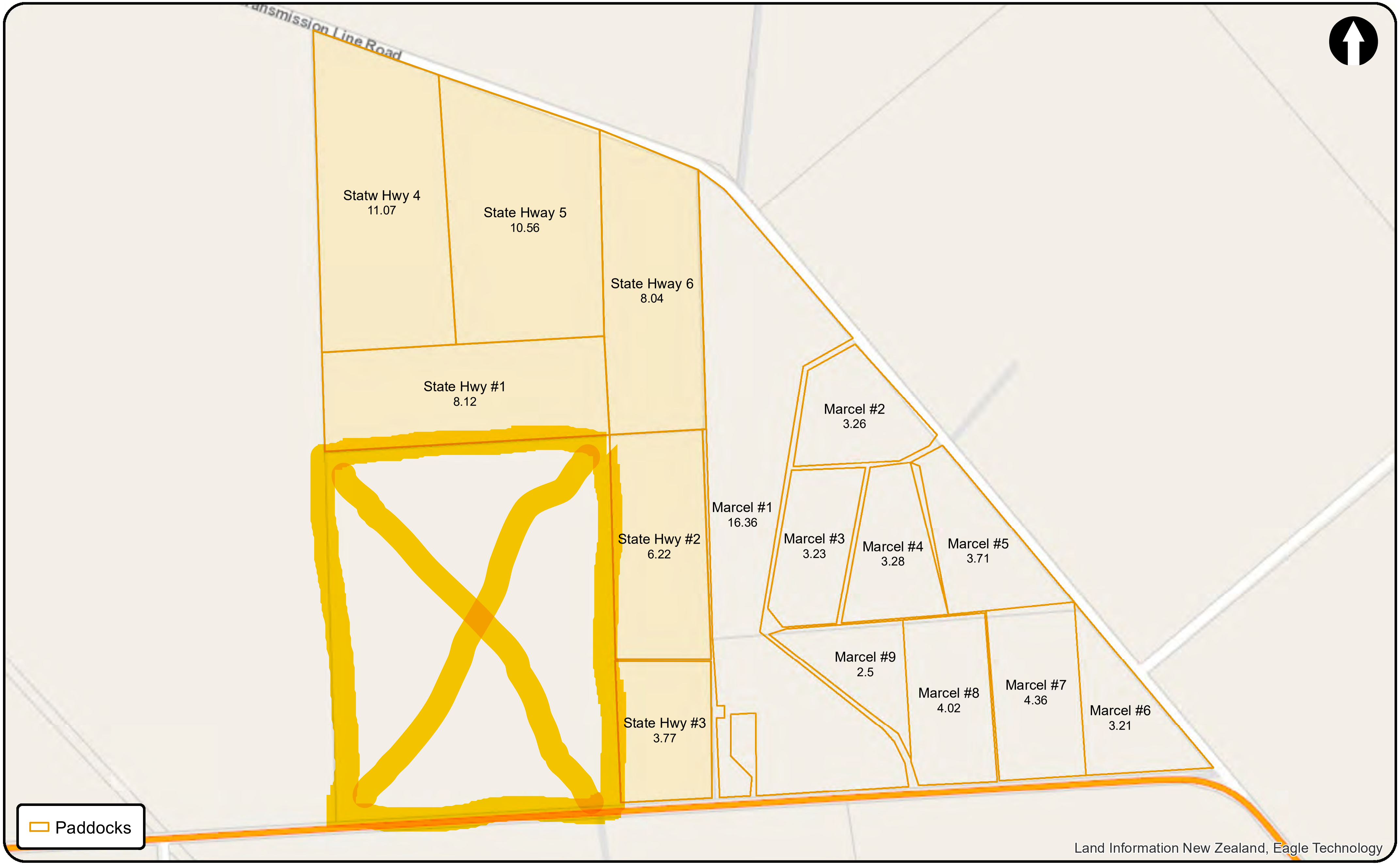
	07/12/2016	3	Marcel post 2nd Cut	357	86	23	34	15	-	-
	30/01/2017	3	Gladfield Post 3rd Cut	237	49	22	32	1	-	-
	21/03/2017	3	Urea	106	49	-	-	-	-	-
	27/09/2017	2.9	CROPMASTER DAP BULK	158	28	32	-	2	-	-
	Area weighted total				**951**	**220**	**319**	**148**	**94**	**4**
Marcel #7	05/08/2013	4.2	SMIX	274	56	14	-	17	30	-
	06/11/2013	3.9	Cropmaster 15	249	38	25	25	19	-	-
	10/01/2014	4.1	Urea	149	68	-	-	-	-	-
	03/12/2014	4.1	Non-Ravensdown product *	304	-	-	-	-	-	-
	06/01/2015	4	BAN-Urea	149	69	-	-	-	-	-
	14/10/2015	4.2	Cropmaster 15	374	56	37	37	29	-	-
	17/11/2015	4.1	UREA	208	96	-	-	-	-	-
	02/02/2016	4.2	UREA + 50% POT SUPER	464	71	14	77	17	31	-
	24/03/2016	4.1	20 POT SUP FLEXI-N	288	32	15	21	18	33	4
	19/08/2016	4.1	MARCEL	332	76	21	32	16	-	-
	30/08/2016	4.1	Urea/Potash	199	63	-	31	-	-	-
	18/10/2016	4.1	Marcel Post 1st cut	394	105	22	33	14	-	-
	07/12/2016	4.1	Marcel post 2nd Cut	328	79	21	31	14	-	-
	30/01/2017	4.1	Gladfield Post 3rd Cut	236	49	21	32	1	-	-
	21/03/2017	4.1	Urea	103	47	-	-	-	-	-
	27/09/2017	4	CROPMASTER DAP BULK	165	29	33	-	2	-	-
	Area weighted total				**879**	**210**	**303**	**139**	**90**	**4**
Marcel #8	05/08/2013	3.8	SMIX	277	56	14	-	17	31	-

	06/11/2013	3.6	Cropmaster 15	265	40	26	26	20	-	-
	10/01/2014	3.8	Urea	158	73	-	-	-	-	-
	03/12/2014	3.8	Non-Ravensdown product *	321	-	-	-	-	-	-
	06/01/2015	3.8	BAN-Urea	157	72	-	-	-	-	-
	14/10/2015	3.9	Cropmaster 15	381	57	38	38	29	-	-
	17/11/2015	3.9	UREA	210	97	-	-	-	-	-
	02/02/2016	3.9	UREA + 50% POT SUPER	469	72	14	78	17	31	-
	24/03/2016	3.8	20 POT SUP FLEXI-N	293	33	15	21	19	34	4
	19/08/2016	3.8	MARCEL	328	75	21	32	16	-	-
	30/08/2016	3.8	Urea/Potash	206	65	-	32	-	-	-
	18/10/2016	3.9	Marcel Post 1st cut	386	103	22	33	14	-	-
	18/10/2016	0.3	Marcel Post 1st cut	355	95	20	30	13	-	-
	07/12/2016	3.9	Marcel post 2nd Cut	336	81	21	32	14	-	-
	30/01/2017	3.9	Gladfield Post 3rd Cut	240	49	22	33	1	-	-
	21/03/2017	3.9	Urea	106	49	-	-	-	-	-
	27/09/2017	3.7	CROPMASTER DAP BULK	174	31	35	-	2	-	-
	Area weighted total				**920**	**219**	**315**	**144**	**92**	**4**
Marcel #9	05/08/2013	2.2	SMIX	292	60	15	-	18	32	-
	06/11/2013	2.2	Cropmaster 15	293	44	29	29	23	-	-
	10/01/2014	2.3	Urea	169	78	-	-	-	-	-
	03/12/2014	2.3	Non-Ravensdown product *	358	-	-	-	-	-	-
	06/01/2015	2.3	BAN-Urea	186	85	-	-	-	-	-
	14/10/2015	2.3	Cropmaster 15	390	58	39	39	30	-	-
	17/11/2015	2.3	UREA	219	101	-	-	-	-	-

	02/02/2016	2.3	UREA + 50% POT SUPER	493	76	15	82	18	33	-
	24/03/2016	2.2	20 POT SUP FLEXI-N	320	36	17	23	20	37	5
	19/08/2016	2.2	MARCEL	334	77	21	32	17	-	-
	30/08/2016	2.2	Urea/Potash	229	72	-	36	-	-	-
	18/10/2016	2.1	Marcel Post 1st cut	435	116	25	37	16	-	-
	18/10/2016	0.5	Marcel Post 1st cut	402	107	23	34	15	-	-
	07/12/2016	2.3	Marcel post 2nd Cut	354	85	22	34	15	-	-
	30/01/2017	2.3	Gladfield Post 3rd Cut	263	54	24	36	1	-	-
	21/03/2017	2.3	Urea	115	53	-	-	-	-	-
	27/09/2017	1.7	CROPMASTER DAP BULK	165	29	33	-	2	-	-
	30/04/2018	0.3	UREA BULK	76	35	-	-	-	-	-
	Area weighted total				**940**	**214**	**322**	**146**	**93**	**4**
Weighted average rate based on applied areas and rates for selected areas					**928**	**229**	**389**	**163**	**314**	**3**

Note: Total and average rates assume product applications cover effective area of paddock(s) selected.
This is dependent on positional accuracy of paddock boundaries

* The product that you have created, is missing nutrient values. This will affect any averages or totals in the Nutrient summary. Please go to the event concerned and add the nutrient values to the appropriate product.



My Ravensdown Smart Maps
www.myravensdown.co.nz
Note: Areas are in hectares
Copyright Ravensdown Ltd

SH96 map

0 55 110 220 330 440 Metres

ravensdown

28 May 2018

Cain Duncan

From:	Kieran Anderson <Kieran.Anderson@ravensdown.co.nz>
Sent:	Thursday, 14 June 2018 11:39 a.m.
To:	Cain Duncan
Cc:	Abe de Wolde
Subject:	Woldwide farms fertiliser - 2013/14 season
Attachments:	Parent Customer Sale Summary (7).xlsx

Gday Cain
Attached is report of fertiliser applied in the 2013/14 season under Woldwide farms which this block (X on map) was under then.
I have highlighted the fertiliser dispatched to the SH96 block which Abe confirmed this area was part of. This part (X) of the SH96 block was bang on 30ha. The numbers highlighted in orange are orders that correspond to 30ha orders (apart from the first order 17.3T). Mixes are as below. I am asking our spreading guys to look back into the archives of the spreading info to confirm these for me.
August mix 17.31T - Spread rate 270kg/ha area 64 ha – this mix would have gone across majority of SH96 block.

- 150kg/ha Superphosphate
- 120kg/ha Urea

October mix 11.5T - Spread rate 380kg/ha area 30ha – (the other 24T order on this month was at spread rate 500kg/ha – 48ha, so again the rest of the SH96 block)

- Urea 180kg/ha
- DAP 80kg/ha
- Potassium Chloride 100kg/ha

December mix 50.03T – spread rate 860kg/ha

- Lime 500kg/ha
- Urea 180kg/ha
- DAP 80kg/ha
- Potassium Chloride 100kg/ha

January mix 11.11T – Spread rate 370kg/ha

- Superphosphate 150kg/ha
- Urea 120kg/ha
- Potassium Chloride 100kg/ha

Hopefully this makes sense. Any questions let me know.

Cheers Kieran

Parent Customer Sale Transactions

	customer	Item #	Item Description	UOM	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
					2013/14										
					Quantity										
TOTAL	**60848385**	**DE WOLDE GROUP HOLDING ACCOUNT**			**1**	**52**	**6**	**102**	**18**	**56**	**25**	**13**	**15**	**31**	**319**
Parent	**60848385**	**DE WOLDE GROUP HOLDING ACCOUNT**			**1**	**52**	**6**	**102**	**18**	**56**	**25**	**13**	**15**	**31**	**319**
	60842383	WOLDWIDE FARM LTD - DE WOLDE A & J J			**1**	**52**	**6**	**102**	**18**	**56**	**25**	**13**	**15**	**31**	**319**
		0001930	SODIUM CHLORIDE G22 COARSE SI	MT			1.20								1.20
		3004600	CROPMASTER DAP BORATE 46 BULK	MT					3.60	0.60					4.20
		4300000	UREA BULK	MT	0.50		4.30		14.52		2.61		14.81	4.45	41.19
		9343953	tzd - HORNER BLOCK	MT		34.67									34.67
		9343954	tzd - STATE HIGHWAY 96	MT		17.31									17.31
		9351967	SH96 Post 1st cut + Selinium	MT				24.01							24.01
		9352418	Barley Starter	MT				14.51							14.51
		9353255	SH96 Post 1st cut + Selinium	MT				11.50							11.50
		9353256	Post 1st Cut + Se	MT				41.12							41.12
		9353266	Marcel post 1st cut + Se	MT				7.00							7.00
		9353948	Barley Starter	MT				3.71							3.71
		9362544	Marcel Post 2nd Cut	MT						5.60					5.60
		9362546	Post 2nd Cut	MT						50.03					50.03
		9367391	SH96 Post 3rd Cut	MT							11.11				11.11
		9367406	Marcel Pasture - Post 3rd Cut	MT							7.33				7.33
		9367681	JXR - turnip mix pdk 8	MT							3.90				3.90
		9369651	EX WHOLE CROP FEB 2014	MT								13.29			13.29
		9374524	UNDER SOWN HORNERS CROP	MT										9.15	9.15
		9374532	EX BARLEY S.H.96	MT										17.71	17.71

My Ravensdown Smart Maps
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Note: Areas are in hectares

Woldwide Horner Block

0 45 90 180 270 360 Metres

ravensdown

26 July 2018

Nutrient summary report

WOLDWIDE FARM LTD - 60842383

Query range : 01 Jun 2016 to 26 Jul 2018

Name	Date	Area (ha)	Product	Rate (kg/ha or l/ha)	N kg/ha	P kg/ha	K kg/ha	S kg/ha	Ca kg/ha	Mg kg/ha
Paddock 1	18/08/2016	10.5	HORNER BLOCK	286	81	23	-	18	-	-
	31/08/2016	10.5	UREA	73	34	-	-	-	-	-
	11/10/2016	10.8	super / urea	408	70	23	-	28	51	-
	11/10/2016	10.9	Ag Lime	1069	-	-	-	-	385	-
	09/12/2016	10.4	SH96/Horner 2nd Post Cut	231	36	13	-	16	29	5
	31/01/2017	10.5	Gladfield Post 3rd Cut	241	50	22	33	1	-	-
	23/03/2017	10.7	UREA BULK	108	50	-	-	-	-	-
	15/08/2017	9.9	AMMO36 + SE	167	59	-	-	16	-	-
	07/09/2017	10.5	UREA BULK	108	50	-	-	-	-	-
	26/10/2017	8.8	Ag Lime	1545	-	-	-	-	556	-
	31/10/2017	10.5	POST DRESS CUT	387	103	22	33	14	-	-
	15/12/2017	10.6	GLadfield post 2nd Cut	336	81	21	32	13	-	-
	15/01/2018	10.3	UREA / SOA / KCL	217	61	-	27	12	-	-
	06/03/2018	10.6	POST HARVEST MIX	328	80	22	44	1	-	-
	09/04/2018	10.9	UREA BULK	118	54	-	-	-	-	-
	Area weighted total				**687**	**124**	**143**	**101**	**802**	**4**
Paddock 2	18/08/2016	39.2	HORNER BLOCK	271	77	22	-	17	-	-
	31/08/2016	38.7	UREA	71	32	-	-	-	-	-
	11/10/2016	39.7	super / urea	377	65	21	-	26	47	-

	12/10/2016	35.9	AGLIME	1045	-	-	-	-	376	-
	09/12/2016	38.9	SH96/Horner 2nd Post Cut	212	33	12	-	15	27	4
	31/01/2017	38.7	Gladfield Post 3rd Cut	234	48	21	32	1	-	-
	23/03/2017	39.8	UREA BULK	104	48	-	-	-	-	-
	15/08/2017	38	AMMO36 + SE	164	59	-	-	16	-	-
	07/09/2017	39.3	UREA BULK	106	49	-	-	-	-	-
	26/10/2017	3.2	AGLIME	1594	-	-	-	-	574	-
	26/10/2017	16.3	Ag Lime	1587	-	-	-	-	571	-
	26/10/2017	18.8	Ag Lime	1565	-	-	-	-	563	-
	15/01/2018	38.8	UREA / SOA / KCL	210	59	-	26	12	-	-
	06/03/2018	39.8	POST HARVEST MIX	312	76	21	42	1	-	-
	06/03/2018	0.1	POST HARVEST MIX	327	79	22	44	1	-	-
	10/04/2018	39.9	UREA BULK	107	49	-	-	-	-	-
	Area weighted total				**571**	**93**	**96**	**83**	**932**	**4**
Paddock 3	18/08/2016	95.1	HORNER BLOCK	268	76	21	-	16	-	-
	31/08/2016	96.2	UREA	70	32	-	-	-	-	-
	07/10/2016	46.4	SH96/Horner 1st Post Cut	379	59	21	-	26	47	7
	07/10/2016	49.2	SH96/Horner 1st Post Cut	395	61	22	-	27	49	8
	07/10/2016	38.5	Ag Lime	1027	-	-	-	-	370	-
	11/10/2016	18.6	Ag Lime	1060	-	-	-	-	382	-
	09/12/2016	96.2	SH96/Horner 2nd Post Cut	215	33	12	-	15	27	4
	31/01/2017	27.7	Gladfield Post 3rd Cut	228	47	21	31	1	-	-

	31/01/2017	67.2	Gladfield Post 3rd Cut	241	50	22	33	1	-	-
	23/03/2017	98.2	UREA BULK	105	48	-	-	-	-	-
	15/08/2017	37.6	AMMO36 + SE	159	57	-	-	15	-	-
	15/08/2017	57.9	AMMO36 + SE	160	57	-	-	15	-	-
	07/09/2017	97.7	UREA BULK	105	48	-	-	-	-	-
	26/10/2017	97.9	AGLIME	1564	-	-	-	-	563	-
	31/10/2017	3.3	POST DRESS CUT	378	101	21	32	14	-	-
	29/11/2017	93.2	SUL FLE POT	433	54	23	16	40	52	7
	15/12/2017	3.5	GLadfield post 2nd Cut	338	82	21	32	13	-	-
	15/01/2018	18.5	UREA / SOA / KCL	205	57	-	26	12	-	-
	15/01/2018	78.7	UREA / SOA / KCL	209	59	-	26	12	-	-
	06/03/2018	11	POST HARVEST MIX	306	74	20	41	1	-	-
	06/03/2018	87.1	POST HARVEST MIX	316	77	21	42	1	-	-
	09/04/2018	27.2	UREA BULK	107	49	-	-	-	-	-
	09/04/2018	37.7	UREA BULK	110	50	-	-	-	-	-
	09/04/2018	19.8	UREA BULK	109	50	-	-	-	-	-
	10/04/2018	8.6	UREA BULK	101	46	-	-	-	-	-
	Area weighted total				**623**	**117**	**115**	**122**	**885**	**18**
Weighted average rate based on applied areas and rates for selected areas					**614**	**111**	**112**	**110**	**891**	**13**

Note: Total and average rates assume product applications cover effective area of paddock(s) selected.
This is dependent on positional accuracy of paddock boundaries

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Woldwide One Limited and *Woldwide Two Limited*

(WW1&2)

Farm Environmental Management Plan – Appendix N

Version 1.4

1 June 2019 – 31 May 2020

A **Phosphorus Mitigation Plan** prepared by Mr. Cain Duncan (CNMA), Tiaki, Farm Source Sustainable Dairying, forms part of this FEMP. The plan provides specific details regarding on-farm features, mitigation actions and target implementation dates.

Table of Contents

1 Property details

Name	Woldwide One Limited and Woldwide Two Limited (WW1&2)
Physical address	Hundred Line Road East, Heddon Bush, Southland
Description of landholding ownership	The landholding is owned by Woldwide One Limited, Woldwide Two Limited, Dykes (leased) and Woldwide Farm Limited (leased). Woldwide Farm Limited owns the Horner Block.
Landholding owner's details	A and JJ de Wolde 104 Shaws Trees Road, Heddon Bush, RD3 Winton, 9783
Contact Person:	WW1 unit - Jacques Jooste - 027-4554550 WW2 unit- Hamish (Dusty) Wright: 021-440006
Legal Descriptions (WW1&2):	Part Lot 18 DP 942 Section 420 Taringatura SD Part Lot 1 DP 4092 Part Lot 18 DP 942 Part Lot 2 DP 4092 Part Lot 1 DP 4092 Part Section 417 Taringatura SD Section 418 Taringatura SD Section 419 Taringatura SD Lot 1 DP 9925 Lot 1 DP 14660 Lot 1 DP 14661 Lot 1 DP 451158 Lot 1 DP 13077 Lot 1 DP 5610 Lot 3 DP 5610 Lot 1 DP 10885
Horner Block*	Lot 4 DP399915
Land Areas:	Milking platform – 502 hectares (479 ha effective) Horner block 97 ha – slurry discharge only
Resource Consents:	Discharge consent **301663** – expiry 9/11/27 Water permit **301664** – expiry 9/11/27 Discharge consent **300626-V2** – expiry 2/12/21 Water permit **300627-V1** – expiry 2/12/21

	WW2 also holds a discharge consent (20171278-01), water permit (20171278-02) and land use consent for expanded dairy farming (20171278-03). All expire on 18/11/27 *Note: the consent holder in future consents will be "Woldwide One Limited and Woldwide Two Limited."*

*The Horner Block is a nearby cut and carry block, where slurry from the dairy platform is applied at very low depth. It is included in this FEMP for completion, although no stock is grazed there.

This document is designed to be a living document and should be updated at least yearly.

2 Maps

2.1 Accompanying notes to maps

- WW1&2 dairy platform lies north of Hundred Line Road East Road and north and south of Wreys Bush Highway.
- Stock access to land north of Wreys Bush Highway is via an underpass.
- The Horner Block, which is a cut and carry block receives slurry effluent from the dairy platform, lies to the south west of the platform.
- Topography is very flat and soils are well developed. There are minimal critical source areas. CSAs are identified, described and evaluated in the appended Phosphorous Mitigation Plan.
- Waterways are best described as surface drains, are fully fenced and flow in a north to south/south east direction.
- All crossings are culverted; stock do not have access to surface waterways. Locations where lanes cross drains are managed as critical source areas to minimise runoff from tracks and lanes into surface waterways. Further description is provided in the appended Phosphorous Mitigation Plan.
- The location, position and outfall of subsurface drainage is indicated in respective maps. The relative depth of subsurface drainage is drainage is c.800 mm. Subsurface drainage occurs in areas where Braxton soils are found. Drummond/Glenelg soils are free draining and do not have subsurface drainage installed.
- Major infrastructure includes two dairy sheds & yards, two wintering barns, two slurry effluent storage ponds, two silage pads and a stock underpass.

2.2 WW1&2 boundary

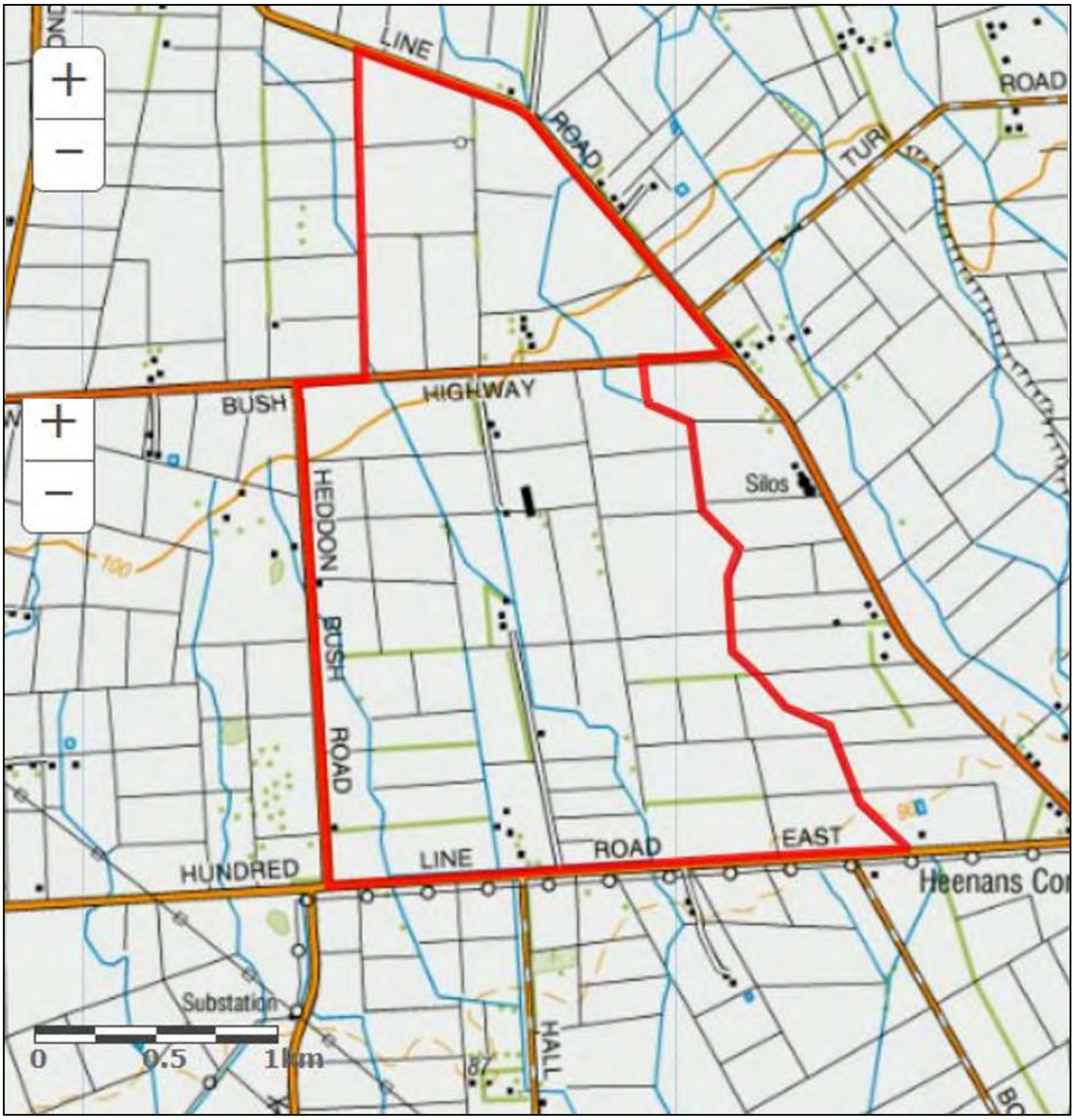


Figure 1a. WW1&2 boundary

Figure 1b. Horner Block boundary

2.3 Waterways, Stock Crossings

Figure 2. Waterways and crossings (Source: Tiaki – Phosphorous Mitigation Plan)

2.4 Critical source areas (CSAs)

For location and descriptions, please the appended Tiaki Phosphorous Mitigation Plan.

2.5 Physiographic Zones

WW1&2 and the Horner Block overlie Oxidising and Central Plains Physiographic Zones.

Figure 3. WW1&2 - PZs

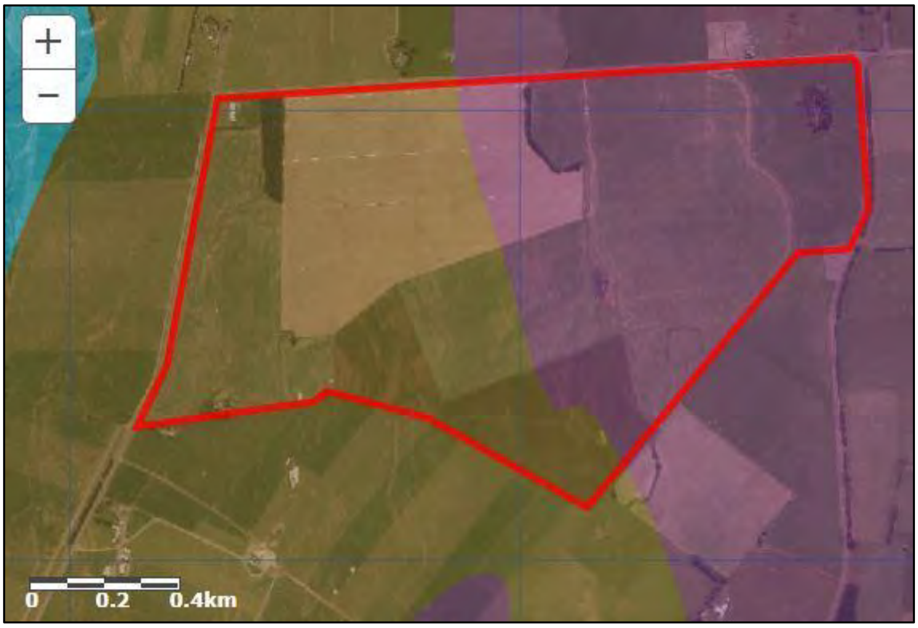


Figure 4. Horner Block - PZs

Physiographic Zones

- Alpine - No Variant
- Bedrock/Hill Country - Artificial Drainage
- Bedrock/Hill Country - No Variant
- Bedrock/Hill Country - Overland Flow
- Central Plains - No Variant
- Gleyed - No Variant
- Gleyed - Overland Flow
- Lignite - Marine Terraces - Artificial Drainage
- Lignite - Marine Terraces - No Variant
- Lignite - Marine Terraces - Overland Flow
- Old Mataura - No Variant
- Oxidising - Artificial Drainage
- Oxidising - No Variant
- Oxidising - Overland Flow
- Peat Wetlands - No Variant
- Riverine - No Variant
- Riverine - Overland Flow
- Urban Area

2.6 Tile drains

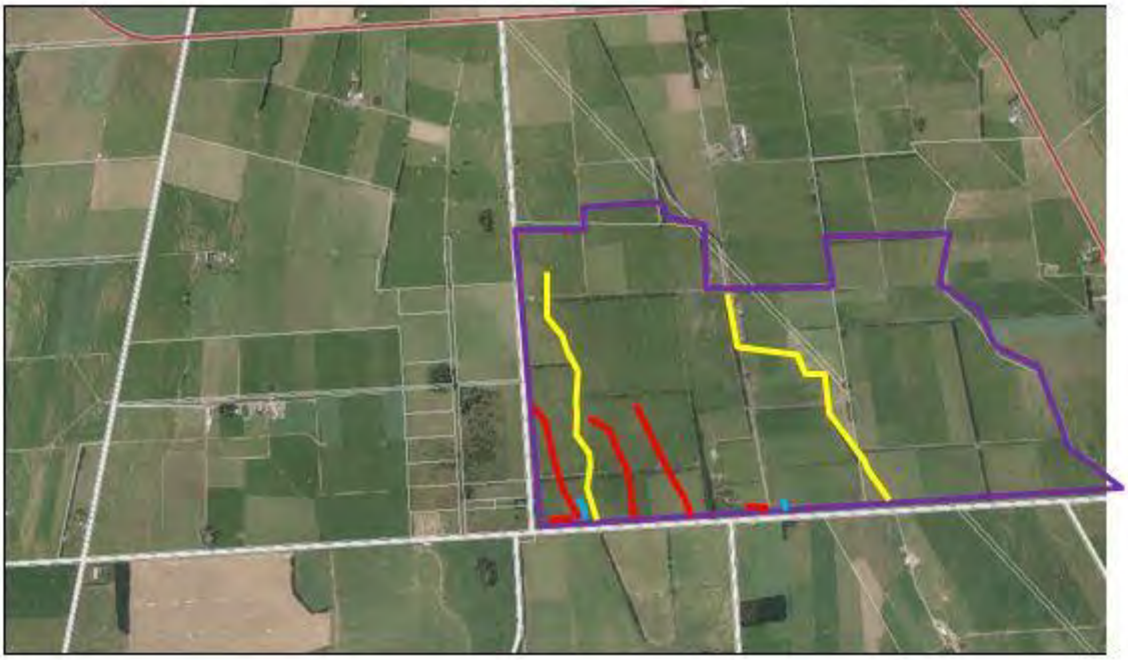


Figure 5. Tile drain locations at WW1 unit (annotated with red lines)

Figure 6. Tile drain locations at WW2 unit (annotated with red lines)

Figure 7. Tile drains at Horner Block (annotated with red line)

2.7 Riparian Vegetation and Fencing

Streams and drains flow in a north to south/south east direction. All streams and drains are fenced off to ensure cows cannot enter the waterways.

2.8 Heritage

There are no known or recorded heritage sites.

2.9 Significant Indigenous Biodiversity

There are no known or recorded sites of significant indigenous biodiversity.

2.10 Soils

The soil types and areas shown on Topoclimate appear to be incorrect, John Scandrett (Scandrett Rural Limited) carried out a field investigation and has mapped the soil as shown in Figure 8.

The soils for the Horner block have been obtained from the Topoclimate layer in Environment Southland’s Beacon mapping service. The Horner block has Braxton/Pukemutu, Drmmond/Glenelg and Waiau soils as shown in Figure 9.

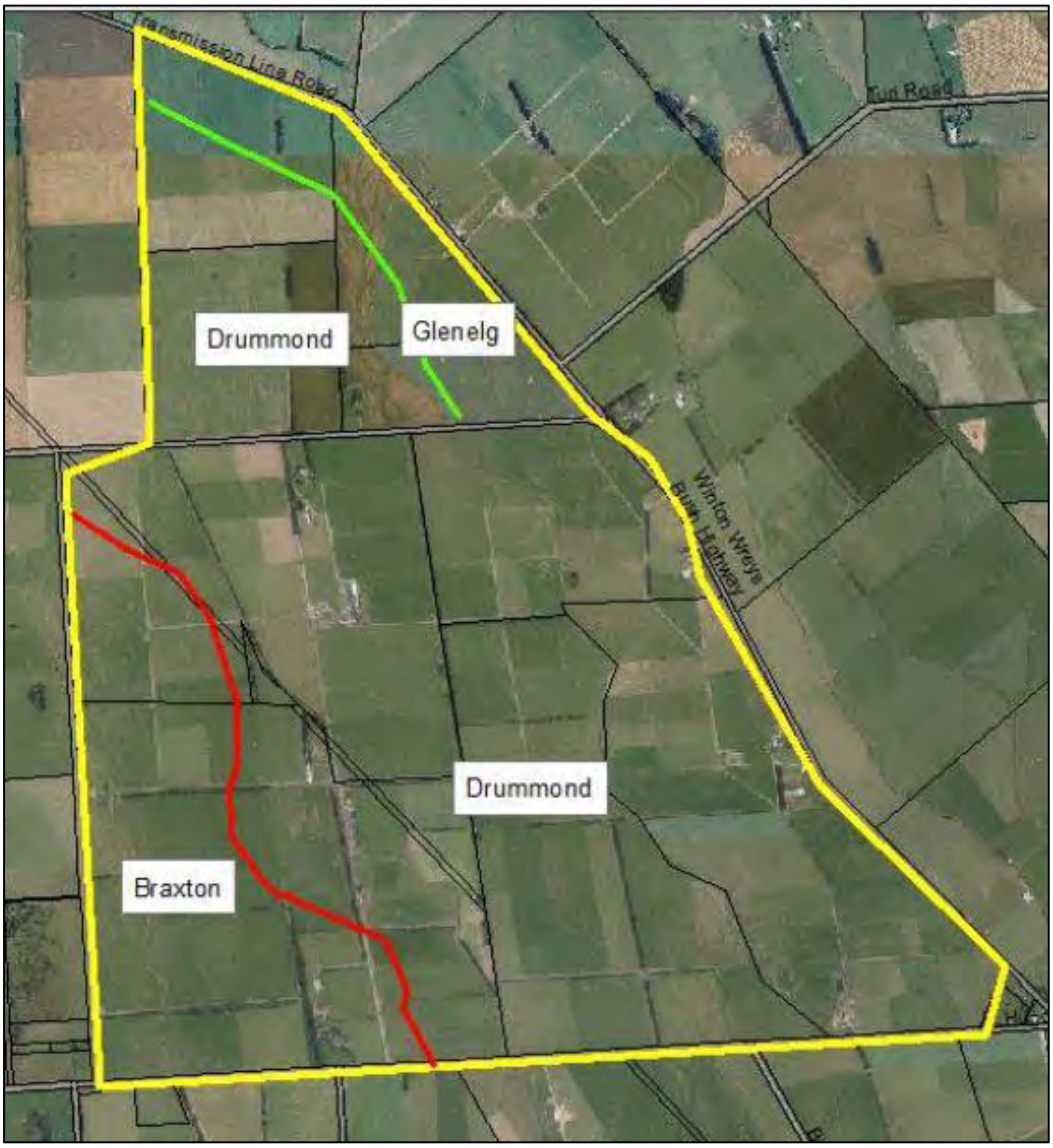


Figure 8. Soil types and boundaries at the WW1&2 according to field investigation by J. Scandrett, January 2017. Map sourced from Environment Southland.

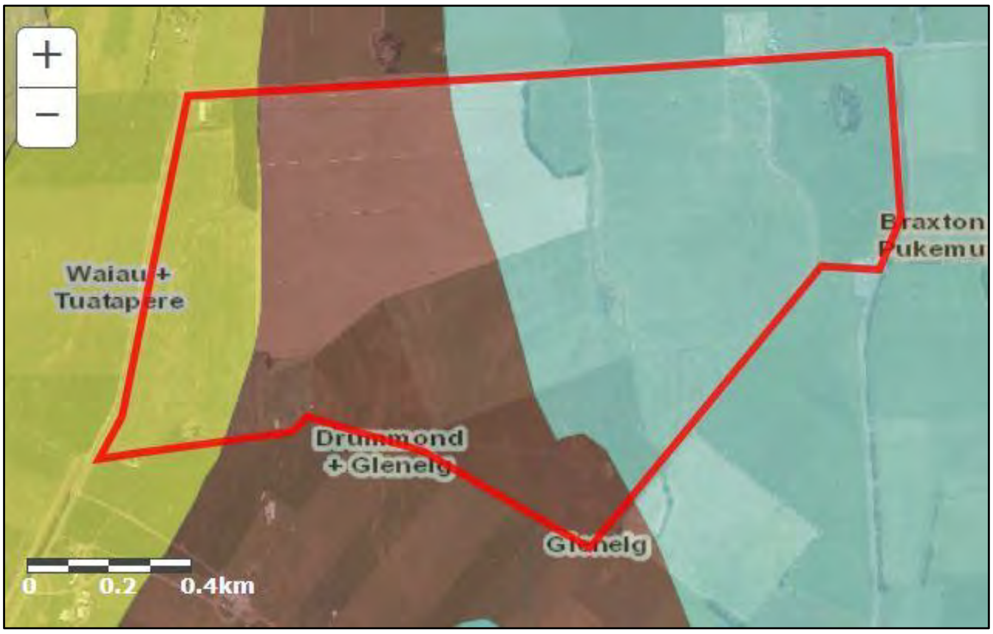


Figure 9. Soil types at the Horner Block

The vulnerability of the soils on the property are shown in Table 1.

Table 1: Vulnerability of soils at WW1&2 and Horner Block

Soil type	Compaction	Nutrient Leaching	Erodibility	Organic Matter Loss	Waterlogging
Braxton	Moderate	Slight	Slight	Slight	Severe
Drummond	Minimal	Moderate	Minimal	Slight	Slight
Glenelg	Slight	Very severe	Minimal	Moderate	Nil
Waiau	Moderate	Very severe	Slight	Moderate	Nil

3 Nutrient Management

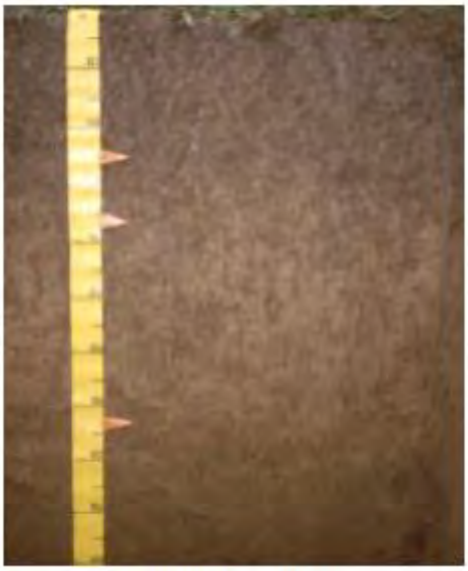
3.1 Soils and Properties

The dominant soil types are Braxton (found on the west of the dairy platform and at the Horner Block) and Drummond types (mid to east on the dairy platform and at the Horner Block). Drummond soils may have intergrades to Glenelg soils in places. Glenelg soils are found at the north east of the dairy platform.

Drummond Soils

Drummond soils have deep potential rooting depth, with no major rooting restriction. The soils are well drained, have good aeration, and high plant available water. Textures are generally silty clay to heavy silt loam, with topsoil clay content of 35– 40%. The moderately deep phase will have gravels below 45cm depth, resulting in less rooting depth and available water.

Topsoil organic matter levels are 8–11%; P-retention values 40–70%; pH values usually above 5.7 in all horizons; cation exchange values and base saturation medium to high. Natural levels of phosphorus, potassium and magnesium are moderate, with responses to P and K occurring in intensive farming operations. Micro nutrient levels are generally adequate.



Drummond profile

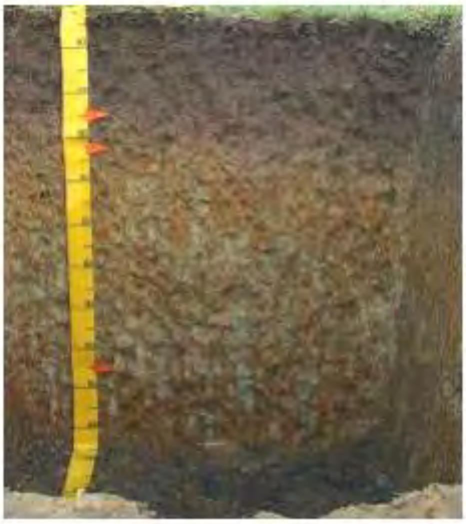
Figure 10. Drummond soil profile.

Braxton Soils

Braxton soils have a deep rooting depth and high available soil water, although the rooting depth may be limited by poor aeration during wet periods due to the poor drainage and slow subsoil permeability. Mottles occur in all horizons – another indication of poor drainage. Texture varies between heavy silt loam and silty clay in the subsoil, and silt loam topsoil clay content is 22–30%. The soils are typically stone-free, although the moderately deep phase will have gravel between 45 and 90cm depth.

Topsoil organic matter levels range from 7 to 10%; P-retentions 30–60%, with moderate pH values (5.5–6.2) that change little down the profile. Cation exchange values are moderate and base saturation values high. Available magnesium and potassium are low. Reserve phosphorus values are low. Micro-nutrient levels are generally adequate, although boron responses in brassicas and molybdenum responses in legumes are likely.

Braxton soils have swell/crack properties. They can become waterlogged in wet conditions so tend to have subsurface drainage installed. They can crack during dry summer conditions. Deep cracks can provide a pathway for contaminants to reach groundwater via bypass drainage to the underlying aquifer.



Braxton profile

Figure 11. Braxton soil profile.

Glenelg Soils

Rooting depth in Glenelg soils is restricted to varying degrees, depending on the gravel content and depth to the cemented pan in the subsoil. Plant available water varies from moderate to low depending on the quantity of gravel present. Textures are loamy silts and silt loams grading to sandy loams and sand. Topsoil clay content is 15–25%. Gravel occurs throughout the profile, with gravel content often above 70% in the subsoil.

Topsoil organic matter levels are 10–16%; P-retention values 50–75% and pH values moderate. Cation exchange vales are high in the topsoil but decrease down the profile with base saturation values low. Available calcium, magnesium and potassium are low, as is reserve phosphorus and sulphur. Micro-nutrient levels are generally adequate.

Figure 12. Glenelg soil profile.

Waiau Soils

Waiau soils have a moderate to slightly deep rooting depth, depending on the gravelness of the subsoil. Plant available water will vary from moderate to low depending on the amount of gravel present. The soils are well drained (sometimes excessively) and aerated. Textures are usually silt loams to sandy loams in the topsoil, grading to sand in deeper horizons, with topsoil clay content of 20–28%. Topsoils often are slightly too moderately gravelly, and moderately to extremely gravelly below.

Topsoil organic matter content is 8–13%, P-retention 40–70% and pH moderate (high 5s). Cation exchange levels are moderate, but low in the subsoil, with base saturation levels similar. Reserve calcium levels are high, magnesium levels moderate and potassium levels low. Soil reserve phosphate and sulphur levels are low. Micronutrient levels are generally adequate.

Figure 13. Waiau soil profile.

Plant Available Water (PAW)

The PAW in the top 30 cm of the soil profile values for the soils have been obtained from the Landcare SMap database and are provided in Table 2.

Table 2: PAW values

Soil Type	PAW_{30}
Braxton	92 mm
Drummond	146 mm
Glenelg	53 mm
Waiau	50 mm

3.2 Environmental Management Actions

To mitigate the potential loss of nutrients the following actions will be implemented:

i. Soil and herbage testing to monitor soil chemistry and inform on decisions regarding fertiliser and lime application to maintain optimum soil fertility levels. Testing should be annual until an understanding and trends have been established;

ii. Fertiliser and lime management plan prepared annually with guidance from Overseer output reports;

iii. Exclude stock from streams;

iv. Monitor soils for the formation of cracks, particularly deep cracks that can form in Braxton soil types in dry summer conditions. If and where deep cracks form avoid grazing stock and discharging effluent to the area;

v. Tracks and lanes sited away from streams where possible. Lanes constructed and maintained to divert run off away from potential waterway ingress. Water tables will be designed to shed water to pasture for riparian treatment;

vi. Effluent application depth is managed for optimum use of nutrients;

vii. Stock will be managed in a placid manner to reduce the collection of effluent at the dairy shed; and

viii. Winter cows off paddocks in barns. Use barns in the shoulders of the season to avoid soil compaction/runoff and optimise nutrient management.

3.3 Fertiliser Application Best Management Practices

The following practices will be implemented:

i. The spreaders used to apply fertiliser are 'Spread Mark' accredited and have Tracmap or a similar recording system to show proof of placement;

ii. Buffer distances are maintained such that there is no direct contamination of waterways from the application of fertiliser;

iii. A minimum 10 m buffer between fertiliser placement and waterways is maintained when there is no riparian strip with a minimum 5- metre setback at all times;

iv. Fertiliser is not applied to saturated soils;

v. Nitrogen-containing fertilisers are only applied to actively growing pastures;

vi. Fertiliser is not applied from 1 June to 31 July, and only in the months of May and August when soil temperature and moisture conditions are suitable;

vii. Fertiliser is not applied when or where air drift can occur beyond the farm boundaries;

viii. The need for large fertiliser dressings will be achieved through split dressings rather than a single application; and

ix. Observe 'The Code of Practice for Nutrient Management (With Emphasis of Fertiliser Use)' Fertiliser Association, 2013, ISBN 978-0-47328345-2'.

Note: The application of fertilisers is deemed a permitted activity by Environment Southland provided:

- Application must not occur within 30 m of a neighbouring residential unit without approval. Spray drift must also be minimised.

- There must be no direct discharge to water and no discharge when soil moisture exceeds field capacity. For permanently flowing waterbodies (including artificial drains), fertiliser in riparian plantings where stock is excluded can only be applied to establish the planting. If there is no riparian planting, a setback of 10 m is required.

3.4 Effluent Application Best Management Practices

To mitigate the potential effects of the discharge of effluent to land the following practices will be implemented:

i. Effluent nutrient concentrations have been tested and apply the depth that corresponds with the nutrient content of the effluent. This accounts for the higher strength nature of pond slurry compared to dairy shed effluent;

ii. The soil test values for the paddocks receiving effluent will be considered and the depth of application adjusted to suit;

iii. Defer irrigation where soil and climatic conditions are unsuitable for irrigation;

iv. At all times the management of the effluent system will comply with the discharge consent conditions, including annual N loadings per hectare at the dairy platform and the Horner Block;

v. Low depth application effluent irrigation systems and deferred storage are utilised. Very low depth application of pond slurry (1.7 mm per application) is achieved by applying slurry with the slurry tanker with the trailing shoe, at a rate of 17.2 m^3/hectare;

vi. Apply slurry at a maximum depth of 2.5 mm per application by applying 25 m^3 per hectare;

vii. Do not apply effluent to areas prone to cracking in dry summer periods. Braxton soils, with swell crack characteristics, are found on the western part of WW1&2 and at the east of the Horner Block. Monitor Braxton areas for signs of cracking and avoid if and where there is evidence of cracks;

viii. Buffer distances in the discharge consent will be followed;

ix. 7 -10 days post grazing before liquid effluent application;

x. Application of sludge solids – less than 10 mm depth to suitable ground, with consideration of climate conditions;

xi. Apply maintenance rates of nutrient to a large area rather than load up a smaller area with all the effluent/nutrient;

xii. Do not use the slurry tanker when there is risk of soil compaction due to its weight; instead employ the service of an umbilical system contractor;

xiii. Carry out maintenance on effluent management systems regularly; and

xiv. Implement, review and update an effluent management plan.

3.5 Potential Nutrient Loss Effects of Dairying

Nutrient budgets were prepared in OverseerFM Version 6.3.1 by Mr. Cain Duncan, Tiaki Fonterra, Certified Nutrient Advisor, in accordance with the latest version of the OVERSEERFM Guidance/Best Practice Data Input Standards.

Four nutrient budgets were prepared to reflect actual lawful use of land over 4 prior years at WW1&2. One nutrient budget has been prepared for the proposed farming system should consent be granted.

A nutrient budget analysis report has been prepared by Mr. Duncan and is available for review. Please refer to the report for an analysis of nutrient losses, including inputs and outputs. Nutrient budgets are available in Overseer FM for review.

A summary of the nutrient loss from Overseer calculations is provided in Table 3.

Table 3: Nutrient loss summary for WW1&2

Indices	WW1&2 – pre-expansion average over 4 years	WW1&2 - proposed	% change
N loss to water (kg/ha/y)	41	38	-7.3
N loss to water (kg/y)	20,427	18,938	
P loss (kg/ha/y)	0.7	0.7	-2.2 (-6.1)
P loss (kg/y)	360	352 (338)*	
Pasture production (kg DM/ha/y)	15,109	15,513	

*Additional P reductions calculated outside of Overseer (See Phosphorus Mitigation Plan)

3.6 Key mitigation measures

Should consent be granted, the proposed farming system will be implemented, which is expected to achieve a reduction in N and P loss on average compared to prior land use at the landholding.

Key drivers for the 7.3% reduction in nitrogen loss are:

- Removal of winter and summer crop
- Removal of cows & young stock wintered outside on crop or grass
- Expansion of the size and use of the wintering barn facilities
- More efficient use of nitrogen fertiliser

Key drivers for the 2.2% reduction in phosphorus loss are:

- Decrease in winter crop area
- Maintaining Olsen P at a target level of 30
- Expansion in the size and use of the wintering barn facilities (less wintering)

Additional P mitigation is proposed, which has calculated outside Overseer. This increases the level of P mitigation up to 6.1%. Please see WW1&2's Phosphorous Mitigation Plan for details of measures.

3.7 The Effect of Effluent Application

Effluent will be applied to the best suited soil types and topography based on time of the year, e.g. soil moisture conditions, climate conditions and pasture growth.

Account for the higher strength nature of slurry effluent when applying slurry, applying no more than 25 m^3/ha as a control to approximately 400 hectares available at WW1&2 and Horner Block.

3.8 Deep drainage of nitrogen – cracking and fissures

To reduce the occurrence of deep drainage of nitrogen and microbes, the formation of deep cracks and fissures will be prevented as much as possible. This will be achieved by:

- Maintaining a high level of pasture cover;
- Discharging effluent little and often to prevent soil from drying out and cracking.

Before each effluent application or stock grazing event, a visual assessment will be carried out to check for any cracks in the soil. If cracks do occur, the areas with cracking will be avoided and/or the activity will be moved to another part of the property where there are no cracks.

If there are substantial cracks and no areas suitable to discharge effluent, then effluent will be stored until the soil moisture level improves and cracking disappears. Given the cracks are likely to occur after prolonged dry periods in the summer, the effluent storage facility is likely to provide adequate storage volume for these events.

4 Good Management Practices

4.1 Land

Key strategies to achieve this objective:

i. Fence off all waterways;

ii. Maintain riparian vegetation;

iii. Always maintain good pasture coverage. Plant roots help to prevent soils from cracking during dry summer periods and help to avoid the formation of deep cracks;

iv. Soil test regularly and operate a fertiliser management plan;

v. Exclude stock from high risk critical collection source areas and swales when the soil is near or at field capacity. Where necessary, increase setbacks and fence off CSAs;

vi. Carry out maintenance on crossings and culverts to ensure runoff to waterways in minimised and there are no blockages;

vii. Ensure adequate buffer zones from waterways during tillage;

viii. Maintain sustainable stocking rate; and

ix. Stock management to avoid excessive pugging over high-risk months, e.g. winter cows in barn, use barns in the shoulders of the season.

4.2 Effluent and Nutrients

Key strategies to achieve this objective:

i. Prepare, implement and monitor a Nutrient Management Budget to maximise the returns and minimise losses from the resource, particularly N, P and K;

ii. Controlled, judicious and justifiable use of fertiliser and other imported nutrients including nutrients in supplementary feed;

iii. Implement an effluent management plan;

iv. Subject to soil moisture and weather conditions, irrigate effluent at every practical opportunity to keep storage ponds as empty as possible;

v. Ensure that all appropriate staff are trained and competent in the effluent system operation, and are aware of the need to continuously monitor the effluent management system, the farm's drainage networks and the potential for Braxton soil types to develop cracks;

vi. Record each application of dairy effluent, including the location of travelling irrigators and the depth applied;

vii. Record each application of slurry effluent, including paddock number and quantity (and depth) applied. Apply a standard depth if possible;

viii. Ensure by regular and programmed checks that the supporting effluent infrastructure is in good condition, is inspected regularly and maintained under a preventative maintenance schedule;

ix. Ensure by regular inspection (that coincides with effluent application) that the farm's drains do not contain any obvious signs of dairy effluent contamination; and

x. Remain alert to new and emerging technologies that can be incorporated into the system to reduce risk, improve environmental and farm outcomes, whilst reducing input efforts and costs.

4.3 Physiographic Zones and Transport Pathways

Physiographic zones are shown on a map in figures 3 and 4. These zones have the potential for N and P to leach to waterways and groundwater through artificial drainage, deep drainage and overland flow (to a lesser extent) as shown in Table 4. Good Management Practices for these transport pathways are listed in section 4.6.

Table 4: Physiographic zones and transport pathways

Physiographic Zone	Variant	Key Transport Pathway
Central Plains	N/A	Artificial drainage, deep drainage
Oxidising	N/A	Deep drainage, overland flow

Note: Due to the flat topography, overland flow is not deemed to be a particular risk for soils except close to waterways and around CSAs following periods of prolonged, heavy rain.

4.4 Review

General good management practices and those specific to the transport pathways to be implemented in the current year are contained in the tables in sections 4.5 and 4.6. These good management practices will be reviewed annually as part of the overall review of the Farm Environmental Management Plan.

4.5 General Good Management Practices

A policy of general good management practice has been implemented since 3 June 2016. Most of the practices are described in the table 5 below have been implemented since 3 June 2016.

However, some practices described in table 5 have not been fully implemented since 3 June 2016:

*Not all cows have been wintered off paddocks in barns since 3 June 2016;

*IWG on fodder crop has occurred since 3 June 2016;

*Young stock has been grazing on farm since 3 June 2016, including IWG.

* Some individual features (e.g. lanes, CSAs) and locations have been identified in the Tiaki Phosphorous Mitigation Plan as requiring mitigation. Please refer to the plan for details, including target implementation dates.

A policy of good management practice will be undertaken on farm over the coming 12-month period (see table 5). All policies will be reviewed in June 2020

Table 5. General good management practices (1 June 2019 – 31 May 2020).

Strategy Type	Summary of Management Practices
Capital	Fence and enhance riparian areas;
	Upgrade FDE handling equipment as new technology improves the utility and reduces risks of these systems.

Strategy Type	Summary of Management Practices
Operational	Utilising a nutrient management plan;
	Soil testing is carried out each year; soil Olsen P levels are maintained at a biological optimum and no higher;
	Surface waterways are fully fenced and with good grass cover, fencing is maintained and stock are excluded from the riparian areas;
	*Wide riparian buffers are maintained;
	All surface waterways are culverted;
	Sufficient land area is available for the dairy operation;
	*Young stock is grazed off farm from weaning;
	*Cows are wintered off paddocks in wintering barns;
	*No intensive wintering grazing of cows on fodder crops;
	Ongoing implementation of good soil management practices;
	Nutrients from wintering of cows are stored and returned to pastures at the dairy platform and the Horner block, where they are used to promote grass growth when plants are actively growing and taking up nutrients;
	Tracks and lanes are predominantly sited away from waterways;
	Use specialist machinery when harvesting grass at the Horner Block to avoid soil compaction;
	*Lane runoff diverted to land with remedial work at lane/culvert/bridge crossings carried out as required;
	Good management practice of silage pads is implemented;
	Restricted grazing of draining pastures in autumn/spring;
	Wintering barns are used as stand-off pads during severe adverse weather events;
	Care in irrigation of FDE, especially when the ground is near or at field capacity;
	A large land application area is available to ensure N & K returns are not excessive;
	Effluent volumes are minimized at source through efficient water use;
	Appropriate FDE storage volume to allow for deferred irrigation for effluent;
	All data and maps are kept up to date and all staff are trained and informed of any changes;

Strategy Type	Summary of Management Practices
	Programmed maintenance is done in and around FDE, and piping infrastructure around the dairy shed, silage bunkers, cow yards etc.;

4.6 Good management Practices for Key Transport Pathways (1 June 2019 – 31 May 2020)

WW1&2 is classed in the Oxidising and Central Plains physiographic zones. The Horner block also is classed both in the Oxidising and Central Plains physiographic zones.

Both physiographic types are susceptible to nitrate accumulation in soils and aquifers. Nitrates are transported to the underlying aquifer via deep drainage. Central Plain's type soils (Braxton) may have risk of nitrate and contaminant (pathogen) loss to groundwater via cracks that can form in silty clay soils over extended dry summer periods. Subsequent heavy rainfall can transport nitrate or microbes down to the underlying aquifer. There is risk of contaminant loss (nutrients N and P, sediment and microbes) to surfacewaters via artificial drainage in Central Plain's type soils following heavy or prolonged rainfall.

Given the very flat topography and the tendency of soils to have good phosphorous retention, there is lower risk of contaminant loss to surface waters via overland flow. Any risk of contaminant loss to surface waters from tracks and lanes via overland flow should be mitigated by good management of areas where tracks and lanes are close to surface waters.

Recommendations described on Good Practice Management factsheets issues by Environment are implemented where practical. These measures will be reviewed annually with the inclusion of new measures where appropriate.

Table 6. Good management practices for key contaminant transport pathways.

Mitigation	Good Management Practise	Key transport pathway
Reduce accumulation of surplus N in the soil, particularly during autumn and winter, leading to reduced loss of N to groundwater and at times to surfacewaters	Inputs of N, such as fertiliser or nitrogen contained in imported feed, to be maintained at a level to minimise leaching losses	Deep drainage of nitrogen Artificial subsurface drainage
	Control the duration of grazing of pasture (on-off grazing)	
	Winter all cows in wintering barn	
	Optimise timing and amounts of effluent application to minimise leaching losses, accounting for the higher nutrient content of slurry compared to dairy shed effluent.	
	Wintering barns are also used to house cows during April, May, August and September as required, and as stand-off pads during wet weather at other times	

Mitigation	Good Management Practise	Key transport pathway
	Cut and carry feed to cows in barns	
	Time N application to meet pasture demand using split applications. Do not apply N in high risk months.	
	Reduce inputs of N where possible through optimal fertilizer application on farm, use little and often approach	
	Only apply nitrogen fertiliser if soil temperature is above 6 ºC	
	Re-sow areas of bare or damaged soil in September or October, depending on climatic conditions	
Protect soil structure, particularly in swales and near stream areas to reduce contaminant loss (P, sediment, microbes) in runoff to surfacewaters.	Only re-sow 10 % of property at most each year	Artificial subsurface drainage Overland flow
	Cultivate before 1st March to avoid Autumn loss of nutrients	
	Fence off waterways. Stock will not graze riparian strips and riparian strips are sufficiently large and well vegetated;	
	Re-sow areas of bare or damaged soil in Sept/Oct, depending on climatic conditions	
	No IWG on fodder crop is carried out	
	Avoid heavy grazing on vulnerable or wet soils. Match stock management to land use capability, e.g. avoid grazing cows on more vulnerable soils, especially when wet. Wintering barns are used during wet periods to prevent pastures from pugging.	
Reduce phosphorus use to reduce potential loss to receiving surfacewaters	Soil test whole farm every 4 years, reduce use of P fertiliser where Olsen P values are above agronomic optimum	Artificial subsurface drainage Overland flow
	Stand cows off pastures during wet periods to prevent pastures from pugging	
	Fertilise only when there is minimal risk of nutrient loss to water. Fertilise outside high-risk months in autumn.	
	Manage CSAs close to surface drains to prevent runoff. Fence off major CSAs to prevent compaction and runoff.	

Mitigation	Good Management Practise	Key transport pathway
Avoid preferential flow of effluent through drains or soil cracks to prevent contaminant loss (N, P, microbes) to groundwater and/or surfacewaters	Defer effluent application when soil moisture levels are high	Artificial subsurface drainage Deep drainage
	Observe buffer zones and placement guidelines e.g. do not over tile drains or over areas where cracks have formed in the soil during high risk periods.	
	At all times observe discharge consent conditions.	
	Apply slurry effluent at very low application depth (< 2.5 mm per application)	
	Apply dairy shed effluent at low application depth (at all times < 10 mm per application and less than 50% PAW)	
Manage CSAs; low areas overlying tiles close to outfalls at surface drains to protect soils, prevent erosion and reduce contaminant loss (N, P, sediment and microbes) to surfacewaters	Restrict grazing of pasture critical source areas when soils are near saturation	Overland flow
	Avoid working critical source areas and their margins	
	Leave grassed areas (or native vegetation) around critical source areas and margins	
	Reduce runoff from tracks and races (using cut offs and shaping)	
Avoid loss of contaminants (nitrate and faecal microbes) to groundwater via cracks formed in summer dry periods in Braxton soil types.	Monitor paddocks for deep cracks in summer/autumn. If and where they form, avoid grazing the area and irrigating effluent to the area.	Deep drainage

4.7 Key mitigation measures associated with expansion

It is proposed to milk an additional 160 cows at WW1&2 in the 2019/20 season. Changes will be made to the farming system to offset a potential increase in nutrient losses and associated effects. As summarised in sections 3.5 and 3.6 and explained in detail in the nutrient budget analysis report and the phosphorous mitigation plan, the proposed system is expected to lose less N and P than the pre-expansion system.

Key drivers of controlling nutrient losses are regarded as key mitigation measures. These are as follows:

N loss – key changes/mitigations leading to 7.3% reduction

i. Removal of summer and winter crop from WW1&2;
ii. Removal of cows & young stock wintered outside on crop (IWG) or on grass;
iii. Expansion of size and use of wintering barn facilities. The barns and effluent systems have already been upgraded to accommodate additional cows and effluent. Use of the barns will also occur in April, May, August and September;
iv. More efficient use of N fertiliser.

P loss – key mitigations leading to 6.1% reduction

v. Removal of winter crop area;
vi. Maintaining Olsen P at target level of 30;
vii. Expansion of size and use of wintering barn facilities.
viii. Additional P mitigation is proposed by mitigating runoff from specific locations and features, which has calculated been outside Overseer. Please see WW1&2’s Phosphorous Mitigation Plan for details of measures, including target dates for implementation.

If consent if granted for the proposed farming system, these key mitigation measures (i to viii inclusive) will be implemented in the 2019/2020 season.

In the future any material change to the farming system will be modelled in Overseer prior to the changes being made, to ensure that the change(s) will not result in an increase in N or P loss.

5 Riparian Management

5.1 Streams, Creeks and Drains

i. All waterways are riparian fenced on both sides;

ii. Regular riparian fencing checks will be completed, and any damaged sections or breakages/breaches are repaired immediately;

iii. Calves or other stock that are found in the riparian areas will be removed immediately;

iv. Check all crossings are contoured to channel run-off onto pasture;

v. Carry out weed control as required following best practice methods;

vi. Remove drain cleanings and spread over paddocks to utilize the nutrients and to prevent material returning to the water way; and

vii. Make sure fish have passage through all culverts and underneath bridges;

viii. Plant riparian areas and maintain rank grass to reduce runoff of contaminants – see phosphorous mitigation plan for details.

5.2 Weeds and Pests

Weeds (e.g. gorse, broom, blackberry, ragwort, thistles etc.) are controlled by manually removing them or by using sprays:

i. When sprays are used to control weeds, care is taken to ensure all sprays are certified to be aquatic safe and that appropriate staff training is given to ensure good health and safety practices are fully implemented;

ii. Spraying is best carried out when there is active growth (e.g. mid/late spring). The aim is to spray plants when they are small as less chemical is required;

6 Cultivation

6.1 Cultivation

Area under cultivation

For winter 2020, no fodder crop cultivation (beet, root or brassica) is planned.

However, the move to grass to grass re-grassing is dependent on the farming system changing pending the granting of consent; it is proposed that cow numbers are increased by 160 and cows wintered in the barn are increased by 225. If the farming system remains as per the 2017/2018 season, then there may be some fodder crops sown and IWG in the future.

Re-grassing

An extensive re-grassing policy has been carried out, with most paddocks having been re-grassed at the time of writing. Approximately 5% of the farm's effective area will undergo cultivation into new grass each year. Where re-grassing occurs, paddocks are sprayed off and direct drilled with grass seed or undergo full cultivation depending on factors such as soils, drainage, paddock performance.

Forage brassica or beet crop

This is not planned in the future:

- Paddocks are sprayed off in October/November;
- Paddocks are direct drilled or fully cultivated into fodder crop from mid-October to mid-November;
- Fodder crop is IWG in over winter by cows;
- Paddocks are subsequently re-grassed in September/October;

Surplus grass is harvested as baleage.

Grass harvested at the Horner Block is fed fresh to cows in the barns or is stored as silage at the silage pad or goes to other dairy farms. Specialist machinery is used to avoid the risk of soil compaction when harvesting grass if required.

Grass production, soil structure and fertility are the primary factors in paddock selection, with poorly performing pastures targeted for renewal. Soil moisture content is also a factor in the choice of paddock selection and timing of cultivation.

6.2 Cultivation Good Management Practices

If any fodder crop is sown in the future, good management practices will be followed:

i. Where drainage depressions in crop paddocks are likely to channel sediments and nutrients to drainage, these will be left uncultivated to act as sediment traps;

ii. Direct drill paddocks where this approach is deemed to be suitable;

iii. Choose paddocks away from waterways to plant winter feed crops;

iv. Plough lines will be kept 5 metres back from the top of drain banks. This ensures at least a 5 m buffer along waterways;

v. Observe permitted activity rules as per Rule 25 clauses (a) and/or (b) of the pSWLP.

7 Intensive Winter Grazing

7.1 Stock Grazing Management

The Environment Southland Intensive Winter Grazing Rule covers the period from 1 May until 30 September. It is intended that all stock will be wintered in wintering barns during June and July 2020. Barns will also be partly used during April, May, August and September 2020.

However, if consent is not granted IWG may occur in the future to utilise land. If and where this occurs within the Environment Southland defined winter period, the following management will be employed. These procedures would also be applicable to returning stock in early spring.

7.2 IWG

Paddock selection

Judicious paddock selection based on the soil moisture content is a key tool. This is important not only to avoid overland flow, pugging etc. but to ensure that the pasture and soils are not damaged to any extent that would inhibit spring pasture growth. The range in soil types gives some flexibility of being able to move away from waterways to better draining soils during wet weather.

Back fencing

The eating of the excess feed will not (for spring growth reasons) result in the paddocks being eaten down hard, or pugged.

- Breaks once eaten off, will be back fenced;
- Breaks will be sequenced to ensure grazing is towards the watercourse, leaving a “last bite”;
- If the area to be grazed is located on sloping ground, stock will be progressively grazed from the top of the slope to the bottom, with a 20 metre ‘last-bite’ strip is left at the base of the slope. This is unlikely to be necessary due to the very flat topography;
- If baleage is used, place baleage in the paddock before soil becomes too wet thereby preventing heavy vehicles from damaging the ground;
- Portable feeders will be used to feed baleage/hay/straw to stock.

Water

Where breaks do not encompass a trough, a portable trough will be used to avoid pug lanes between the water troughs and the feed breaks.

Buffer zones

There will be fenced buffer zones (minimum 5-metres) along all water ways, and higher risk areas over tiles, drainage depressions (swales) or cracked soils will be temporarily fenced off.

Wet weather

In wet weather, where there is risk of pasture and soil damage, care must be taking to minimise grazing and avoid supplement feeding and pugging within 10 metres of a waterway or drain.

8 Other Environmental Issues

8.1 Lanes and Races

Run-off from races can in some situations constitute an illegal discharge to land. These will be mitigated by:

i. Ensuring that lanes and races are not used as feed pads, cow yards, or herd holding areas;

ii. Ensuring that riparian vegetation is adequate to treat storm water;

iii. Checking after heavy rain the lane/track edge cut-outs, to ensure they are not blocked and there is no risk of large single point discharges;

iv. Install nib boarding or kerbing to prevent point source discharges from lanes and tracks to waterways occurring;

v. Gateways – to avoid compaction around the gateways and reduce lane edge wear, where possible bring the cows out of the paddock at a different gate to which they were let in; and

vi. Ensure that swales away from culverts are kept clear, and discharge is directed away from the waterway.

Annual maintenance to races can often result in the "run back" shaping over culverts and lane edge discharge cutouts not being restored. All lane edges and culverts should be checked after lane maintenance.

8.2 Silage pad

A concrete silage pad (1,200 m^2) is located adjacent to a wintering barn. It is constructed on a dry site. The silage pad has concrete walls and a dual drainage system; one for clean rainwater and one for silage leachate. Under the stack and immediately in front of it, the drains are opened into the leachate channel. This takes leachate to a sump from where it is pumped into the effluent storage pond and irrigated appropriately. The sumps in the rest of the pad are open to the farm drainage system so that clean rainwater can be diverted. Rain landing on the silage cover does not mix with leachate and is diverted to the farm drainage.

A second silage pad has been constructed on a dry site underlain by compacted clay. Rain landing on silage covers does not mix with leachate and is diverted to the farm drainage. It is managed to ensure that no leachate flows off the pad at any time and any leachate is contained at the pad.

Only wilted silage is used and stacks remain covered to minimise leachate

8.3 Underpass

An underpass connects the block north of Wrey's Bush Highway with the dairy platform south of the highway. The underpass has its own effluent system, with a dedicated sprinkler. The sprinkler irrigates rainwater and effluent that collects on the underpass at low rate and depth to nearby paddocks.

The underpass is inspected regularly to ensure that the effluent system in operating correctly and that there is no ponding of rainwater/effluent at the underpass.

8.3 Cut and Carry

Grass harvesting at the Horner Block is carried out according to best practice management. Specialist equipment is used to minimize the risk of soil compaction. Harvesting is not carried out if the risk of soil compaction cannot be avoided.

Health and safety protocols are adhered to when operating machinery.

8.4 Animal Pests

i. Rabbits, hares, possums – regular culls using night shooting, poisoning etc.

ii. Magpies – trap, shoot;

iii. Rodents – poison according to appropriate health and safety requirements

9 Emergency Response

9.1 Storage Overflow

Where the slurry ponds are approaching full very low application depth effluent irrigation (<1.5 mm depth) will be carried out on the driest part of the farm available. The umbilical system can be contracted to achieve this.

9.2 Ponding

Should light ponding be detected effluent irrigation will immediately stop. Checks should be made to ensure that there is no overland flow or that the ponding is not draining into tile lines etc.

9.3 Drainage

Overland Flow

See Ponding Section 9.2.

Discharge Ex-Tile and/or Effluent in Open Drains

i. Attempt to immediately contain the contaminants by damming the drain. This will be done by dumping a bale(s) of straw or hay in the drain and pressing down with the front-end loader, depending on drain size;

ii. Alternately earth and silage wrap will be used to seal or form the required plug; or

iii. pump out and disburse with the vacuum tanker.

12.4 General Procedures

i. Follow consent conditions/notes, mitigate effects;

ii. Advise Regional Council where the consent requires this;

iii. Seek help; and

iv. Advise authorities.

12.5 Emergency Contacts

As per contact details in Section 1.

Environment Southland – 0800 768 845 or 03 2115115

Dairy Green Limited – 03 215 4381

10 Review

Review whole effluent management plan and update by 1 June each year – and complete the version control below.

i. Development targets for coming season/plan.

ii. Nutrient Management

- Overseer Inputs
- New Overseer report if applicable

iii. Good Management Practices

iv. Implementation of key mitigation measures

v. Cultivation Areas

vi. Intensive Winter Grazing, if applicable

vii. Effluent System

- High risk/low risk effluent irrigation areas due to new tiling etc.;
- Any developments in infrastructure – i.e. new/more irrigators, extensions to effluent system, fencing changes;
- Training/retraining, etc.

viii. Emergency Contacts

Version	Date	Reviewed	Distribution List
1.0	22 August 2017	JS	A & JJ de Wolde
1.2	15 July 2018	Nessa Legg, Dairy Green Limited	A & JJ de Wolde
1.3	25 Feb 2019	Nessa Legg, Dairy Green Limited	A & JJ de Wolde
1.4	21/8/19	Nessa Legg, Dairy Green Limited	A & JJ de Wolde

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QUALITY INFORMATION

Reference:	**19180**
Date:	26 August 2019
Prepared by:	Mike Freeman
Reviewed by:	Matilda Ballinger, Landpro & Nessa Legg, Dairy Green
Client Review:	Abe and Anita de Wolde
Version Number:	**Final**

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1 Background

1.1 This report has been prepared to assess the water quality effects of the proposed changes for Woldwide One and Two (WW1&2) and Woldwide Four and Five (WW4&5). One report has been prepared for all the resource consent applications because of the close proximity of the properties, the commonality of existing environment information (e.g., the same river water quality monitoring sites) the largely common receiving environments and to endeavour to provide assessments in the most cost-effective and informative manner.

1.2 The detailed backgrounds to the applications are covered in detail in the primary assessments of environmental effects (AEEs) prepared by Dairy Green Limited and Landpro. Those AEEs also includes a significant amount of information related to the existing environment and potential adverse effects. This report has been prepared to provide a more detailed assessment of key aspects of the existing environment and the potential effects of the proposed activities on both groundwater quality and surface water quality.

2 Soil and physiographic environment

2.1 The soils and physiographic zones have also been described in detail in the primary AEEs together with the implications for contaminant loss and are not repeated here.

3 Receiving water bodies

3.1 The WW1&2 dairy platforms and the Horner Block (HB) are spread across the catchments of the Aparima River, the Waimatuku Stream and the Oreti River as indicated in Figure 1. There are long-term water quality monitoring sites for these rivers at Thornbury, near Waimatuku and Wallacetown respectively.

3.2 The WW4&5 dairy platforms and the Gladfield Block are further south and east from the WW1&2 blocks and are spread across the Aparima River and Waimatuku Stream catchments, with the majority of WW5 in the Aparima River catchment.

3.3 The surface water catchments are illustrated in figures 1 & 2 together with the Environment Southland GIS system's approximate catchment boundaries.

3.4 The runoff blocks are in the catchment of the Orauea River and there is a long-term water quality monitoring site at the Orawia Pukemaori Road, as indicated in more detail in Figure 3.

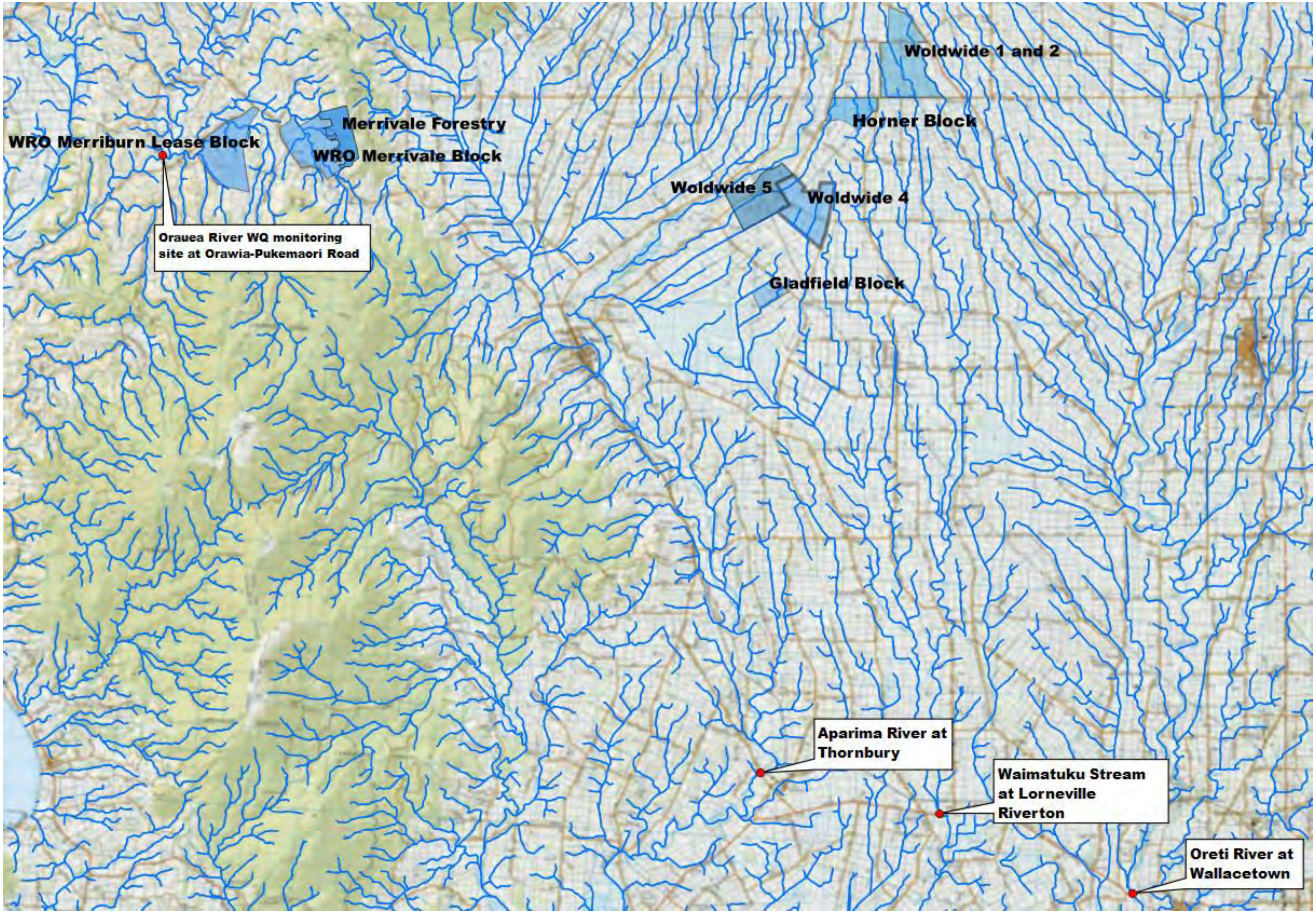


Figure 1: Location of all properties and catchments above the Orauea River, Aparima River, Waimatuku Stream and Oreti River monitoring sites

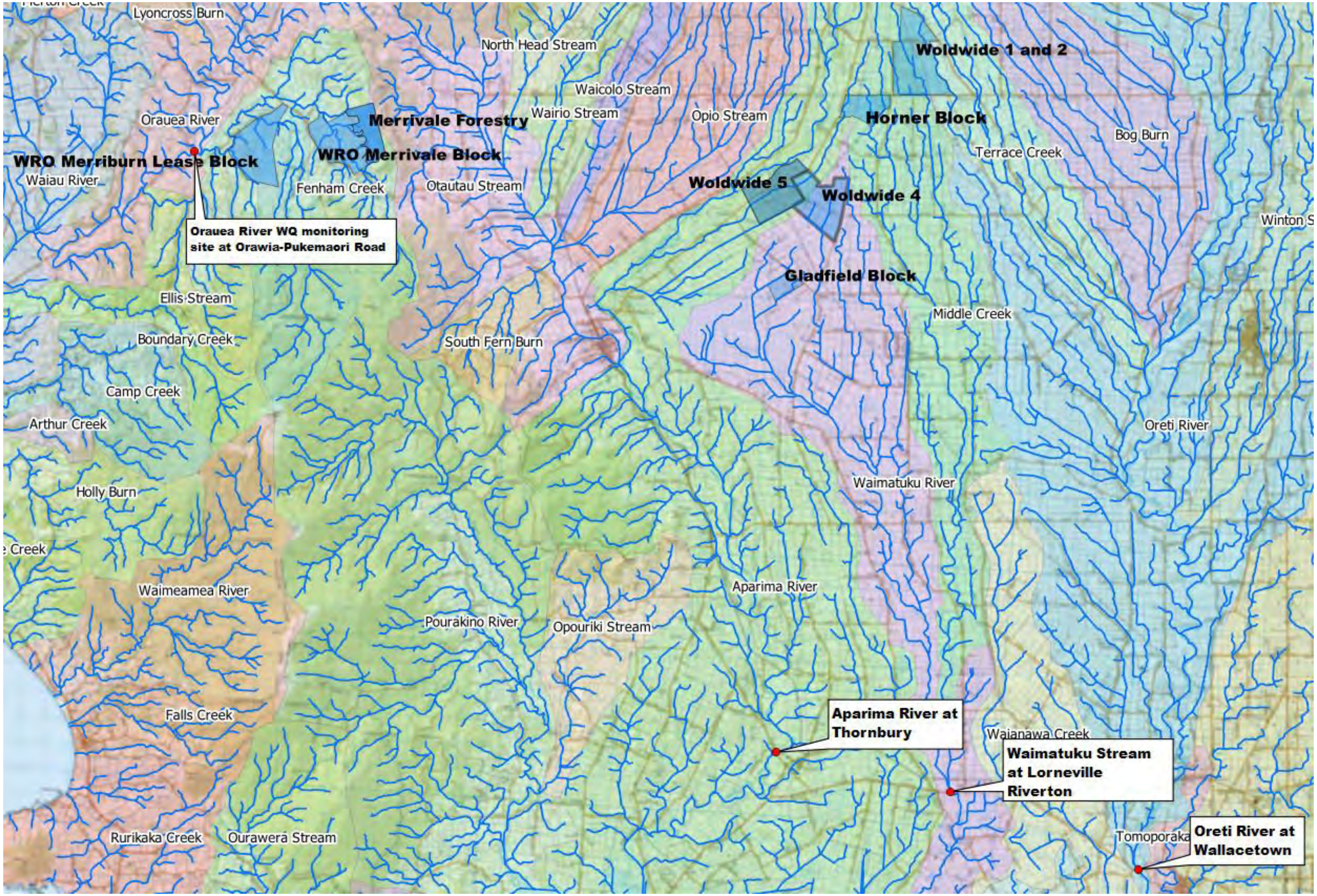


Figure 2: Location of properties and catchment above the Aparima River and Waimatuku Stream river monitoring sites, shaded areas showing Environment Southland GIS surface catchment areas

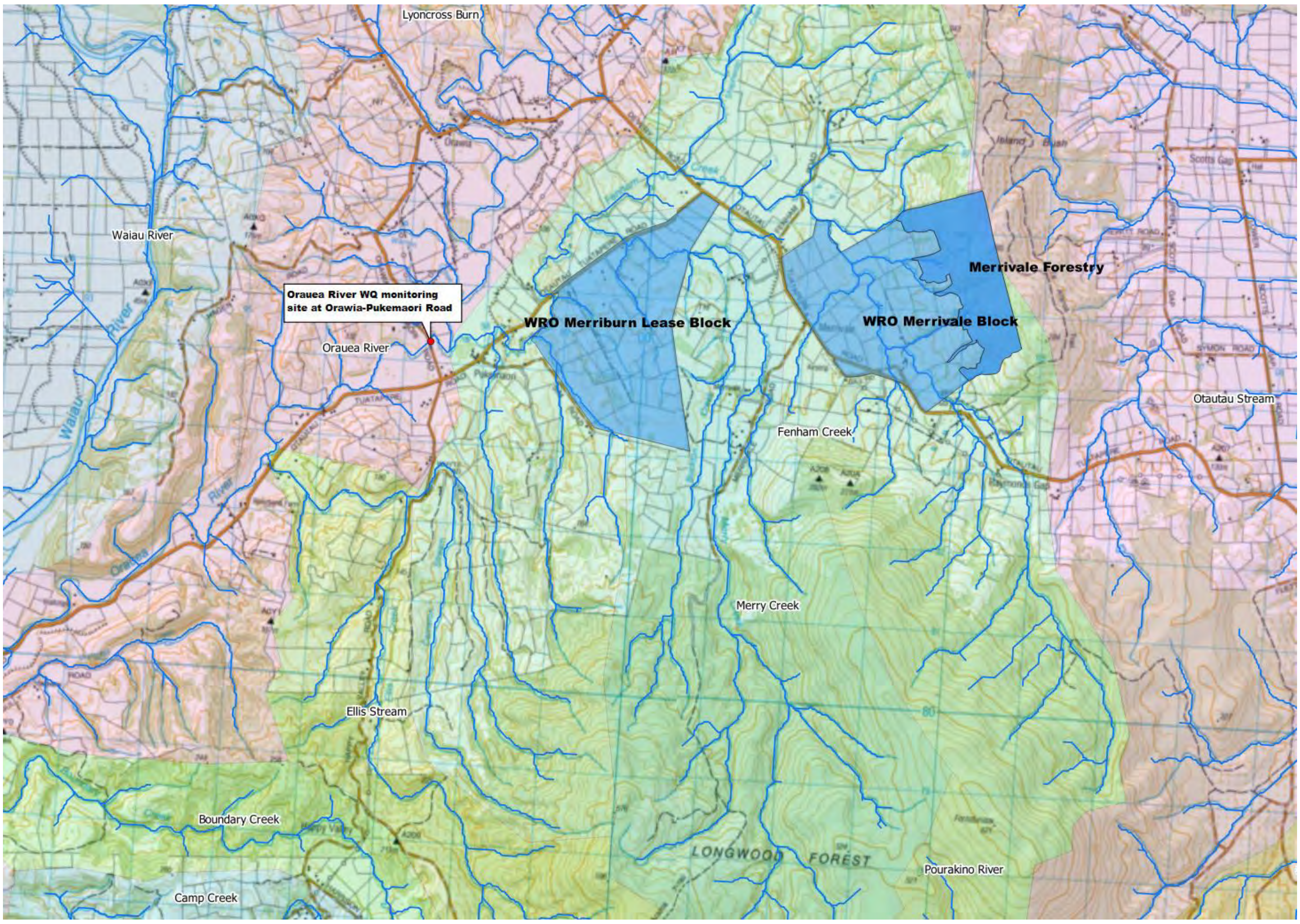


Figure 3: Location of the WRO properties and catchment above the Orauea River monitoring site, shaded areas showing Environment Southland GIS surface catchment areas

3.5 The land use in the catchments is predominantly sheep and beef, dairying and some grain growing. The primary AEE summarises the results of on-site soil investigations. In addition to these assessments, the Landcare Research S-map database[1] has been assessed and supports the conclusions that the WW1&2& HB properties have both deep poorly drained soils (Braxton) and shallow well-drained soils (Glenelg). This is illustrated in Figure 4 and the primary AEEs have a more detailed discussion on the results of a field investigation of soil characteristics and the implications of soils for contaminant loss to water. The WW5 land has a greater proportion on the well-drained soils.

3.6 The heavier soils provide for significant run-off during rainfall events and artificial drainage provides an important transport route. The free-draining soils provide a primary contaminant transport route to groundwater.

[1] https://smap.landcareresearch.co.nz/app#

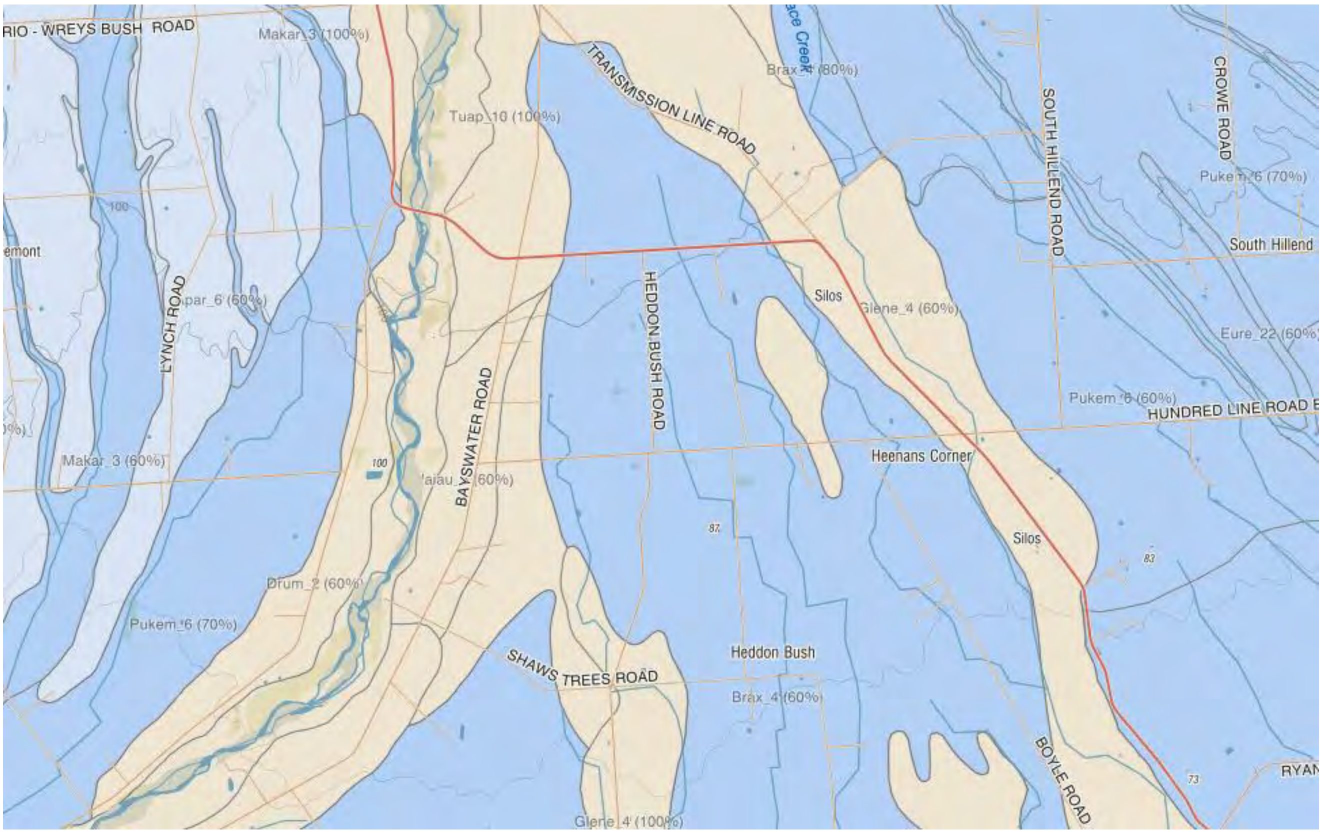


Figure 4: S-map representation of soils in the area of the dairy platforms and the Horner Block (blue = heavy poorly drained soils, cream/yellow = relatively shallow well-drained soils)

3.7 Excluding WRO, the properties are underlain by groundwater that is part of the Upper Aparima, Waimatuku, and Central Plains groundwater management zones (as specified in the PSWLP). Information used to inform the PSWLP process (LWP 2017[2]) strongly indicates that the groundwater in this general area is primarily recharged via rainfall and some infiltration of runoff from surrounding hills. Groundwater discharge is primarily to drains and streams in the area, and the general direction of groundwater flow is southerly.

3.8 There is little piezometric contour information available for the wider area with the exception of an MSc thesis[3] undertaken in the upper catchment of the Waimatuku Stream. A figure from that thesis helps to clarify the direction of groundwater flow in the upper reaches of the Waimatuku Stream and is reproduced as Figure 5.

[2] Landwaterpeople (2017) Groundwater Provisions of the Proposed Southland Water and Land Plan, Technical Background, Report for Environment Southland

[3] Hitchcock MK (2014) *Characterising the surface and groundwater interactions in the Waimatuku Stream, Southland*, MSc Thesis

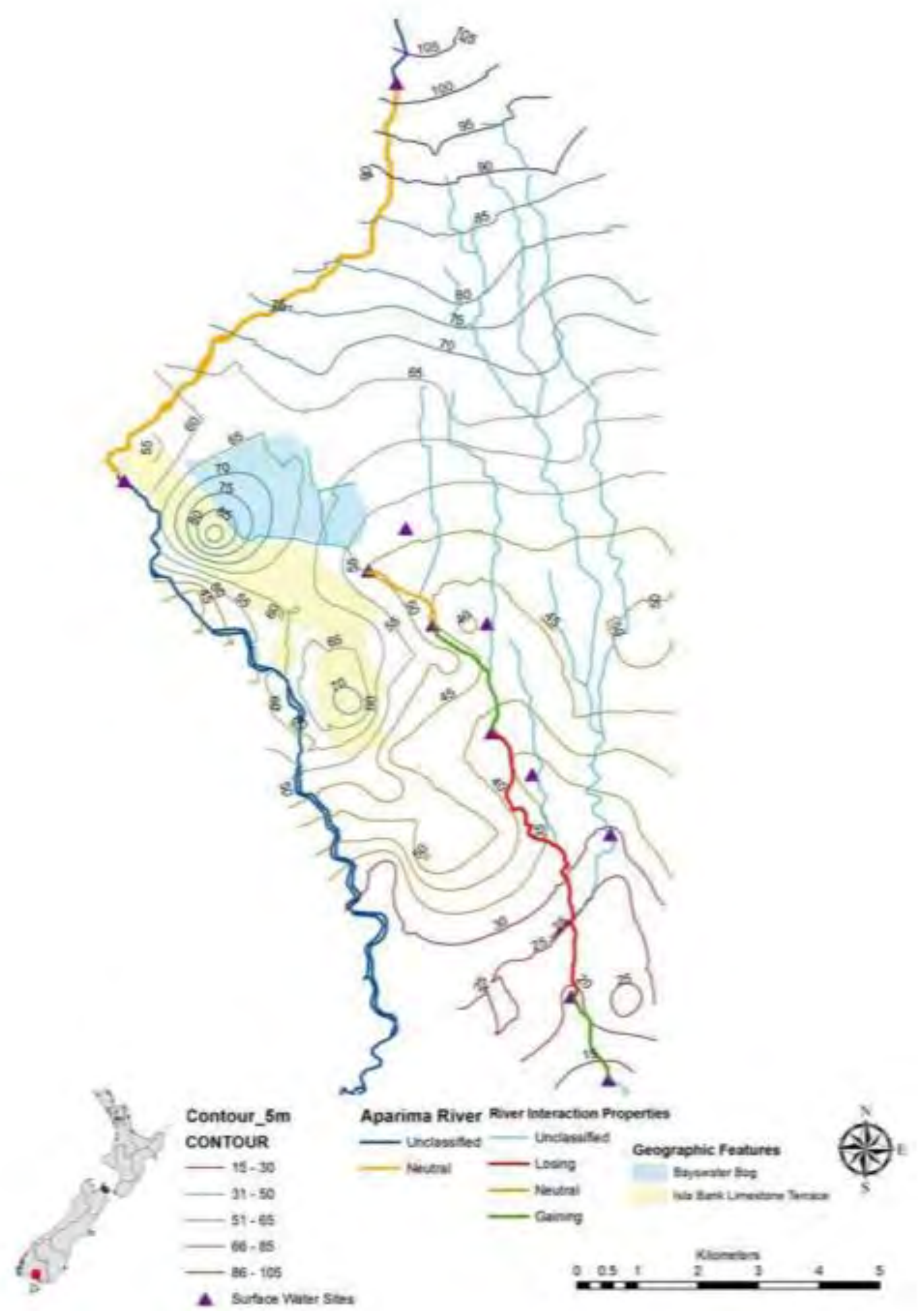


Figure 5: Piezometric contour diagram from Hitchcock thesis showing groundwater flow direction and some stream sections losing/gaining flows to/from groundwater

3.9 This groundwater contour information strongly indicates that groundwater flow direction is generally southerly and depending on groundwater levels would recharge tributaries of the Waimatuku Stream, Aparima River and Oreti River depending on location. Some drainage water will enter groundwater and recharge surface waters some distance down-gradient and some drainage water will discharge more quickly and directly into surface waters via artificial/natural drainage.

3.10 To assist in identifying the direction of groundwater flow relative to each of the properties the diagram from Ms Hitchcock's thesis has been georeferenced to Google earth and the location of the Woldwide properties to more clearly indicate the direction of groundwater flow relative to the properties. This is illustrated in the following figure.

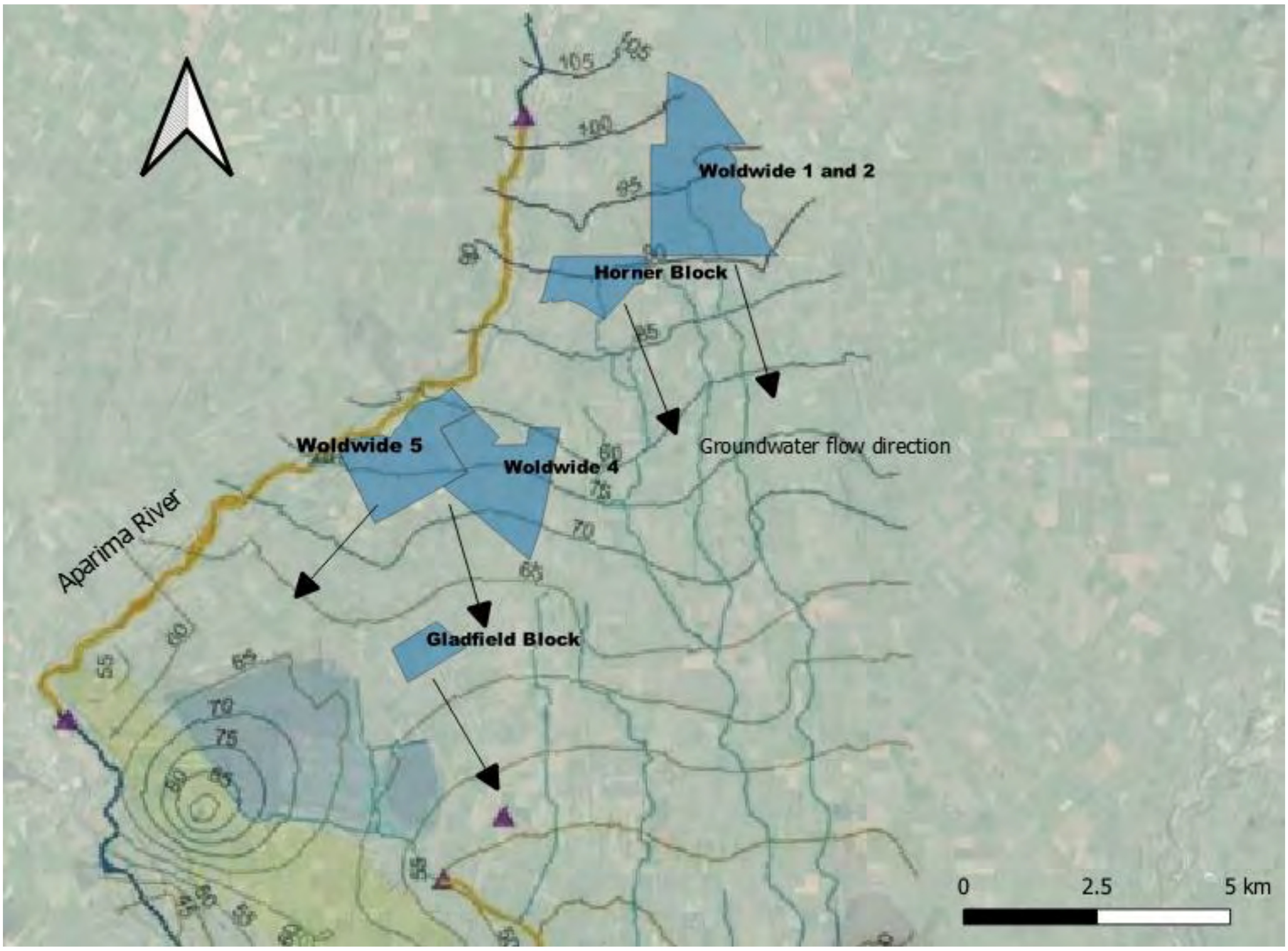


Figure 6: Piezometric contour diagram from Hitchcock thesis georeferenced showing groundwater flow paths relative the location of Woldwide properties

4 Statutory water quality objectives and standards

4.1 The most directly relevant planning documents are the Regional Water Plan for Southland (RWPS) and the Proposed Southland Water and Land Plan (PSWLP). These specify the values, objectives, policies and 'standards' for water in the Southland region.

4.2 Under the RWPS and the PSWLP, surface water bodies at downstream monitoring sites appear to be classified as Lowland Soft Bed (Orauea River) and Lowland Hard Bed (Aparima River, Waimatuku Stream and Oreti River). Table 1 summarises the values associated with these water body 'classifications' as specified in the RWPS. The PSWLP does not establish values for rivers and streams. However, the relevant regional objectives in the PSWLP are also provided in Table 1.

4.3 The relevant numerical water quality standards and guidelines are included in Section 5 of this evidence along with the results from water quality monitoring.

4.4 The Southland Regional Coastal Plan also contains a diverse suite of objectives and values that apply to the Jacobs River Estuary. Those are not repeated here but it is important to appreciate that there is a relationship between regional plans and the overarching Southland Regional Policy Statement.

Table 1: Summary of key regional plan surface water values & objectives for water in this location

Regional Plan	Classification	Values/objectives specified in the relevant plan
Southland Regional Water Plan 2010 Objective 3	Lowland hard & soft bed	- Bathing in those sites where bathing is popular; - Trout where present, otherwise native fish; - Stock drinking water; - Ngāi Tahu cultural values, including mahinga kai; - Natural character including aesthetics.
Proposed Southland Water and Land Plan Objectives 3, 6, 7, & 8	Region-wide	3 The mauri (inherent health) of waterbodies provide for te hauora o te tangata (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody). 6 There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons by, (a) maintaining the quality of water in waterbodies, estuaries and coastal lagoons, where the water quality is not degraded; and (b) improving the quality of water in waterbodies, estuaries and coastal lagoons, that have been degraded by human activities. 7 Any further over-allocation of freshwater (water quality and quantity) is avoided and any existing over-allocation is phased out in accordance with freshwater objectives, freshwater quality limits and timeframes established under Freshwater Management Unit processes. 8 (a) The quality of groundwater that meets both the Drinking Water Standards for New Zealand 2005 (revised 2008) and any freshwater objectives, including for connected surface waterbodies, established under Freshwater Management Unit processes is maintained; and (b) The quality of groundwater that does not meet Objective 8(a) because of the effects of land use or discharge activities is progressively improved so that: (1) groundwater (excluding aquifers where the ambient water quality is naturally less than the Drinking Water Standards for New Zealand 2005 (revised 2008)) meets the Drinking Water Standards for New Zealand 2005 (revised 2008); and

Regional Plan	Classification	Values/objectives specified in the relevant plan
		(2) groundwater meets any freshwater objectives and freshwater quality limits established under Freshwater Management Unit processes

4.5 These values and objectives are relevant reference points here to understand the implications of existing water quality particularly where that quality is not consistent with relevant objective and values specified in relevant regional plans.

4.6 The detailed policy assessment is contained in the AEEs and in the planning evidence.

5 Existing water quality in the vicinity and downstream of the property

Surface water quality

5.1 The following tables and figures provide summary information on the quality of surface water and groundwater in the vicinity of the properties. The water quality data has been provided by Environment Southland via the LAWA (Land Air Water Aotearoa) website[4] or more recent data directly. This water quality information is compared to the most relevant guidelines, specifically the National Objective Framework (NOF) attributes (e.g., *E. coli*, clarity (black disc), dissolved reactive phosphorus, ammonia, etc.) contained within the National Policy Statement Freshwater Management (2017)(NPSFM), the PSWLP Appendix E Water Quality 'Standards' (referenced primarily via Policy 16 of the PSWLP), and the Australia New Zealand Environment and Conservation Council (ANZECC) water quality 'trigger values'[5].

5.2 The interpretation of the data in the following four tables is challenging for a number of reasons including because there is often a disconnection between the sampling methodology and the NPSFW NOF specified attribute states and some of the PSWLP Appendix E Water Quality 'Standards'. For example, the monthly river sampling does not enable an assessment against the dissolved oxygen numeric attribute states ('standards') which effectively require daily

[4] https://www.lawa.org.nz/

[5] Water quality that exceeds an ANZECC trigger value indicates marginal water quality for supporting ecosystem health. If the median value of a water quality variable for a particular site exceeds the trigger value, then it is intended to 'trigger' an investigation response to identify the cause and significance of the degraded water quality. (Hart, B.T., Maher, B., & Lawrence, I. (1999) New generation water quality guidelines for ecosystem protection. Freshwater biology 41: 347-359).

sampling between 1 November and 30 April, the PSWLP clarity standard requires concurrent flow monitoring but this information is not always available.

5.3 The stream water quality definitions and locations (Lowland Hard and Soft Bed) appear[6] to provide direction for the PSWLP water quality standards and do provide some indication of the likely natural background water quality. However, regardless of the legal status of the PSWLP water quality standards, they are generally specified as absolute maxima so that even one observed breach is counted as non-compliance with that standard. In recent decades surface water quality management has moved towards more complex and meaningful water quality standards and guidelines such as those in the NPSFM that focus more on a statistical description against specific targets that relate more directly with specific uses and values of that water. For example, the PSWLP sets a faecal coliform standard of <1,000/100ml while the NPSFM focuses on medians and 95th percentiles combined with various states that describe the level of infection risk.

[6] There does not appear to be an explicit linkage from the PSWLP Appendix E water quality standards to the maps contained in the separate Maps volume of the PSWLP. Environment Southland Planning staff have been made aware of this issue.

Table 2: Summary of State and Trend of the Orauea River at Orawia Pukemaori Road water quality monitoring site (LAWA/Environment Southland data)

Primary WQ indicators	State	LAWA National Objective Framework (NOF) Band, Annual Median (2008 – 2017) PSWLP Maximum (2009 -18)	Trend	PSWLP water quality standard (Lowland Soft Bed) & ANZECC[∞] trigger values
E. Coli	In the worst 25% of all lowland rural sites	**E** – For more than 30% of the time, the estimated risk is >=50 in 1000 (>5% risk). The predicted average infection risk is >7%. 5-year median = **315 n/100ml** Maximum = **21,000 cfu/100ml**	Likely Improving	≤1,000/100ml Faecal coliforms[#] Highly unlikely to meet standard
Clarity (Black Disc)	In the worst 25% of all lowland rural sites	No NOF attribute band set 5-year median = **1.13 metres**	Not assessed	≥ 1.6 m when flow below median flow (~1.46 m3/s), Unlikely to meet standard
Total Oxidised N	In the worst 50% of all lowland rural sites	**A** – High conservation values system. Unlikely to be effects on even sensitive species. 5-year median = **0.415 g/m^3** Maximum = **7.8 g/m^3**	Very likely improving	≤0.444 g/m^3 (ANZECC, 2000)* Greater than this trigger value
Ammoniacal N	In the best 25% of all lowland rural sites	**A** – 99% species protection level. No observed effect on any species tested. 5-year median = **0.005 g/m^3** Maximum = **0.16 g/m^3**	Not assessed	<2.5-0.9 (pH 6.0-8.0) Meets standard
Dissolved Reactive P	In the worst 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.011 g/m^3** Maximum = **0.04 g/m^3**	Indeterminate	≤0.01 g/m^3 (ANZECC, 2000)* Greater than this trigger value
Macroinvertebrate Community Index	Fair	MCI 5-year median = **93.** Range 88 – 109 (2012 – 2018) Fair ecological condition. Indicative of only fair water quality and/or habitat condition.	Not assessed.	>80 Meets standard
Additional PSWLP Water Quality Stds		**Observed WQ range Jan 2009 – Dec 2018**		**PSWLP water quality standard (Lowland Soft Bed)**
Temperature		1.8 – 20.3°C		≤23°C Meets standard
pH		7 – 8.7		6.5 – 9.0 Meets standard
Sediment cover		Not assessed by ES		
Dissolved oxygen		77% - 152% (8.3 – 16.2 g/m^3) NOF Attribute **B**		> 80 % sat. Does not meet standard
Bacterial/fungal slime		Not assessed by ES		
Periphyton		0.0 – 129.6 mg chl *a*/m^2 (2014 – 2019) 83%ile = 49 mg chl *a*/m^2 NOF Attribute potentially **A**		<120 mg chl *a* /m^2 filam. algae < 200 mg/m^2 diatom/cyanob. Likely to meet standard
Fish		Not assessed by ES		

[∞]Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.
[#] PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.
* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

Table 3: Summary of state and trend at the Aparima River at Thornbury water quality monitoring site (LAWA/Environment Southland data)

Primary WQ indicators	State	LAWA National Objective Framework (NOF) Band, Annual Median (2008 – 2017) PSWLP Maximum (2009 -18)	Trend	PSWLP water quality standard (Lowland Hard Bed) & ANZECC[∞] trigger values
E. Coli	In the worst 50% of all lowland rural sites	**D** – 20-30% of the time, the estimated risk is >=50 in 1000 (>5% risk). The predicted average infection risk is >3%*. 5-year median = **130 n/100ml** Maximum = **68,000 cfu/100ml**	Very likely Improving	≤1,000/100ml Faecal coliforms[#] Highly unlikely to meet standard
Clarity (Black Disc)	In the best 50% of all lowland rural sites	No NOF attribute band set 5-year median = **2.305 metres** Maximum = **5.72 meters**	Likely improving	≥ 1.6 m when flow below median flow (27.4 m3/s), Does not meet standard
Total Oxidised N	In the worst 50% of all lowland rural sites	**B** – Some growth effect on up to 5% of species. 5-year median = **0.665 g/m³** Maximum = **1.78 g/m³**	Very likely improving	≤0.444 g/m³ (ANZECC, 2000)* Greater than this trigger value
Ammoniacal N	In the best 25% of all lowland rural sites	**A** – 99% species protection level. No observed effect on any species tested. 5-year median = **0.005 g/m³** Maximum = **0.12 g/m³**	Not assessed	<2.5-0.9 (pH 6.0-8.0) Meets standard
Dissolved Reactive P	In the best 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.006 g/m³** Maximum = **0.05 g/m³**	Likely improving	≤0.01 g/m³ (ANZECC, 2000)* Greater than this trigger value
Macroinvertebrate Community Index	Good	MCI 5-year median = **100**. Good ecological condition. Streams in good ecological condition. Indicative of good water quality and/or habitat conditions.	Indeterminate	>90 Meets standard
Additional PSWLP Water Quality Stds		**Observed WQ range Jan 2009 – Dec 2018**		**PSWLP water quality standard (Lowland Hard Bed)**
Temperature		3.0 – 20.8 °C		≤23°C Meets standard
pH		6.6 – 8.0		6.5 – 9.0 Meets standard
Sediment cover		Not assessed by ES		
Dissolved oxygen		74.8 – 134% (7.45 – 15.3 g/m³) NOF Attribute **B**		> 80 % sat. Meets standard
Bacterial/fungal slime		Not assessed by ES		
Periphyton		0.0 – 301 mg chl *a*/m² (2014 - 2018) NOF Attribute potentially **C** 92%ile = 181 mg chl *a*/m²		<120 mg chl *a* /m² filam. algae < 200 mg/m² diatom/cyanob. Unlikely to meet standard
Fish		Not assessed by ES		

[∞]Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.
[#] PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.
* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

Table 4: Summary of state and trend of the Waimatuku Stream at Lorneville Riverton Highway water quality monitoring site (LAWA/Environment Southland data)

Primary WQ indicators	State	LAWA National Objective Framework (NOF) Band, Annual Median (2008 – 2017) PSWLP Maximum (2009 -18)	Trend	PSWLP water quality standard (Lowland Hard Bed) & ANZECC∞ trigger values
E. Coli	In the worst 25% of all lowland rural sites	**E** – For more than 30% of the time, the estimated risk is >=50 in 1000 (>5% risk). The predicted average infection risk is >7%. 5-year median = **450 n/100ml** Maximum = **21,000 cfu/100ml**	Very likely Improving	≤1,000/100ml Faecal coliforms# Highly unlikely to meet standard
Clarity (Black Disc)	In the worst 50% of all lowland rural sites	No NOF attribute band set 5-year median = **1.22 metres** Maximum **= N/A**	Very likely Improving	≥ 1.6 m when flow below median flow (~1.46 m3/s), Unlikely to meet standard Flows not measured at this site. Measured at a site approx. 2 km downstream.
Total Oxidised N	In the worst 25% of all lowland rural sites	**C** – Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects 5-year median = **3.0 g/m^3** Maximum = **7.8 g/m^3**	Very likely improving (pre 2018 data)	≤0.444 g/m^3 (ANZECC, 2000)* Greater than this trigger value
Ammoniacal N	In the worst 50% of all lowland rural sites	**A** – 99% species protection level. No observed effect on any species tested. 5-year median = **0.01 g/m^3** Maximum = **0.16 g/m^3**	Very likely Improving	<2.5-0.9 (pH 6.0-8.0) Meets standard
Dissolved Reactive P	In the worst 25% of all lowland rural sites	No NOF attribute set 5-year median = **0.0425 g/m^3** Maximum = **0.1 g/m^3**	Very likely degrading	≤0.01 g/m^3 (ANZECC, 2000)* Greater than this trigger value
Macroinvertebrate Community Index	Fair	MCI 5-year median = 83- 91. Fair ecological condition. Indicative of only fair water quality and/or habitat condition.	Not assessed. Only two results for past five years	>90 Does not meet standard
Additional PSWLP Water Quality Stds		**Observed WQ range Jan 2009 – Dec 2018**		**PSWLP water quality standard (Lowland Hard Bed)**
Temperature		3.8- 21.0°C		≤23°C Meets standard
pH		6.9 - 9.0		6.5 – 9.0 Meets standard
Sediment cover		Not assessed by ES		
Dissolved oxygen		82 – 132% (7.4 – 14.2 g/m^3) NOF Attribute **B** band		> 80 % sat. Meets standard
Bacterial/fungal slime		Not assessed by ES		
Periphyton		**<1 – 124 mg chl *a*/m^2** (annual sampling, 2014 - 2018) 92%ile = 88 mg chl *a*/m^2 NOF Attribute potentially **B**	Periphyton monitoring site 2 km downstream	<120 mg chl *a* /m^2 filam. algae < 200 mg/m^2 diatom/cyanob. Does not meet standard
Fish		Not assessed by ES		

∞Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.
PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.
* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

Table 5: Summary of state and trend at the Oreti River Wallacetown water quality monitoring site (LAWA/Environment Southland data)

Primary WQ indicators	State	LAWA National Objective Framework (NOF) Band, Annual Median (2008 – 2017) PSWLP Maximum (2009 -18)	Trend	PSWLP water quality standard (Lowland Hard Bed) & ANZECC[∞] trigger values
E. Coli	In the worst 50% of all lowland rural sites	**D** – 20-30% of the time, the estimated risk is >=50 in 1000 (>5% risk). The predicted average infection risk is >3%*. 5-year median = **130 n/100ml** Maximum = **10,000 cfu/100ml**	Likely Improving	≤1,000/100ml Faecal coliforms[#] Highly unlikely to meet standard
Clarity (Black Disc)	In the best 50% of all lowland rural sites	No NOF attribute band set 5-year median = **1.815 metres** Maximum = **6.2 meters** Seven results during 2009 – 2018 did not comply with PSWLP WQ standard	Indeterminate	≥ 1.6 m when flow below median flow (27.4 m3/s), Does not meet standard
Total Oxidised N	In the worst 25% of all lowland rural sites	**B** – Some growth effect on up to 5% of species. 5-year median = **0.94 g/m³** Maximum = **2.5 g/m³**	Not assessed	≤0.444 g/m³ (ANZECC, 2000)* Greater than this trigger value
Ammoniacal N	In the best 25% of all lowland rural sites	**A** – 99% species protection level. No observed effect on any species tested. 5-year median = **0.005 g/m³** Maximum = **0.04 g/m³**	Not assessed	<2.5-0.9 (pH 6.0-8.0) Meets standard
Dissolved Reactive P	In the best 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.006 g/m³** Maximum = **0.04 g/m³**	Not assessed	≤0.01 g/m³ (ANZECC, 2000)* Greater than this trigger value
Macroinvertebrate Community Index	Fair	MCI 5-year median = 95. Fair ecological condition. Indicative of only fair water quality and/or habitat condition.	Likely degrading	>90 Meets standard
Additional PSWLP Water Quality Stds		**Observed WQ range Jan 2009 – Dec 2018**		**PSWLP water quality standard (Lowland Hard Bed)**
Temperature		4.2 – 21 °C		≤23°C Meets standard
pH		7.0 – 7.8		6.5 – 9.0 Meets standard
Sediment cover		Not assessed by ES		
Dissolved oxygen		82 – 130% (7.4 – 14.4 g/m³) NOF Attribute **B** band		> 80 % sat. Meets standard
Bacterial/fungal slime		Not assessed by ES		
Periphyton		4.5 – 361 mg chl *a*/m² (annual sampling, 2004 - 2018) 92%ile = 158 mg chl *a*/m² NOF Attribute potentially **C**		<120 mg chl *a* /m² filam. algae < 200 mg/m² diatom/cyanob. Does not meet standard
Fish		Not assessed by ES		

∞Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.
[#] PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.
* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

5.4 These data indicate that water quality in all four major surface water bodies that receive drainage from these properties is degraded to a greater or lesser extent, and does not, or is currently unlikely to, meet all the relevant numerical standards or guidelines. This is generally the situation for all rivers in Southland that have the majority of their recharge coming from drainage through extensive agricultural land.

5.5 The water quality data has been compared with the PSWLP standards on the basis of simple maximum because those standards are specified as maximum values, not medians.

5.6 It is not possible to provide a comprehensive and definitive assessment of water quality in the context of all of the PSWLP water quality standards because not all the water quality standards appear to be monitored (sediment cover, bacterial/fungal slime and fish) and determining compliance with the water clarity standard effectively requires concurrent flow gauging. Flows are monitored on three of these rivers but a detailed analysis of hydrology information would be required to estimate or extract the flow at the time of sampling and flows are not measured at the Waimatuku Stream site. In addition, there are notes that accompany the sampling results that state that because of safety concerns clarity measurements have not been taken at very high flows, so a small number of high results are not included.

5.7 It is not of any significant benefit to undertake a detailed comparison of all water quality variables for each river/stream. Instead it useful to appreciate that while there are some significant differences there are three significant common broad water quality-related issues:

1. High concentrations of faecal indicator microorganisms;
2. Raised nutrient concentrations leading to plant growth in the stream and further downstream; and
3. Generally poor water clarity at times.

5.8 It is also useful to compare some key water quality variables to appreciate some significant apparent differences between the four rivers. This is outlined in the following table.

Table 6 Summary of some key water quality variables for the four rivers (Five year medians, 2012-2017)

	Orauea River	Aparima River	Waimatuku Stream	Oreti River
E. coli (n/100ml)	315	130	450	130
Clarity (BD) (m)	1.13	2.305	1.22	1.815
Total oxidised N (g/m^3)	0.415	0.665	3.0	0.94
Dissolved reactive P (g/m^3)	0.011	0.006	0.0425	0.006
Periphyton (mg chl-*a* /m^2) (83 & 92%iles)	49 (83 %ile)	181 (92 %ile)	88 (92 %ile)	143 (92 %ile)
MCI	93	100	87*	95

* Estimate

5.9 One key feature of the above summary table is that the Waimatuku Stream stands out as significantly degraded when compared to the other three rivers and with the exception of periphyton biomass, this is generally consistent across these key variables.

5.10 The LAWA water quality monitoring information only goes up to December 2017 (as at mid-August 2019). Additional information was provided separately from Environment Southland for the sites in Excel files. A comprehensive statistical comparison of this dataset with the LAWA statistical summaries has not been undertaken. However, more recent data has been compiled and presented along with the older data dataset, primarily to obtain a general understanding of recent water quality. One feature of the more recent data has been to illustrate the challenges in establishing meaningful statistical assessments. For example, the recent peaks in nitrate nitrogen has abruptly ended the apparent earlier five year trends of decreasing concentrations in all rivers except the Oreti River.

5.11 For the purposes of this report, it is not necessary to provide detailed comparisons of all key variables for all rivers over time.

Nitrate nitrogen concentrations

5.12 An example of the differences in water quality and the nature of the annual changes in nutrient concentrations is illustrated in the following diagram that compares the changes in total oxidised nitrogen in the four rivers over recent years.

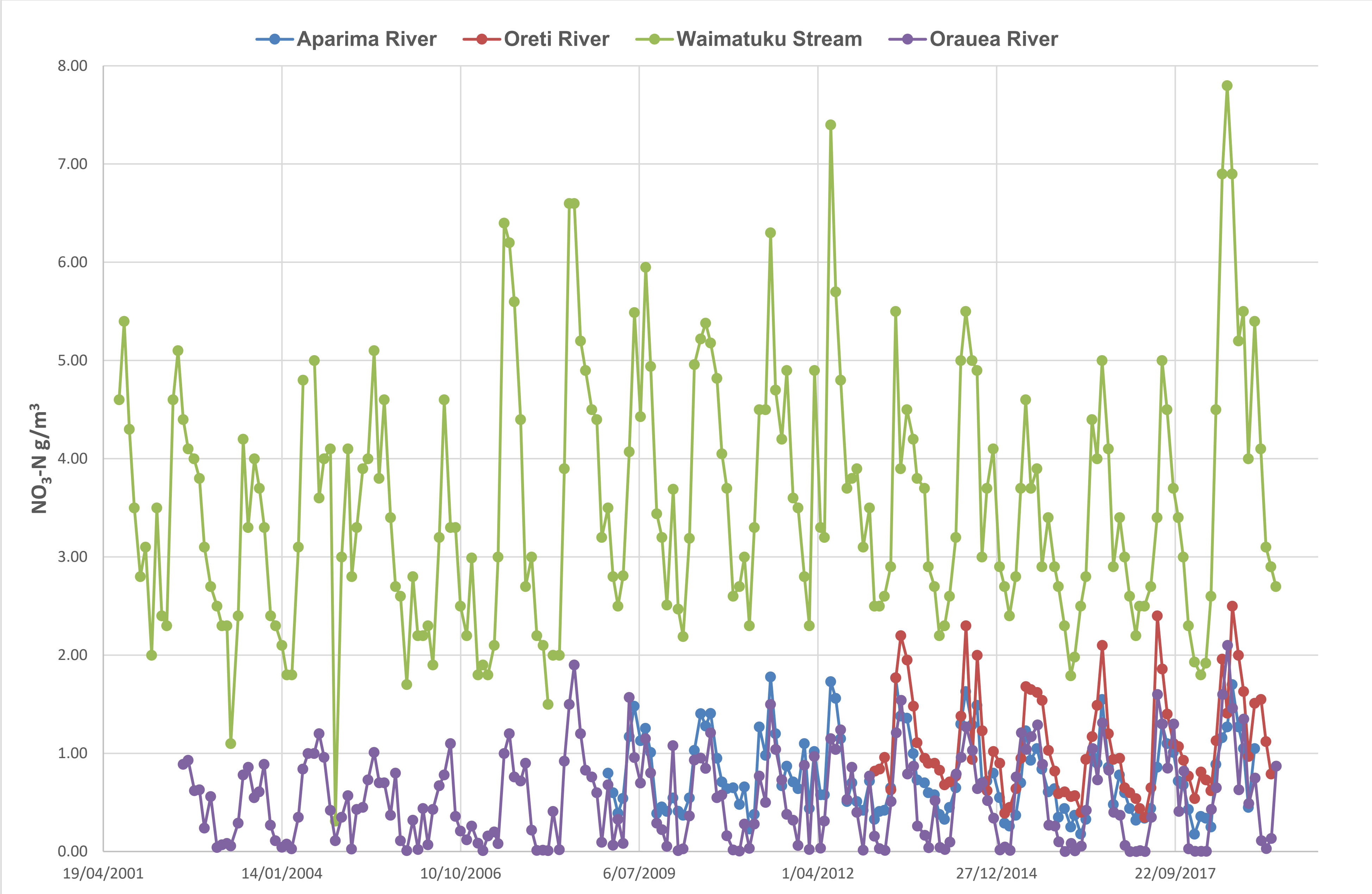


Figure 7 Total oxidised nitrogen changes over the last ~20 years in the four rivers/streams

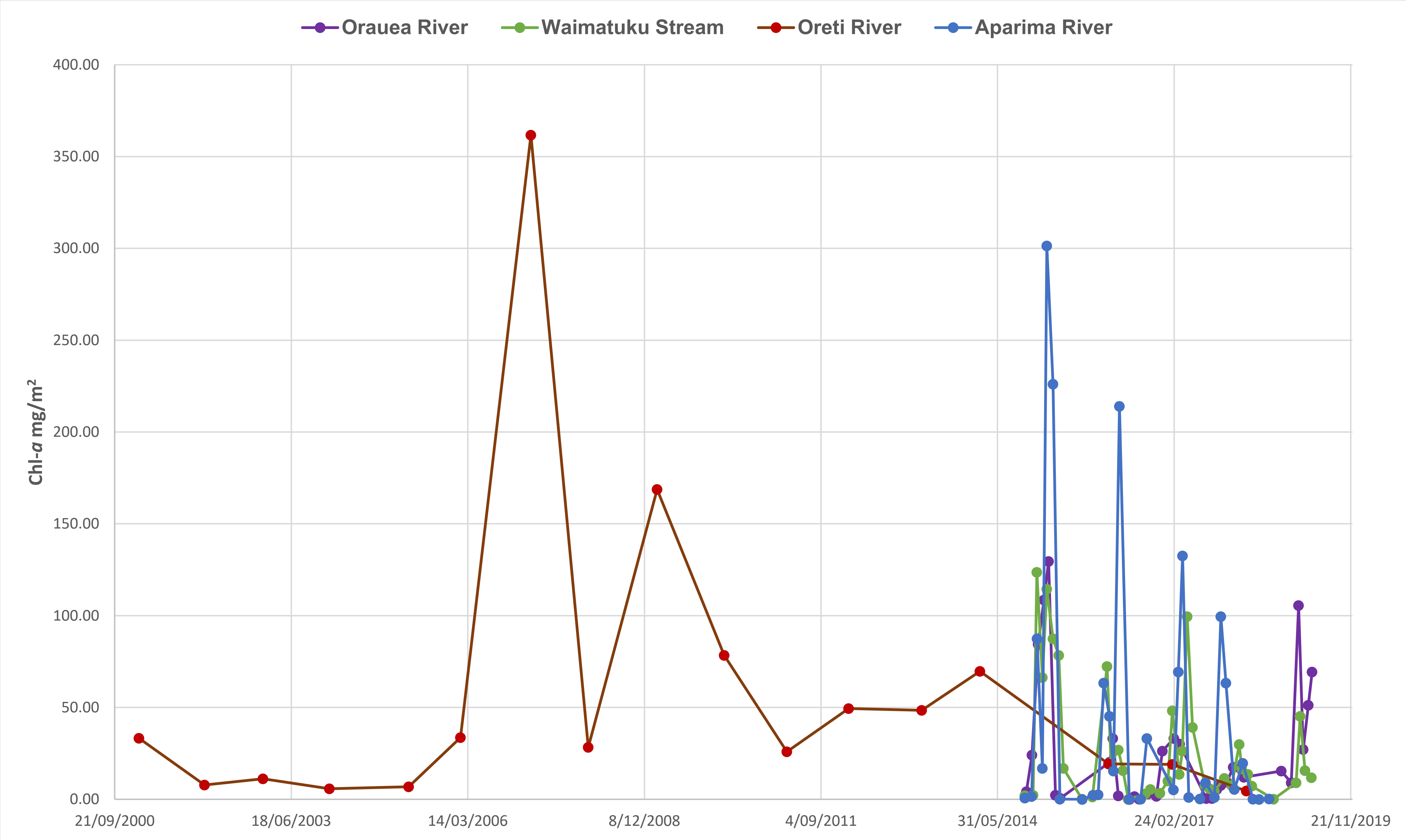


Figure 8: Periphyton chlorophyll-a biomass at four sites on the four rivers/streams

5.13 The nitrate nitrogen data illustrate the annual rise and fall in nitrate nitrogen concentrations that happens; generally during/after the winter period when surplus nitrogen in the soil profile drains through to groundwater and then moves through to surface water. In addition, the data highlights the significantly higher nitrate nitrogen concentrations in the Waimatuku Stream with annual winter high concentrations recently peaking at 7.8 g/m^3.

Periphyton biomass

5.14 The long-term data on periphyton for all four rivers are illustrated in Figure 7 above.

5.15 The nature of the sampling methodology and the range of factors controlling periphyton growth (e.g., substrate suitability) and biomass removal (e.g., in freshes and flood events) means that it is challenging to interpret both changes over time in one river and particularly in comparing one river with another. One feature that does stand out from Figure 7 is the apparently relatively low periphyton biomass in recent years. However, because this is not matched by similar reductions in river nutrient concentrations it would be inappropriate to assume that this reflects a reduction in nutrient sources.

5.16 It is also challenging to interpret periphyton data in terms of the NPSFM NOF attribute because of the methodology (including sampling frequency required) used in the NPSFM to define attribute state and the sampling frequency adopted by Environment Southland. The NPSFM indicates that monthly sampling for a minimum of three years is needed. However, Environment Southland has generally sampled approximately seven to nine times per year. Environment Southland also has an annual periphyton sampling programme.

5.17 The NPSFM requires that the River Environment Classification (REC) be used to distinguish between a “Productive” and “Default” category. In this situation, the Orauea River is defined as “Productive” because the REC Geology bed is defined as “Soft Sedimentary”. The Waimatuku Stream and the Oreti River are both defined as “Default” (Geology is “AL” or Alluvium). Similarly, the Aparima River at the Thornbury site has a REC geology class of “HS” or Hard Sedimentary Rock. This means that the States are defined in terms of these categories using a percentile attribute assuming monthly sampling for a minimum of three years.

5.18 Using the available data the periphyton information is included in tables 2 – 6 and figure 7. These calculations have been done to give an indication of the extent of periphyton biomass and because the data does not comply with the NPSFM requirements is not a complete assessment against the NPSFM periphyton attributes.

Additional sources of contaminants.

5.19 In addition to loss of contaminants to water from pastoral agriculture there are a range of other activities that result in contaminants entering these rivers such as arable land use, treated wastewater and stormwater from small settlements, septic tank discharges and stormwater discharges from roading and other settlements/activities.

Conclusions on current surface water quality

5.20 The available data indicate that the rivers/streams in this area have raised concentrations of faecal indicator bacteria, reduced clarity and raised concentrations of dissolved N and P, and as with probably all lowland rivers in Southland are likely to not comply with all the PSWLP water quality standards, specifically the faecal coliform and water clarity standards. The primary cause of reduced water quality is most likely contaminant losses from agricultural land use with minor contributions from other sources e.g., treated sewage and stormwater discharges, septic tank effluent discharges, and roading run-off.

5.21 There are some significant methodological issues involved in assessing water quality against standards, guidelines and attributes when the sampling of water quality has not always been consistent with the methodology prescribed for the standard and/or attribute.

5.22 The long-term water quality monitoring data indicate that agricultural land use activities in the catchment are having adverse effects on water quality and that long-term catchment-scale mitigation of a broad range of land uses and discharges are needed to reduce the concentrations of contaminants in surface waters to be consistent with national and regional statutory standards and relevant guidelines. However, it is unlikely that the current PSWLP faecal coliform standard could always be achieved in pastoral agricultural catchments.

5.23 A detailed assessment of water quality trends is beyond the scope of this report. However, it appears that peak concentrations of nitrate nitrogen in the Waimatuku Stream and the Orauea River are higher than they were 15 – 20 years ago. The concentrations of key contaminants in these rivers/streams are almost certainly greater than they were 35 years ago prior to the significant expansion of dairying in Southland[7].

Groundwater Quality

5.24 The results of Environment Southland's survey of regional nitrate nitrogen concentrations are provided as a layer within the Beacon public GIS system (Figure 9) and indicate that the WW1&2& HB properties are in an area where the underlying unconfined groundwater was likely to have been generally between 1.0 – 8.5 mg/l of nitrate nitrogen between 2007 – 2012, or indicative of "minor to high land use impacts". The 2007 – 2012 survey also indicated that a 'nitrate hotspot' exists to the south west of the WW1&2 property.

5.25 Similarly, the 2007-2012 survey indicates that the WW4&5 properties are primarily in an area of groundwater with nitrate nitrogen concentrations between 3.5 – 8.5 g/m^3. However, the amount of information that supports this contour map may not always be sufficient to justify making significant conclusions about the differences in groundwater quality in different locations.

5.26 Interpretation of the contour data should be done with great care because there are a limited number of results that have been used as the basis for developing these groundwater quality contours, and the source data includes results from a very wide range of bores. Many of these bores, particularly those that have been installed in recent years as a requirement of resource consent conditions are relatively shallow (<8 m depth) and some do not appear to have been installed with appropriate well head protection (in spite of bore land use consent conditions apparently requiring compliance with NZS 4411:2001 (Environmental standard for drilling of soil and rock).

5.27 A recent observation assessment (Attachment A) of six shallow bores used as part of the Environment Southland groundwater quality monitoring in this area indicated that most of them had a combination of poor wellhead protection and nearby potential surface contaminant sources that together potentially provide conduits for contaminated surface water to enter groundwater. Therefore it appears that it is likely that the data illustrated in Figure 9 may include some results that are caused by contaminated surface water entering groundwater via a

[7] Hamil K & McBride K (2003) River water quality trends and increased dairying in Southland, New Zealand, New Zealand Journal of Marine and Freshwater Research, 2003, Vol. 37: 323-332.

bore/well. If bores with poor wellhead protection were rectified it is possible that groundwater quality in this area could be improved.

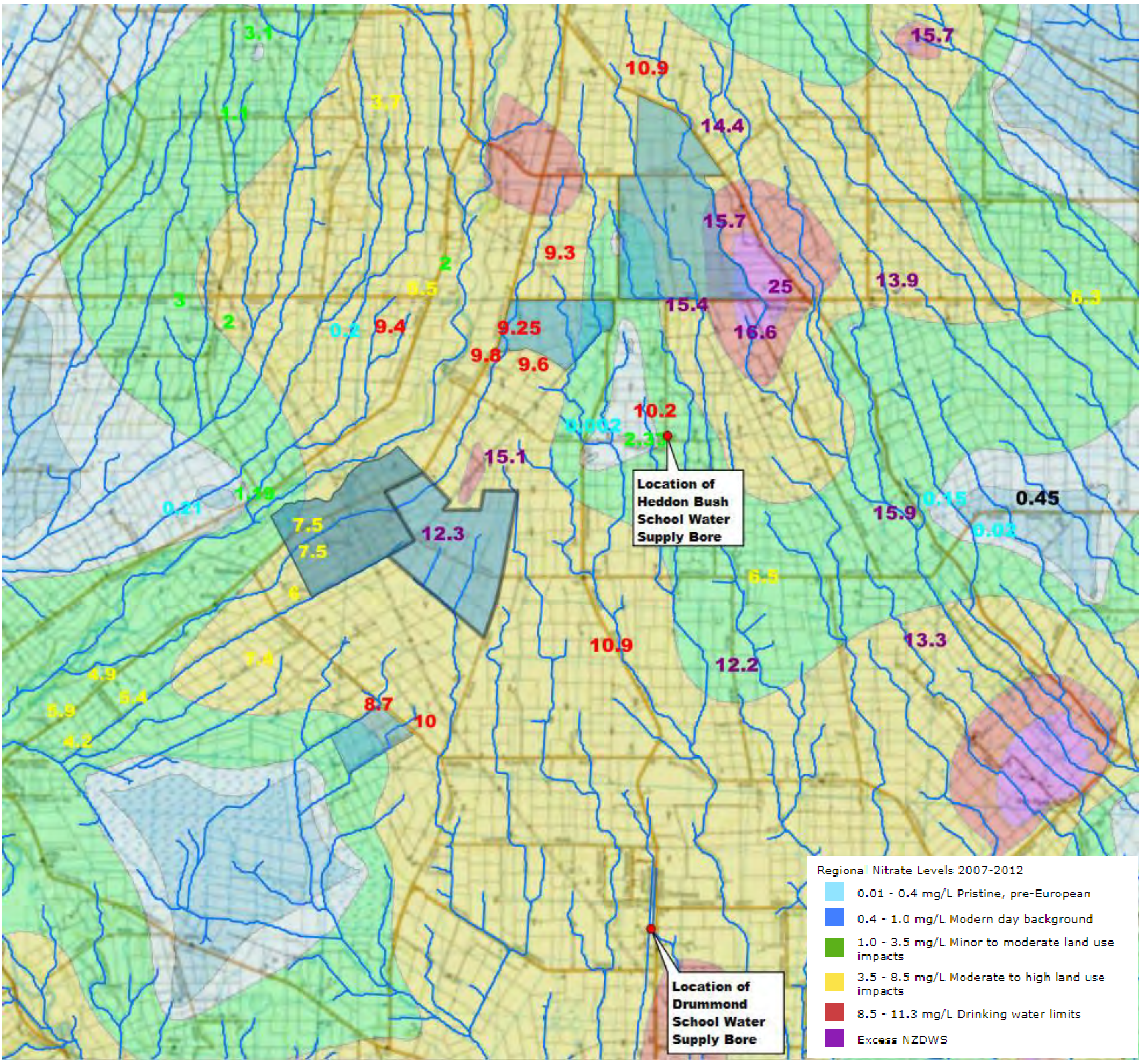


Figure 9: Environment Southland groundwater nitrate nitrogen concentration contour estimates for the period 2007 – 2012 with location of property overlaid, and more recent peak nitrate nitrogen results

5.28 A combination of a wide range of bore depths, timing of sampling, and poor wellhead protection means that interpretation of groundwater quality data is very difficult. Therefore there is some uncertainty about the extent that the reported groundwater quality data accurately represents groundwater quality, and the extent to which some data represents the effects of land use on groundwater quality or the effects of contaminated surface water entering groundwater via bores and/or bore casings. For example, the survey data include results from bores between 3 m and 20 m deep, and at least one Southland study has shown that nitrate nitrogen concentrations in deeper groundwater can have lower concentrations than found in shallow bores[8].

5.29 To further complicate the understanding of groundwater quality there is some indication from the reported measurements of water levels (i.e., significantly deeper than found in shallower bores) that some bores in this area may be tapping a lower confined or semi-confined aquifer that may be separated in part from the overlying unconfined groundwater.

5.30 The highest nitrate nitrogen results for groundwater samples taken from each bore post-2012 is also indicated as spot results on the above figure. All the data provided by Environment Southland has been mapped even though there are challenges involved in interpreting some data. For example, there is not enough information about the wellhead protection, topography, nearby contaminant sources, or depth of bore/screen depth to be able to confidently remove for example, bores that are too shallow, located in an effluent disposal location or currently at risk of contamination from surface runoff (e.g., bore E45/0622)

5.31 There are quite a few bores in the general area that have had nitrate nitrogen monitored over a significant period of time up to 2018. The results from these have been included in this report as ones that appear to provide some useful information on the characteristics of nitrate nitrogen in groundwater in this area. The following bores have been included: E45/0081 (2008 – 2018, reported but unverified depth of 6.5 m deep, no information on screen depth) and E45/0610 (2012 – 2018, reported but unverified 7.3 m deep, no information on screen depth), and

[8] Hughes B (2009) Review of groundwater quality monitoring results from the Heenans Corner nested piezometer site, 20p.

E45/0458 (verified 8.5 m deep with no screen depth information). All of these bores are relatively close to the properties.

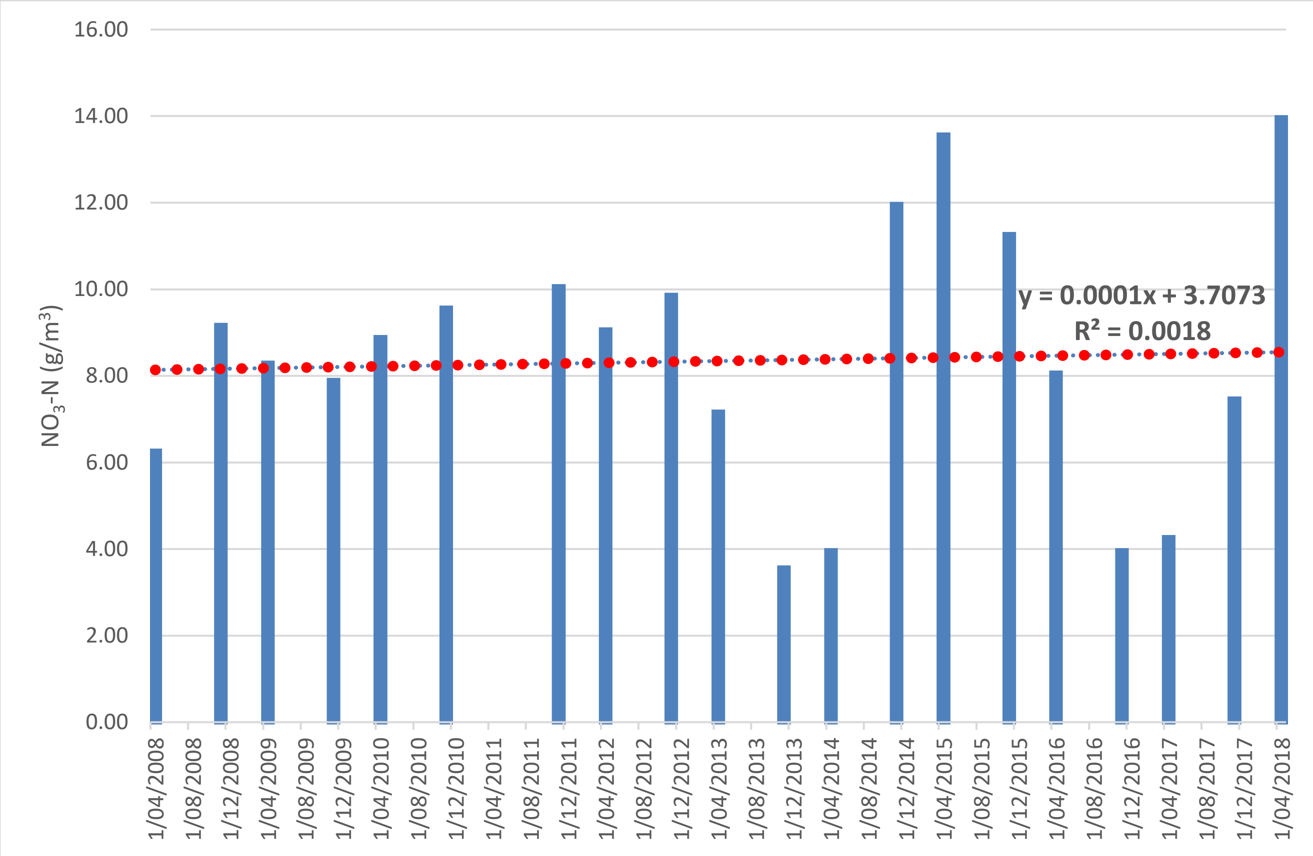


Figure 10: Nitrate nitrogen concentrations in groundwater from bore E45/0081, 2008-2018 (showing as a purple '13.9' east of the property in Figure 9)

5.32 The results from this bore (E45/0081, Figure 13) indicate some significant variability over time that may reflect real changes in regional groundwater quality, for example, the responses to increased drainage after a winter period with significant drainage and the possible decrease in nitrate nitrogen in response to the relatively dry period in 2017, with a significant increase in very recent years that possibly reflects an increase in drainage. However, the use code for the bore is noted in the Environment Southland system as a groundwater quality monitoring which is likely to indicate that it has been established to monitor the localised effects of dairy shed effluent disposal rather than regional groundwater quality. The low R^2 value of 0.0018 and the obvious peaks and troughs indicate that an overall trend is not obvious.

5.33 This bore was included in the observational assessment and was identified as having poor wellhead protection, close to contaminant sources, surface water flow path and stock access, indicating a potential for localised groundwater contamination via the bore.

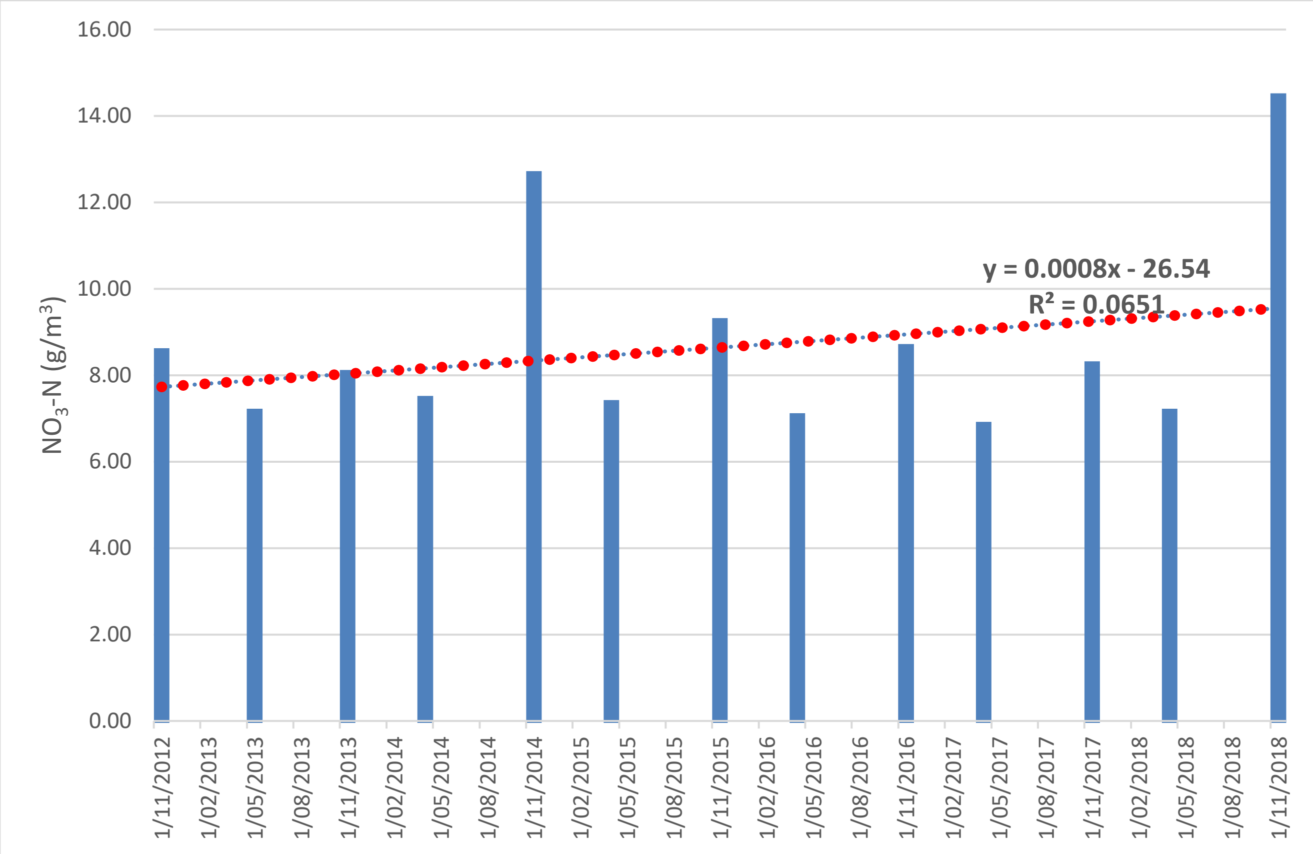


Figure 11: Nitrate nitrogen concentrations in groundwater from bore E45/0610, 2009-2018 (showing as a purple '14.4' north east of the property in Figure 9)

5.34 The data from bore E45/0610 potentially indicate similar summer and winter lows and highs in nitrate nitrogen concentrations. There is an apparent small increasing trend but the very low R^2 value indicates that there is little confidence that this indicates a real trend in groundwater nitrate nitrogen concentrations.

5.35 The use code for this bore is noted as dairy use rather than groundwater quality monitoring so it is less likely that groundwater from this bore is directly influenced by dairy shed effluent discharges. This bore was not inspected as part of the bore observation assessment.

5.36 The results from bore E45/0458 down-gradient from the Horner block are illustrated in the following figure. However, as noted for bore E45/0081, the use code for this bore is also noted in the Environment Southland system as a groundwater quality monitoring which is likely to indicate that it has been established to monitor the localised effects of dairy shed effluent disposal rather than regional groundwater quality. This bore was not inspected as part of the bore observation assessment.

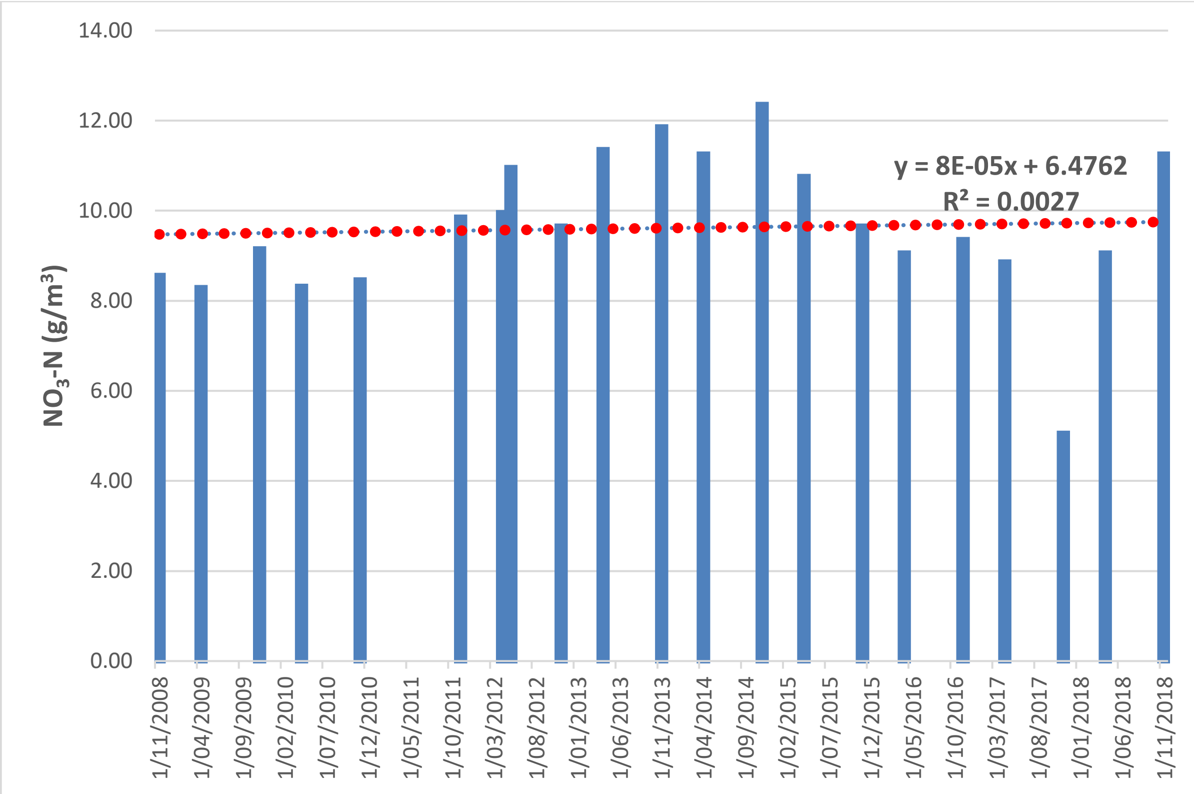


Figure 12: Nitrate nitrogen concentrations in groundwater from bore E45/0458, 2008-2018 (showing as a purple '12.3' south west of the property in Figure 9)

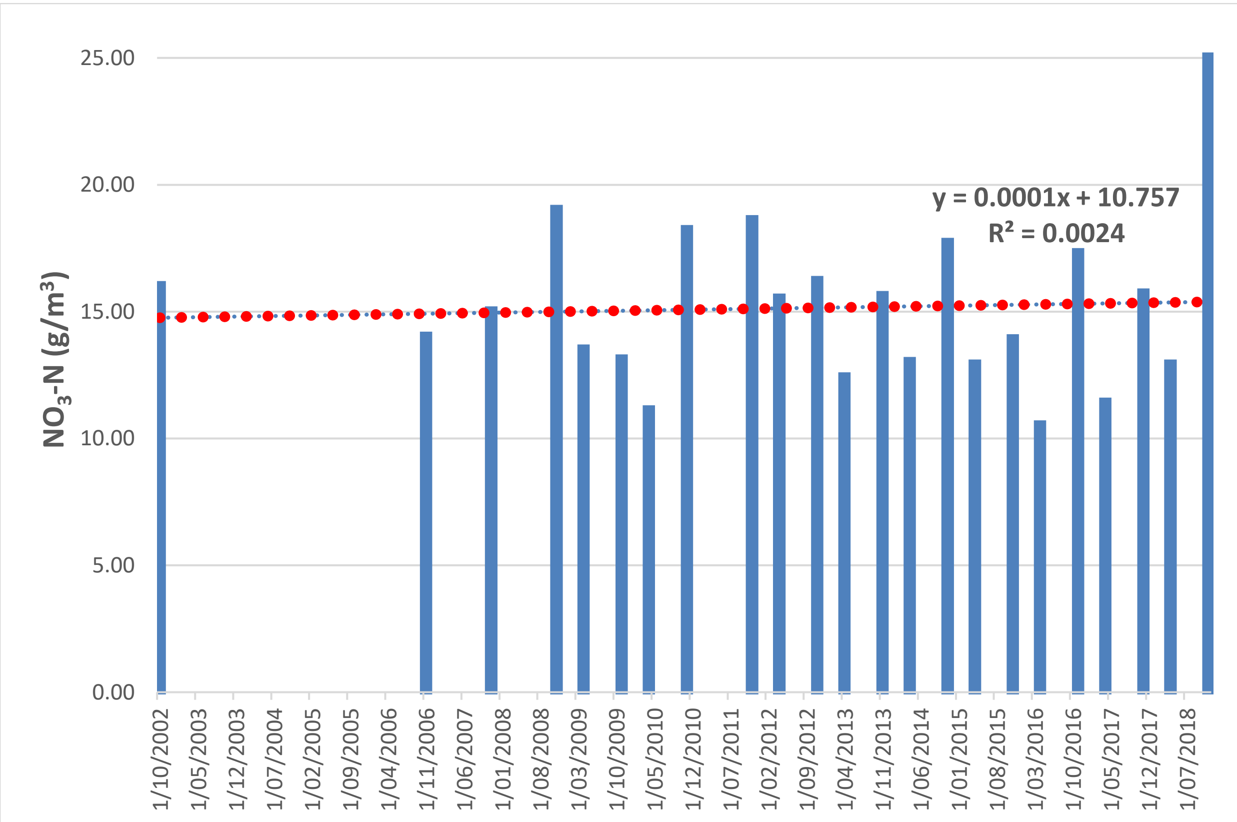


Figure 13: Nitrate nitrogen concentrations in groundwater from bore E45/0060, 2002-2018 (showing as a purple '25' south east of the property in Figure 9)

5.37 The very high concentrations found in groundwater from bore E45/0060 are likely to be related to the proximity to a dairy shed and effluent pond immediately upgradient from the bore of unverified depth. These concentrations are consistently high but with some peaks indicating a possible local source of contamination.

5.38 This bore was included in the observational assessment and was identified as having poor wellhead protection, close to contaminant sources, surface water flow path and close but not immediate stock access, indicating a potential for localised groundwater contamination via the bore.

5.39 The potential limitations of some of the groundwater data are particularly apparent from the results of sampling from bore E45/0622 which is referred to in the main AEE. The results for this bore from 2013 to 2018 are illustrated below. The peak nitrate nitrogen result for 2016 appears to highlight the pitfalls with very shallow (3 m deep, unverified) well/bore without adequate wellhead protection for groundwater quality monitoring. The peak is highly unlikely to represent the quality of the underlying groundwater which is more likely to be represented by the other results that appear to range between 2 – 6 g/m^3 of nitrate nitrogen.

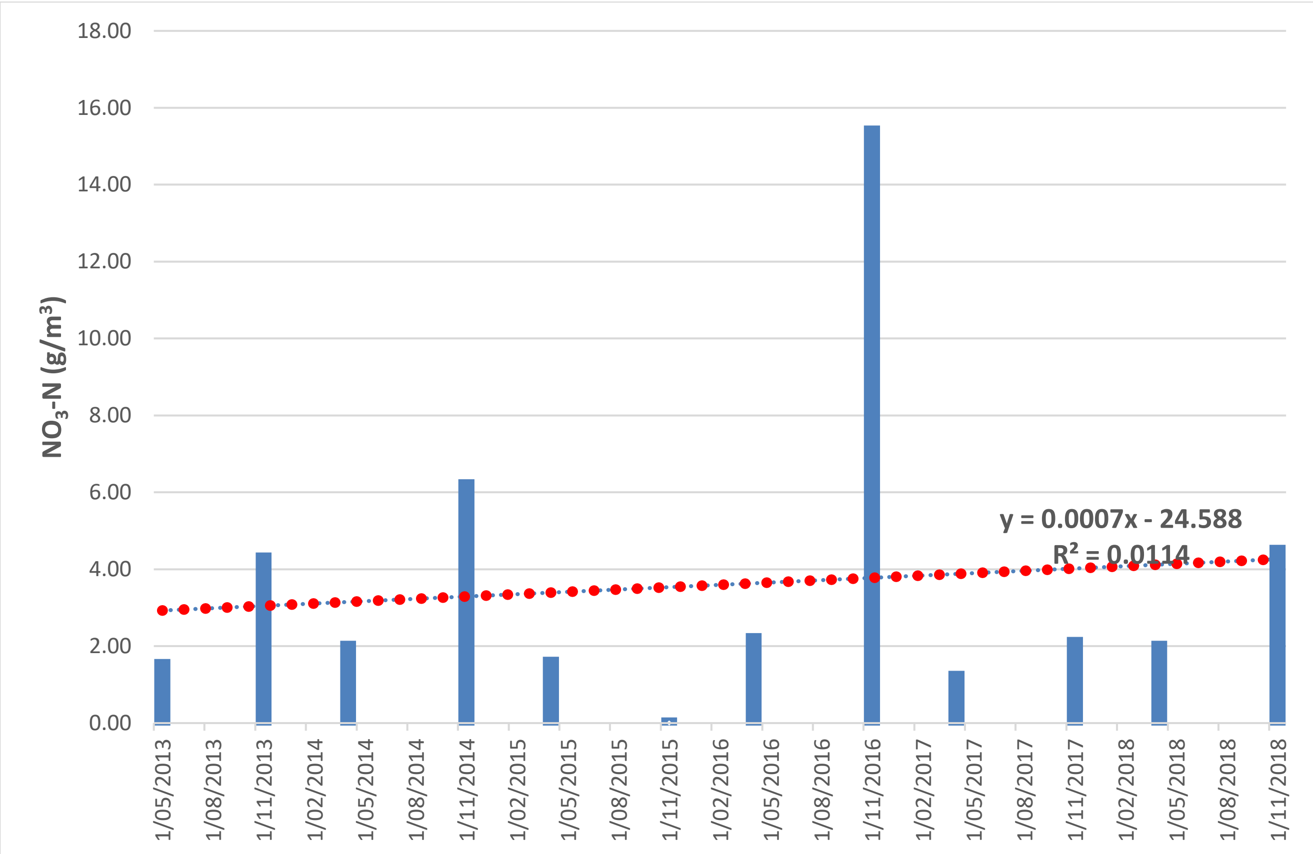


Figure 14: Nitrate nitrogen concentrations in groundwater from bore E45/0622, 2013-2018 (showing as a purple '15.4' south of the property in Figure 9)

Figure 15: Bore E45/0622 in early 2019, showing the lack of wellhead protection and potential for surface water runoff entry

5.40 Bore E45/0622 is scheduled to be modified in late August/early September to raise the well significantly above ground level and a concrete apron will also be installed to ensure that this well meets the requirements of NZS 4411:2001.

5.41 The bore at the Heddon Bush School (E45/0718) has been sampled by Environment Southland in 2017 and is included in Figure 9. However, additional sampling has been undertaken by Dairy Green Limited and analysed at the Watercare (IANZ accredited for nitrate nitrogen testing) and all these results are listed in the following table.

Table 7 Summary of groundwater sample results for bore E45/0718

Date	Nitrate nitrogen (g/m^3)	E. coli (MPN/100ml)
2/6/17 (ES sample)	2.33	<1.0
2/11/17[9]		<1
18/12/17	2.0	<1.0
12/1/18	1.8	<1.0
15/2/18[8]		<1
14/3/18	1.8	<1.0

[9] Analysed by Invercargill Water Testing Laboratory, Ministry of Health approved laboratory.

Conclusions on groundwater quality

5.42 In general, much groundwater quality data reflects the predominant rural land use in the catchment contributing to nitrate nitrogen leaching through to groundwater. A key potential effect is the discharge of groundwater with elevated nitrate nitrogen concentrations to surface waters i.e., the contribution of nitrogen to surface waters contributes to plant growth in streams, and the subsequent rivers, and at the bottom of the catchment in the Jacobs River Estuary. However, the number of groundwater quality samples that appear to have relatively high nitrate nitrogen concentrations are also a potential concern because of the use of groundwater as a source of drinking water (drinking water nitrate nitrogen standard (maximum acceptable value) is 11.3 g/m^3).

5.43 The locations of many groundwater monitoring bores and the many examples of poor wellhead protection mean that it is very challenging to interpret results.

5.44 A 2014 study on a bore near Heenans corner just south west of WW1&2 strongly indicated that groundwater at a depth of approximately 16 m had a significantly lower (~5 g NO_3-N/m^3) concentration of nitrate nitrogen than found in the shallower bores (~12 g NO_3-N/m^3) at the same location. This does indicate that some deeper groundwater in this area may be older groundwater less affected by the affects of the recent decades of land use[10].

5.45 Notwithstanding the significant limitations and difficulties in interpreting the available groundwater nitrate nitrogen data, there are some conclusions that can be tentatively drawn:

- Compared to the 2007 – 2012 survey, groundwater nitrate nitrogen concentrations appear to be generally higher, this is particularly evident with the large number of relatively high results in areas where concentrations may have been lower. However, it is also possible that this may not be a result of more intensive land use and may in part at least be a consequence of other factors relating to monitoring bore locations and wellhead protection.
- Some high nitrate nitrogen results reflect localised effects of dairy shed effluent disposal rather than more regional groundwater quality. However, if a large number of effluent disposal applications are causing significant deterioration of localised groundwater quality this could eventually give rise to a more extensive impact on groundwater quality.

[10] Hughes B (2009) Review of groundwater quality monitoring results from the Heenans Corner nested piezometer site, 20p.

Conversely, it is also possible that very localised high results are being extrapolated beyond their actual affected area to indicate a larger area than actually exists.

- It is highly likely that some high nitrate nitrogen results have been caused by contaminated surface water entering bores with inadequate wellhead protection.
- The number and extent of very high nitrate nitrogen groundwater quality results provided from Environment Southland sampling are not reflected in the same very high concentrations in downgradient surface water quality indicating that: the high nitrate nitrogen groundwater is diluted by lower concentration groundwater; there is a significant lag in travel time to surface water; surface water quality sampling may be missing peak surface water nitrate nitrogen concentrations; the contribution of groundwater recharge to flows is minimal; the groundwater sample results are not indicative of regional groundwater quality; or a combination of all of these potential factors.
- To obtain a more comprehensive understanding of the state of groundwater quality and the activities that may be affecting local and regional groundwater quality would need a detailed assessment of each bore and its setting which is beyond the scope of this report.

Assessment of effects on drinking water supplies sourced from groundwater

5.46 There are many individual property drinking water supplies as well as the Heddon Bush School water supply downgradient from the properties associated with both the land use consent applications and the discharge permit application.

5.47 The WW1/2 and HB properties are spread over two main soil types that differ significantly in terms of the predominant contaminant pathways. The predominant Braxton and Pukemutu soils are poorly drained and the predominant pathway is via runoff and artificial drainage. Conversely, the Glenelg soils are well drained providing a transport route to groundwater. The greatest risk to shallow bores used to supply drinking water is in areas with well-drained soils in locations with activities that can result in contaminants leaching through soils into groundwater.

5.48 The two primary issues for groundwater-sourced drinking water supplies in areas are nitrate nitrogen and faecal indicator organisms (indicators of pathogens, disease-causing organisms). The difficulties involved in understanding current factors influencing nitrate nitrogen concentrations have been outlined above. The factors involved in influencing the transport of faecal indicator organisms are similarly complex, but with the added complexity of a range of complex attenuation factors apply to microorganisms that do not apply to dissolved nitrate nitrogen.

5.49 It has been recognised for many decades that shallow groundwater in those parts of Southland (and other parts of New Zealand) with pastoral catchment land use is vulnerable to microbiological contamination[11]. This 1998 study showed that 75% of the wells sampled and 25% of the bores sampled had faecal coliforms detected. This and other studies around New Zealand have demonstrated that shallow bores/well in areas with well-drained soils and pastoral agriculture are vulnerable to microbiological contamination.

5.50 The good management practices and mitigation measures that are proposed will result in a significant reduction in N loss to groundwater and in P loss to surface water. It is noted elsewhere in this report that it has been generally accepted that the significant reduction in P loss to surface water will also result in a reduction in the risk of microbiological loss to surface water. While there does not appear to be any New Zealand specific research into the consequences for microbiological groundwater quality of mitigation measures designed to reduce N loss to groundwater and P/sediment/microbiological loss to surface water. It is conceivably possible that some mitigation measures could theoretically result in a small increased risk of microorganisms entering soils then eventually entering the underlying groundwater. For example, recontouring laneways and installing culvert cut-offs to ensure that contaminated surface water doesn't enter surface water means that that water is redirected onto soils to allow it to slowly drain into soils.

5.51 However, it would be a complex process to then assess the extent to which a small potential occasional increase in microorganism application to soils could then eventually move into groundwater and then migrate through an aquifer towards drinking water supplies. The scope of this report does not allow a quantitative assessment of the potential risks. In the context of the existing relatively high risk of microbiological contamination of shallow groundwater supplies, it is highly likely that the increased risk posed by these mitigation measures would be insignificant.

[11] Hamil K (1998) Groundwater Quality in Southland" A Regional Overview, Southland Regional Council Publication No 96, 51p.

Estuary water quality

5.52 The four rivers/streams that are relevant to this report have four separate estuary systems:

- The Orauea River discharges int the Waiau River which discharges into the Waiau Lagoon
- The Aparima River discharges into the Jacobs River Estuary
- The Waimatuku Stream discharges into the Waimatuku Lagoon
- The Oreti River discharges into the New River Estuary

5.53 The key water quality issues in all these locations are eutrophication and sedimentation that appears to be driven by N, P and sediment loads to the estuary from the main surface water inputs. Broad-scale mapping has been undertaken by Wriggle Coastal Management for all of these locations at various times including recent (2018) surveys of the Waimatuku Estuary, Jacobs River Estuary[12] and the New River Estuary[13]. The Waiau Lagoon appears to have been surveyed most recently in 2009.

5.54 Generally, the Jacobs River Estuary and New River Estuary have shown evidence over the past 20 years of increased eutrophication with increased coverage by opportunistic macroalgae, combined with soft, poorly oxygenated mud, and decreasing seagrass and saltmarsh. Conversely, the Waiau Lagoon and the Waimatuku Estuary appear to be significantly different estuaries with comparatively well flushed environments. The Waiau Lagoon has been described[14] as in "*Stage 2 (Moderate) condition*" based on biological observations of plant species and predominantly muddy bottom with available bare habitat. The Waimatuku Estuary has been described[15] as follows: "*…low-moderate state overall in relation to subtidal channel condition and trophic status, indicating conditions have deteriorated slightly since 2012. Given its above threshold catchment nutrient load coupled with potential further eastward mouth migration and consequent constriction, eutrophication (presently expressed as*

[12] Stevens, L.M. 2018. Jacobs River Estuary: Broad Scale Habitat mapping 2018. Report prepared by Wriggle Coastal Management for Environment Southland.

[13] Robertson, B.M., Stevens, L.M., and Dudley, B. 2017. New River Estuary - review of water quality data in relation to eutrophication 1991-2015. Report prepared by NIWA and Wriggle Coastal Management for Environment Southland. 33p.

[14] Robertson, B.M. and Stevens, L.M. 2009. Waiau Lagoon 2009 Synoptic survey, macrophyte mapping and vulnerability assessment. 22p.

[15] Robertson, B.P. and Robertson, B.M. 2018. Waimatuku Estuary: Fine Scale Monitoring and Macrophyte Mapping 2018. Report prepared by Wriggle Coastal Management for Environment Southland. 29p.

nuisance macroalgal production and reduced sediment oxygenation in the upper-middle estuary) and to a lesser extent sedimentation are expected to be ongoing issues in the estuary."

5.55 Nutrient loads to the main estuaries in Southland have been estimated by Aqualinc[16]. These are outlined in the following table.

Table 8: Summary of estimated N and P loads to eight Southland catchments

Catchment	Current catchment agricultural source loads (t/year)		Total catchment source nitrogen load (t/yr)	Estimated realised nitrogen loads (t/yr)	Estimated attenuation (%)
	Nitrogen	Phosphorus			
Bluff_Harbour	19	1	36	29	20
Haldane_Estuary	23	0	39	26	33
Jacobs_River_Estuary	1958	53	2133	1300	39
Lake_Brunton	20	0	20	14	30
New_River_Estuary	4969	139	5513	3718	33
Toetoes_Harbour	6256	142	6617	4392	34
Waiau_River	2714	35	4970	1864	62
Waikawa_Harbour	144	4	176	180	-2
Total/average	16,102	374	19, 404	11,524	31 (average)

5.56 The Aqualinc report further identified the potential nutrient load reductions that could result from various levels of mitigation. These are summarised in the following two tables.

[16] Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

Table 9: Estimated reductions in the agricultural source loads under three levels of mitigation for all dairy farms in each Southland catchment

Catchment	M1			M2			M3		
	Nitrogen	Phosphorus	Overall[1]	N	P	Overall[1]	N	P	Overall[1]
Bluff_Harbour	4	26	2	4	29	2	12	29	6
Haldane_Estuary	0	0	0	0	0	0	0	0	0
Jacobs_River_Estuary	6	28	5	8	31	6	18	31	15
Lake_Brunton	0	0	0	0	0	0	0	0	0
New_River_Estuary	6	29	5	8	32	7	18	32	15
Toetoes_Harbour	3	17	3	4	19	4	10	18	9
Waiau_River	1	9	0	1	9	1	4	9	2
Waikawa_Harbour	1	4	1	1	5	1	2	5	2

5.57 The full suite of mitigations assessed by Aqualinc includes the following measures.

Table 10: Description of mitigations assumed to apply under each mitigation level

Mitigation level	Name	Sheep & Beef	Dairy
Mitigation level 1	M1	• Optimised nutrient inputs • Low solubility P • Wetlands	• Stock exclusion from streams • Improved nutrient management • Improved farm dairy effluent (FDE) management
Mitigation level 2	M2	• Stock exclusion from streams • Reduced stocking rates, improved productivity	• Wetlands • Improved FDE management • Reduced stocking rates, improved per animal productivity.
Mitigation level 3	M3	• Grass buffer strips • Feed pad for beef cattle	• Restricted grazing strategies • Grass buffer strips • Improved FDE management

5.58 The proposal provides for all the relevant mitigation measures suggested by the Aqualinc report, with the exception of wetlands. It has not been possible to determine exactly what stocking rate was envisaged in the Aqualinc report or the NZIER report that it was partly based on. However, the winter barn systems proposed as part of the WW4&5 applications are likely to be significantly different from the systems modelled in the Aqualinc report.

6 Implications of water quality for targeting of mitigation

6.1 The water quality results indicate that priorities for contaminant loss mitigation should be faecal indicator organisms, sediment, N, and P. This is largely reflected in the assessment of the physiographic zones (see main AEE) that indicate risks from both artificial drainage and surface runoff because of the generally heavy soils in both areas.

6.2 The primary contribution to the observed water quality issues presented earlier in this report will be from land use activities upstream and downstream in the catchment, with only a relatively tiny contribution from the individual properties.

7 Contaminant loss mitigation proposals, modelling and water quality

Existing and proposed good management practices and mitigation

7.1 The AEEs, the nutrient loss modelling and the Farm Environmental Management Plans (FEMPs) detail the existing good management practices (GMPs) that are currently being implemented on the property and the additional mitigation practices that will be implemented to mitigate nutrient losses from the properties. The following assessments build on that work, particularly the estimates of contaminant losses to water to estimate the effects on water quality.

Overseer and uncertainty

7.2 The nutrient loss modelling undertaken by Mr Duncan and Mr Crawford has primarily been undertaken using OverseerFM (Overseer). Overseer is a complex model that involves combining a model of a farm system together with information on soil characteristics and the long-term climate to estimate the average annual loss of nitrogen and phosphorus to water. Overseer like any complex model of a biological system has inherent uncertainties. The implications of this and other considerations for the use of Overseer as a regulatory tool have been detailed in a report by Freeman *et al*[17].

7.3 The Overseer estimates and effects on water quality have all been undertaken in the light of the inherent uncertainties involved in the application of Overseer.

[17] Freeman, M, Robson, M, Lilburne L, McCallum-Clark, M, Cooke, A, & McNae, D. (2016) Using OVERSEER in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

Overseer modelling and water quality effects

7.4 The evidence prepared by Mr Duncan and Mr Crawford details the Overseer and other modelling undertaken to estimate the N and P loss to water associated with the proposed developments. The following tables provide summaries of current and estimated N and P losses to water.

Table 11 Summary of the N and P loss estimates for the WW1&2 current and proposed scenarios

Woldwide One & Two			
	Current Farm System	Proposed Farm system	Reduction
N (kg/yr)	20,427	18,932	-7.3%
P (kg/yr)	360	338*	-6.1%

* Includes non OverseerFM modelling of P loss mitigation. Refer to Cain Duncan, Tiaki reports

Horner Block			
	Current Total Farm System	Proposed Total Farm system	Reduction
N (kg/yr)	3,155	3,107	-1.5%
P (kg/yr)	24	22	-8%

Combined Woldwide One & Two & Horner Block			
	Current Total Farm System	Proposed Total Farm system	Reduction
N (kg/yr)	23,582	22,039	-6.5%
P (kg/yr)	384	360	-6.3%

Table 12 Summary of the N and P loss estimates for the WW4 (including Gladfield) current and proposed final farm system

Woldwide Four Current & Final Proposed			
	Current Farm System	Proposed Farm system	Reduction
N (kg/yr)	11,792	9,550	-19%
P (kg/yr)	340	337	-0.9%

* Includes non OverseerFM modelling of P loss mitigation. Refer to Mark Crawford, Ravensdown reports

Table 13 Summary of the N and P loss estimates for the WW5 current and proposed final farm system

Woldwide Five Current & Final Proposed			
	Current Farm System	Proposed Farm system	Reduction
N (kg/yr)	15,978	14,378	-10.0%
P (kg/yr)	239	231	-3.3%

* Includes non OverseerFM modelling of P loss mitigation. Refer to Mark Crawford, Ravensdown reports

Table 14 Summary of the N and P loss estimates for WRO current and proposed

Woldwide Five Current & Final Proposed			
	Current Farm System	Proposed Farm system	Reduction
N (kg/yr)	23,033	22,603	-1.9%
P (kg/yr)	516	433	-16%

* Includes non OverseerFM modelling of P loss mitigation. Refer to Cain Duncan, Tiaki reports

7.5 A critical consideration in the context of the estimated nutrient losses is what the implications are of the inherent uncertainties in Overseer and other modelling. The absolute uncertainties involved with Overseer modelling have been commented on extensively and are referred to in the previous reference. However, it is important in this situation to appreciate that that Overseer is not being used to assess compliance with a catchment-based N loss property target. Overseer is being used to estimate losses compared to baseline for one farm system. Many of the concerns about uncertainties involved in Overseer estimates are focused particularly on the former situation i.e., comparing a farm nutrient loss estimate with an absolute N loss target prescribed in a regional plan and/or resource consent. That is a very different situation than the relative comparison that is the focus of these applications. Here the reference point is one existing property, particularly one that is located in a situation that is similar to those used to calibrate key components (or sub-models) of Overseer, the uncertainties are significantly reduced[18]. Indeed, comparisons of modelled and measured nitrate losses for dairy farms in Southland found[19]:

- *"Given the inherent uncertainty associated with measuring and modelling N leaching, there was good agreement between Overseer estimates and measured values reported for 3 key experimental sites in Southland.*
- *Estimates of drainage volumes, based on annual rainfall inputs to the model also agreed reasonably well with those derived from a daily soil water balance model.*
- *The agreement between measured and modelled values indicates that the Overseer model is performing well for this combination of soil-climate-management factors."*

[18] Shepherd M *et al* (2013) Overseer: accuracy, precision, error and uncertainty, FLRC workshop proceedings
[19] Smith, C & Monaghan R (2013) Comparing OVERSEER estimates of N leaching from grazed winter forage crops with results from Southland trial sites, Report for Environment Southland, RE500/2013/123

7.6 This investigation was done with Overseer version 6.1 in 2013 prior to a major change to the hydrological model that would likely have significantly improved drainage estimates.

7.7 Therefore, given that the Overseer N and P loss estimates are being used to compare losses for one property on a relative and not absolute basis, there will be a very low level of uncertainty about the extent to which estimated reductions or increases reflect real reductions or increases.

7.8 All modelling of long-term annual average estimates of N and P loss to water involve uncertainties, i.e., limitations in parts of the modelling process that is a result of incomplete knowledge. Uncertainty is the most relevant term to use for annual average estimates of N and P loss from a whole farm system[20]. However, the uncertainties involved in Overseer modelling are not currently able to be quantified. They are probably greater than 30% for both N and P modelling[21].

7.9 There are two significant implications of this:

- The estimated differences between the current and proposed farm system nutrient loss estimates is significantly less than the likely uncertainties involved in Overseer modelling.
- Overseer modelling should be considered in conjunction with the specific farm systems and mitigation measures that are proposed, to provide a reasonable level of certainty about the relativities of nutrient loss estimates.

7.10 This means that while there may be a relatively high level of uncertainty about nutrient loss estimates, if there are clear, measurable and verifiable changes to one farm system there will be a high level of certainty about the relative changes to long-tern annual average nutrient loss estimates[22]. Therefore, provided that there is assurance that the farm system changes have occurred there will be a high level of certainty there will be relative reduction in long-term annual average N and P losses to water.

7.11 It is difficult of course to model the resultant changes in water quality that would result from decreased nutrient losses to water. At one level it could be sufficient to simply assume that a significant reduction in nutrient losses will be reflected in a reduction in the loading to the

[20] Shepherd M *et al* (2013) Overseer: accuracy, precision, error and uncertainty, FLRC workshop proceedings
[21] Wheeler D & Shepherd M (2013) Overseer: Answers to commonly asked questions, RE500/2012/027
[22] Freeman, M, Robson, M, Lilburne L, McCallum-Clark, M, Cooke, A, & McNae, D. (2016) Using OVERSEER in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

relevant receiving water body. However, given the importance an assessment of that is undertaken in the context of the specific receiving environment.

Surface water and groundwater catchments

7.12 The specific surface water catchments for WW1&2 and the Horner Block are illustrated in the following figure:

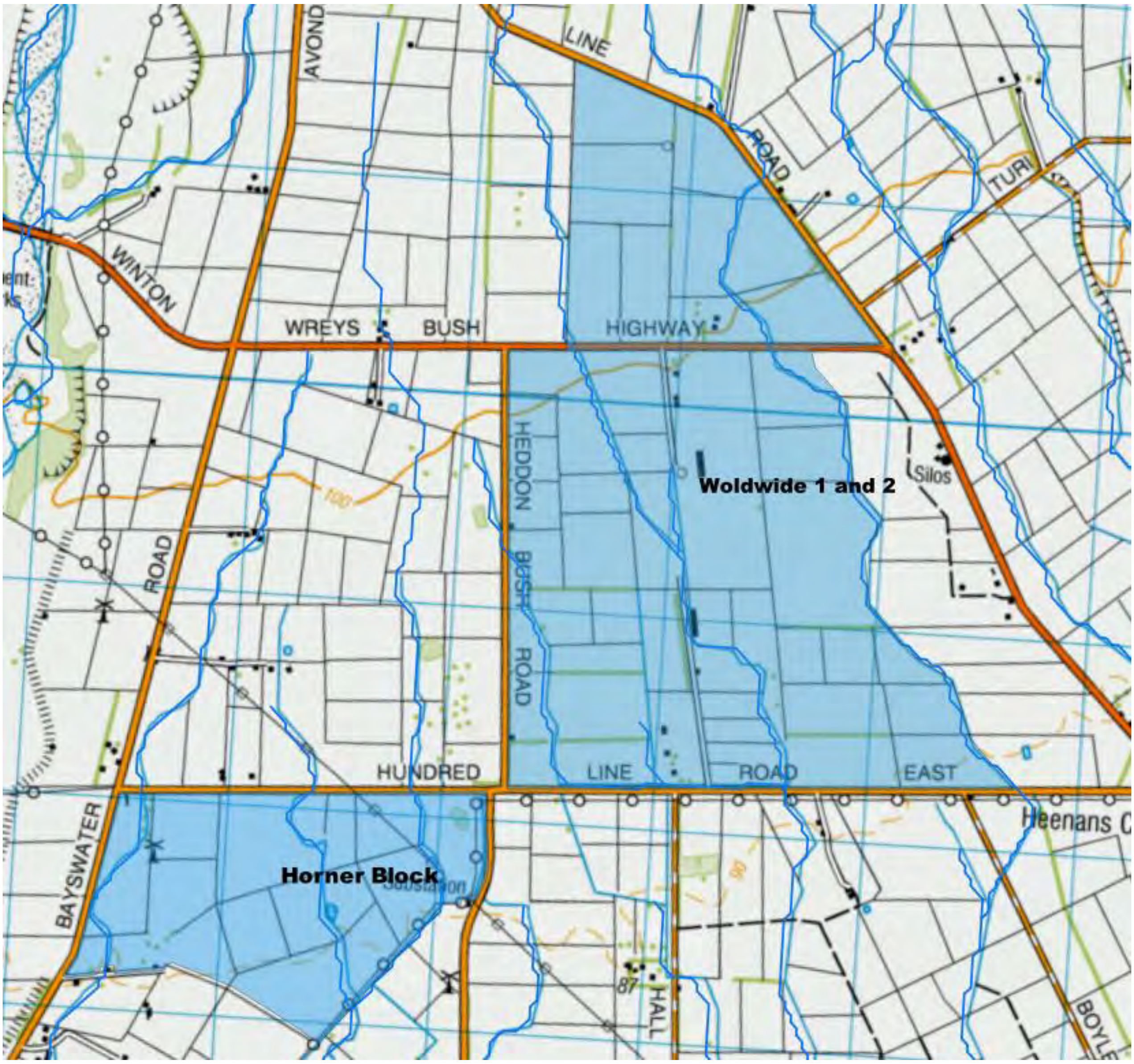


Figure 16: Woldwide 1 & 2 and the Horner Block and key streams/drains

7.13 As noted earlier in this report, the information in the above figure illustrates the locations of the key streams/drains on the properties with the easternmost stream in the Oreti River catchment and the westernmost stream in the Aparima River catchment, with the streams in between draining to the Waimatuku Stream. The nutrient loss modelling has not been 'blocked' on the basis of surface water catchments and the information available, for example, for effluent application on the Horner Block indicates that it is valid to assume that no individual stream would be subject to an increase in nutrient loss. Therefore there is strong evidence to justify a conclusion that all streams that leave the properties would have small reductions in the nutrient losses entering those streams, both in terms of P losses via overland flow and N losses that would occur via artificial drainage to those streams and via recharge further downstream in the catchments.

7.14 The groundwater contour mapping illustrated in Figure 6 strongly indicates that the majority of groundwater that receives drainage from the WW1&2 and Horner Block properties will move in a southerly direction and is likely to eventually recharge the Waimatuku Stream further down the catchment. Nitrogen loading reductions will contribute to a very small loading to groundwater that moves down-gradient in the Waimatuku catchment.

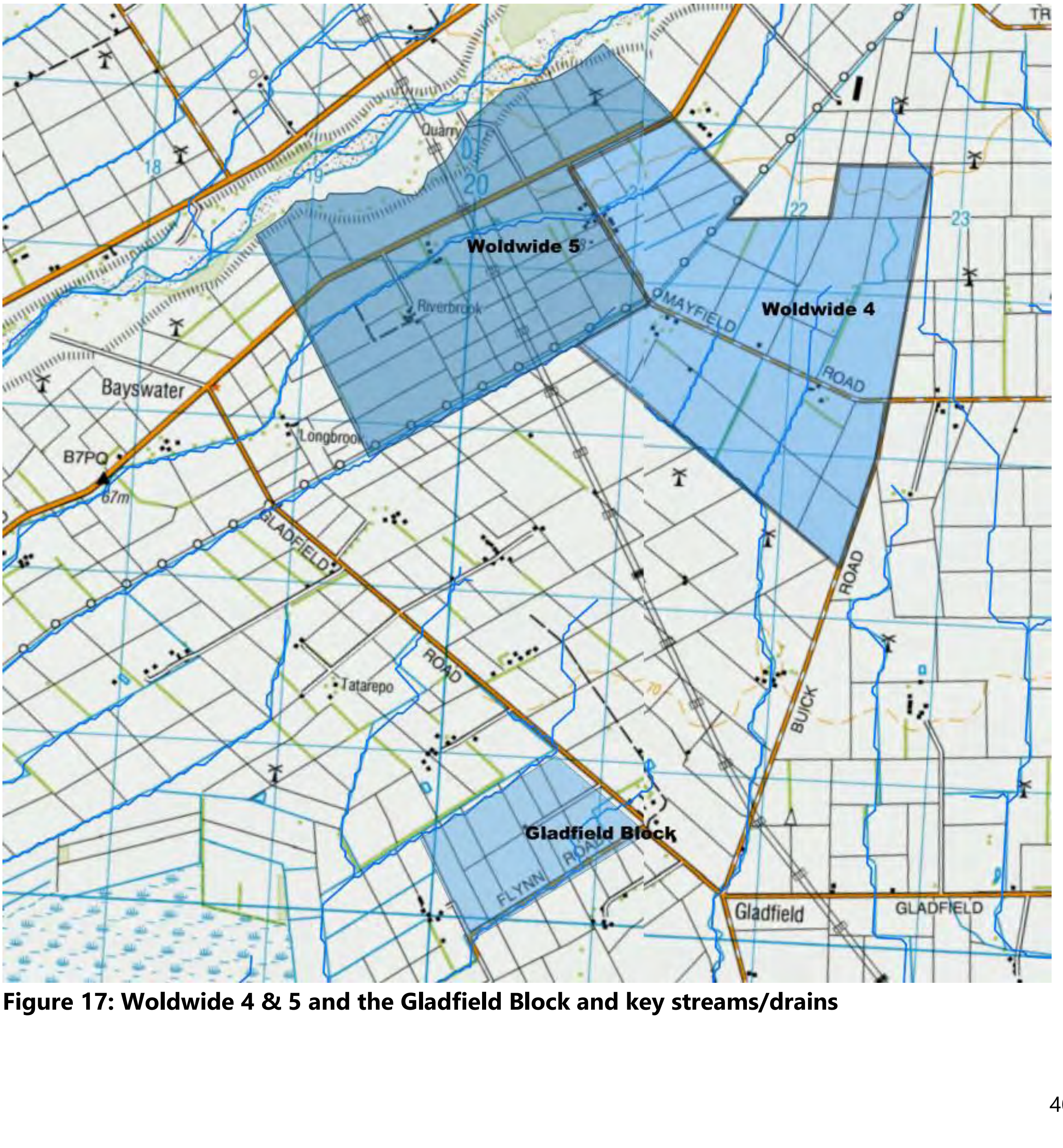


Figure 17: Woldwide 4 & 5 and the Gladfield Block and key streams/drains

7.15 Figure 16 illustrates that the primary surface water catchment for the Woldwide 5 property is the Aparima River while the majority of the WW4 property is in the upper reaches of the Waimatuku Stream catchment. Similarly, Figure 6 indicates that the majority of drainage from WW5 moves parallel to the Aparima River and is likely to eventually recharge that river further downstream. Conversely, the majority of drainage from WW4 is likely to drain away from the Aparima River following the Waimatuku catchment.

7.16 Similar to WW1&2 there does not appear to be any specific high nutrient loss activity occurring on individual blocks in one sub-catchment that would result in an increase in nutrient losses to any individual creek or drain. Therefore it can be concluded that the reduction in losses would contribute to small decreases in nutrient loadings to all surface water bodies as well as groundwater.

7.17 It is possible to develop assumptions that would enable some very crude estimates of the potential consequences in nutrient loss reductions for receiving water quality, e.g., for P loss to estimate the number of significant rainfall events on average per year and by using a simple mass balance approach estimate the effect of this on short-term water quality. However, this would involve some significant assumptions (e.g., mean stream flows) and the resultant estimates have significant uncertainties. In this situation, it is more useful to simply recognise that the combination of modelling together with a high level of confidence that the proposed mitigations will be implemented will mean that there will be an extremely small improvement in both groundwater and surface water quality. However, it is also important to recognise that nutrient loss reductions for these properties in the context of four fairly large surface water catchments and a relatively large groundwater system will not result in measurable improvements in the receiving water bodies in the absence of a coordinated catchment approach.

Water quality effects on estuaries

7.18 There are effectively three estuary/lagoons downstream of these properties: the Jacobs River Estuary (Aparima River), the mouth of the Waimatuku Stream and the New River Estuary (Oreti River). The information summarised in Table 5 does not include a load estimate for the Waimatuku Stream.

7.19 As a proportion of the estimated catchment loads for the Jacobs River Estuary and the New River Estuary, the overall loads from these properties are understandably relatively very small.

For example, if contrary to the hydrological/hydrogeological information all the nutrient load from WW1&2 and the Horner Block was applied to the Aparima River catchment, on a modelled catchment source load basis, using the 2014 Aqualinc data (which is highly likely to need updating) the overall current loads would amount to currently approximately 23.6/1,958 or 1.2% (N) and 0.38/53 or 0.7% (P) of the modelled catchment loads. These figures should be treated with great caution because the catchment load estimates appear to be low based on current dairy farm nutrient loss estimates.

7.20 This calculation is useful to get a very rough appreciation of the potential scale of the overall current contributions to N and P catchment loads. However, it can't be used in any meaningful way to estimate contributions to nutrient concentrations in the relevant estuaries/river mouth because of the complex hydrogeological, physical, chemical and biological processes that operate in the contributing catchments.

8 Faecal indicator organisms and sediment losses before and after development

8.1 It is very difficult to develop quantitative estimates of the loss of faecal indicator organisms or sediment loss. There are no equivalent readily available farm-scale models that can be used. Some sediment loss models such as SedNetNZ, NZeem and HEL have been tested and applied in New Zealand[23]. However, none are currently widely used in RMA planning or regulatory processes. One common current approach[24] is to use Overseer modelled P loss as a surrogate for both. This is because a key component of Overseer P loss modelling is based on an assessment of soil loss which will include faecal indicator organisms as well as sediment. Therefore, the modelled P loss indicating a small reduction in P loss provides a clear indication that there is highly likely to be similar small reductions in both sediment and faecal indicator loss to water as a consequence of the proposed changes.

8.2 Therefore, there is a very high level of certainty that there will be very small improvements in sediment and microbiological water quality for all surface water bodies leaving all the properties.

[23] Palmer D, Dymond J & Basher L (2013) Assessing erosion in the Waipa catchment using the New Zealand Empirical Erosion Model (NZeem®), Highly Erodible Land (HEL), and SedNetNZ models David Palmer, John Dymond, and Les Basher, Landcare Research Report LCR1685.

[24] It was accepted at a 2018 ES consultant meeting that phosphorus loss modelling can be used as an approximate proxy for sediment and microbiological contaminant losses.

However, these changes are unlikely to be measurable unless they are accompanied by similar catchment-wide mitigation measures.

9 Water quality issues raised by submitters

Heddon Bush Primary School

9.1 The Ministry of Education has made a submission in opposition to the resource consent applications made by WW 1 & 2. The main concerns expressed in the submission are as follows:

- Elevated nitrate nitrogen concentrations near to or above the NZ Drinking water Standards at E45/0060 and E45/0330.
- Lag time between application of nutrients to land and reaching groundwater and an implied concern that the relatively low concentrations of nitrate nitrogen at the school bore could increase over time.

9.2 The submission requests that the 'application' be refused unless it is established that the "…Heddon Bush School bore is not adversely affected by the discharge of contaminants…. If a monitoring bore is proposed as part of the operation the proposed location, proposed depth and frequency of sampling and testing and the proposed trigger levels need to be specified by the applicant.".

9.3 As noted earlier in this report, some groundwater quality results may not accurately indicate regional groundwater quality and in some locations groundwater quality is likely to be affected by contaminated surface water entering groundwater because of poor well head protection and proximity to contaminant sources. For example, bore E45/0060 was inspected as part of the survey of six bores. The location of this bore is illustrated in the following figure.

Figure 18: Location of monitoring bore E45/0060 relative to adjacent contamination sources

9.4 Bore E45/0060 is located extremely close to a dairy shed and associated lane and underpass, the wellhead protection is poor and there is a surface water flow path to the well. The results of sampling of this well are illustrated in Figure 11 and indicate that the results are likely to have been affected by these factors.

9.5 Bore E45/0330 does not currently exist. It was previously the bore number for a multilevel piezometer system that provided for sampling groundwater at five depths from approximately 3 m depth to 16 m depth[25]. It appears that the results for these bores (E45/0768-0772) were

[25] Hughes B (2009) Review of groundwater quality monitoring results from the Heenans Corner nested piezometer site, 20p.

recorded as E45/0330 when data was supplied to the Ministry of Education representative. That report did identify that groundwater nitrate nitrogen from the deepest bore had a significantly lower nitrate nitrogen concentration than the shallower bores. The data illustrated in Figure 9 shows the results from the 3 m deep bore E45/0768 with a high of 16.6 g NO_3-N/m^3.

9.6 The concerns expressed by the Ministry of Education based on those two specific bores does not appear to be a robust basis for concern about the nitrate nitrogen concentrations at the Heddon Bush School water supply bore where all the recent sampling results show relatively low concentrations of nitrate nitrogen.

9.7 However, the groundwater quality data do indicate that it is likely that there are broad areas of groundwater with significantly raised concentrations of nitrate nitrogen. This indicates that land use activities in some locations are resulting in high nitrate nitrogen concentrations in shallow groundwater. However, the changes proposed as part of these applications will result in significant reductions in the loss of nitrogen to groundwater from this landholding and if such measures are adopted more broadly across the groundwater catchment there would be measurable improvements in groundwater quality. Therefore the combination of the proposed significant mitigations and the existing relatively low concentrations of nitrate nitrogen mean that it is highly unlikely that the concentrations of nitrate nitrogen in the Heddon Bush School groundwater supply would increase.

9.8 The existing groundwater quality found at the school bore which is a verified depth of 14.9 metres indicates that it is not currently being significantly affected by land use activities, with nitrate nitrogen concentrations in the range of 1.8 – 2.3 g/m3. With the reduction in contaminant loss that will occur at the properties the proposal will not result in any additional risk to the existing quality of the current water supply.

9.9 As noted in Section 5 shallow unconfined groundwater in this and similar locations is already at significant risk of microbiological contamination. Which is one of the reasons why self-supplying schools are recommended to treat such supplied with some form of disinfection[26]. The activities proposed at WW1&2 would not result in a significant increase in the existing level of microbiological risk to this water supply.

[26] https://www.education.govt.nz/school/property-and-transport/school-facilities/energy-water-and-waste-management/drinking-water-quality/self-supplying-schools/

10 Conclusions on the effects of the proposal on water quality

Local and cumulative surface water quality

10.1 The information outlined in this report on the existing quality of surface water downstream of these properties combined with the estimates of the current and likely futures losses of sediment, faecal indicator organisms, N and P from the proposed changes provide strong evidence for a real but extremely small overall improvement in the quality of the surface waters leaving these properties.

10.2 The improvements in water quality are unlikely to be measurable with the current Environment Southland surface water quality monitoring programmes. However, if other properties in the wider catchments implemented equivalent good management practices/mitigation measures there would be significant and measurable improvements particularly for the water quality variables that currently do not comply with the relevant standards or guidelines. The nature of some water quality issues such as deposition of sediment in slow-flowing reaches (which may take many years to move downstream) means that some water quality improvements would take a long time to be realised.

Local and cumulative groundwater quality

10.3 The information from the Overseer and additional modelling combined with the specific good management practices/mitigation measures provide strong evidence for a real but small reduction in the N loading to groundwater and associated artificial drainage from all properties. If this occurs across enough properties in the wider area there would be an improvement in both the underlying groundwater nitrate N concentrations and the concentrations in drainage water discharging to, and/or recharging, streams. Because of the complexity of groundwater systems including the inherent heterogeneity of alluvial aquifers, and travel times for drainage water and groundwater it may be many years[27] before reductions in N concentrations are observed in bores used to monitor groundwater quality and in surface water recharged by that groundwater.

[27] A 2014 study by Environment Southland concluded that the 'transit time' (time from soil to downgradient groundwater) would be less than five years for the majority of the region. Wilson S *et al* (2014) Estimating Time Lags for Nitrate Response in Shallow Southland Groundwater, Environment Southland Technical Report 2014-03

Estuaries and lagoon water quality

10.4 The key water quality issues in the Jacobs River Estuary and the New River Estuary and likely to be an issue in the Waimatuku Stream lagoon, appear to be sediment and nutrient loading. Contaminant losses from this property will be making an almost negligible contribution to these loadings. The good management practices/additional mitigation measures that would be implemented would reduce this contribution by extremely small amounts. By itself this would be insignificant but combined with similar initiatives across the relevant catchments would result in significant reductions in the nutrient and sediment loadings which have the potential to contribute to a significant improvement to the significant estuary/lagoon eutrophication issues.

Mike Freeman, BSc, PhD
Senior Scientist/Planner
Landpro Limited
26 August 2019

Attachment A

Dairy Green Ltd

**Practical Engineering Solutions Consents,
Effluent, Stock water, Irrigation Design
through to Installation**
Irrigation NZ Accredited Designer

Groundwater Well and/or Bore Assessment – Heddon Bush; Central Southland

A visual assessment of 6 shallow groundwater wells/bores was carried out by Quinton Scandrett of Dairy Green Ltd on the 25th July 2019. Wells/bores across the Heddon Bush area of Central Southland were assessed. The assessment targeted shallow wells that have demonstrated high groundwater nitrate concentrations and have been used by Environment Southland to report on the state of groundwater quality in this area of the Southland Region. The same assessment criteria was used for each well site, photos of the site were also taken.

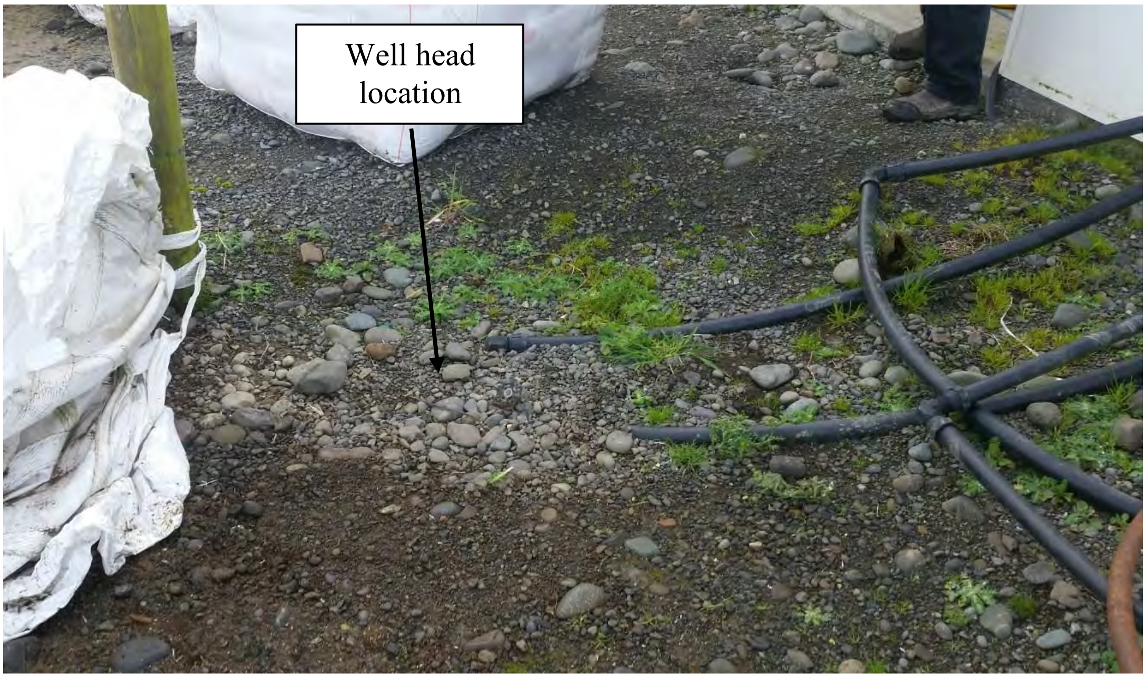
Assessment Criteria:

- Primary use of bore/well
- Well head protection; poor (no protection), moderate (some protection), high (adequate protection)
- Proximity to potential contaminate source; close (<200 m), moderate (200 m – 500 m), distant (>500 m)
- Potential flow path of surface runoff to well; clear route, possible route, no likely route.
- Stock access to bore/well site; yes or no
- Distance to surface waterway; close (<100 m), moderate (100 m – 500 m), distant >500 m
- Suitability for groundwater monitoring; low, medium, high

Well E45/XXXX: Located 2 m from the dairy shed

- Primary Use; Dairy
- Well head protection; Poor
- Proximity to contaminate sources; Close <200 m – Dairy Shed, Stock Lanes, Septic system
- Surface water flow path; Possible route to well
- Stock access; No
- Distance to surface water way; Close <100 m
- Suitability for groundwater monitoring; Low

Photos:



Well E45/XXXX: A well adjacent to a pump shed and 6 m from a stock underpass

- Primary Use; Dairy
- Well head protection; Poor
- Proximity to contaminate sources; Close <200 m – Dairy Shed, Stock Lanes, Underpass
- Surface water flow path; Clear route to well
- Stock access; No, however stock can access within 1 m of the well.
- Distance to surface water way; Close <100 m
- Suitability for groundwater monitoring; Low

Photos:

Well E45/XXXX: A bore adjacent to a shelter belt within a paddock

- Primary Use; Environment Southland Ground Water Monitoring
- Well head protection; Moderate
- Proximity to contaminate sources; Close <200 m – Shelter Belt/Stock Camp, Stock Lane, Water Trough
- Surface water flow path; No likely route to well
- Stock access; Yes
- Distance to surface water way; Moderate 100 m - 500 m
- Suitability for groundwater monitoring; Medium

Photos:

Well E45/XXXX: A well adjacent to a water tank within a paddock

- Primary Use; Environment Southland Ground Water Monitoring
- Well head protection; Poor
- Proximity to contaminate sources; Close <200 m – Stock Camp, Silage Pits
- Surface water flow path; Clear route to well (clear route to inside well pipe due to a hole at ground level)
- Stock access; Yes
- Distance to surface water way; Moderate 100 m - 500 m
- Suitability for groundwater monitoring; Low

Photos:

Well E45/XXXX: A bore adjacent to a fence line within a paddock

- Primary Use; Environment Southland Ground Water Monitoring
- Well head protection; Poor
- Proximity to contaminate sources; Close <200 m – Intensive winter grazing, stock lane
- Surface water flow path; No likely route to bore
- Stock access; Yes
- Distance to surface water way; Moderate 100 m - 500 m
- Suitability for groundwater monitoring; Medium

Photos:

Well E45/XXXX: A well adjacent to a fence within a paddock (close to a house)

- Primary Use; Environment Southland Ground Water Monitoring
- Well head protection; Poor
- Proximity to contaminate sources; Close <200 m – Stock camp, Calf Sheds, Gateway, Septic Tank System
- Surface water flow path; Clear route to bore
- Stock access; Yes
- Distance to surface water way; Moderate 100 m - 500 m
- Suitability for groundwater monitoring; Low

Photos:

Summary of Assessment:

Overall the small number of bores/wells assessed in the Heddon Bush area indicated a significant risk of direct contamination of groundwater via the bore/well from surface contaminates. Well head protection in particular was poor with one well having a hole at ground level allowing direct flow of surface water and or contaminates into the well.

………………………

Author
Q Scandrett
Agricultural & Engineering Consultant
Dairy Green Ltd

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide One Limited and Woldwide Two Limited

Land use consent application for a feed pad/lot – Rule 35 A of pSWLP (2019)

Woldwide 1 unit – wintering barn

Farm Location: Heddon Bush

Application prepared on behalf of applicant by Dairy Green Ltd.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843

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Email: scandrettrural@xtra.co.nz

26/03/2019 10:38:00 a.m.

Table of Contents

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1. Overview

Woldwide One Limited (WW1) and Woldwide Two Limited (WW2) operate two adjoining dairy farms situated at Heddon Bush. Both dairy farms are under the same ownership structure. Each dairy farm has an existing wintering barn that requires consent under Rule 35A of the pSWLP.

WW1 currently operates under an effluent discharge permit (AUTH-301663) and water permit (AUTH-301664). WW2 currently operates under a land use consent for expanded dairy farming (AUTH-20171278-03), effluent discharge permit (AUTH-20171278-01) and water permit (AUTH-20171278-02). An application has been submitted to Environment Southland to bring the WW1 and WW2 dairy platforms under a single land use consent for dairy farming. Respective discharge permits will also be replaced to bring the discharge activities under a single discharge permit. The name of the new consent holder on the land use consent for dairy farming, the discharge and water permits will be "Woldwide One Limited and Woldwide Two Limited." Likewise, the name of the consent holder on the land use consent for the feedpad/lot located on the Woldwide 1 unit will be "Woldwide One Limited and Woldwide Two Limited."

This application is to obtain a land use consent under Rule 35A of the pSWLP (2018), authorising the use of land for an existing feed pad/lot at WW1 unit, WW1&2 dairy farm. In accordance with Rule 35A (b) the use of land for a feed pad/lot is a discretionary activity. The feed pad/lot is a concrete wintering barn that will house a maximum of 625 cows over winter and in the shoulders of the season as required and has supporting effluent infrastructure in place.

The proposed use of land for a feed pad/lot has been considered in terms of key pSWLP policies and based on this assessment should be granted. Effects on the existing environment have been considered and are described in the assessment provided in Section 7. The existing feed pad/lot was designed, located and is managed to avoid or mitigate risks to water quality and soil health. The assessment concludes that effects on receiving surfacewaters, groundwater and soils, including cumulatively, will be less than minor due to the use of land for the WW1 feed pad/lot at WW1&2 dairy farm.

Effluent generated in the barn is collected, stored and applied to land according to best practice management at a time when plants are actively growing, allowing nutrients to be taken up by plants. Construction of a wintering barn and supporting effluent management has been a significant investment by the applicants and demonstrates their commitment to environmental sustainability in the long term. *On this basis a term of 15 years is requested for the land use consent for a feed pad/lot.*

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Figure 1. Wintering barn at WW1 unit, WW1&2 dairy farm.

2. Consent required

The decisions version of the pSWLP was notified on 4 April 2018. In accordance with Section 86B(1)(a) and (3) of the Resource Management Act 1991, all provisions of the Proposed Plan have had legal effect since this date. Although the Southland Regional Water Plan (2010) and Regional Effluent Land Application Plan are still operative, they do not manage the use of land for feed pads/lots through specific rules.

Feed pad/lot

Under Rule 35A, the use of land for a feed pad/lot is a permitted activity, provided the conditions described in Rule 35A (a) are met. In this instance, Rule 35A (a) (i) is not met as the wintering barn houses more than 120 adult cattle at one time. Rule 35A (a) (ii) is not met as a small number of late calving cows will remain in

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the barn during September; some animals will remain on the feed pad/lot for longer than three continuous months. Rule 35A (a) (iii) (1) is not met as the nearest waterway is within 50 metres of the barn; a stream flows adjacent to the west side of the barn. The use of land for the feedpad/lot meets the remaining conditions specified in Rule 35A.

In accordance with Rule 35A (b), the activity is a discretionary activity since it does not meet one or more conditions described in Rule 35A (a).

3. Statutory considerations

Statutory considerations:

Environment Southland must consider the following matters when they consider an application. The application is consistent with all of these relevant plans and policies because effects on water quality and quantity and the soil resource should be less than minor.

Resource Management Act 1991:

- The provisions of section 104 of the Resource Management Act 1991;
- Part 2 of the Resource Management Act;
- The applicant's assessment of effects on the environment;
- The provisions of Sections 104B, 104C, 105 and 107 of the Resource Management Act 1991.

Part 2 of the RMA

The activity is considered to represent an efficient use of natural resources that will give rise to significant positive benefits in terms of providing for the social and economic wellbeing of the applicants and the wider regional economy. There is, however, the potential for adverse effects on the environment to arise, including on water quality. However, it is considered that the effects of the activities have been adequately identified and assessed in the Assessment of Environmental Effects in Section 7 below and that such effects will be no more than minor.

It is considered that the proposed use of land for a feed pad/lot will not impact directly on the coastal environment, wetlands, and lakes and rivers and their margins, although there is potential for adverse effects on the wider receiving environment which is inclusive of some of these features. However, as is discussed in Section 7 below, the actual and potential adverse effects of the activities are considered to be no more than minor.

Section 7 of the Act lists a number of other matters that a Consent Authority must have particular regard to when considering applications for resource consent. For the reasons discussed in Section 7 of this report below, the proposal is considered consistent with relevant provisions of Section 7 of the RMA.

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Section 8 sets out a Consent Authority's responsibilities in relation to the Treaty of Waitangi. The proposal is considered consistent with the provisions of all regional planning documents, including Te Tangi oTauira, and Sections 6(c) and 7(a) of the Act. Therefore the proposal can also be considered consistent with Section 8 of the Act.

To avoid repetition, the following documents have been grouped together under common headings in the sections that follow.

Table 3.1: Ngai Tahu Values

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives C1, D1 • Policies C1, D1
Southland Regional Policy Statement 2017	• Objectives TW.2, TW.3, TW.4 and TW.5 • Policies TW.3, TW.4 and TW.5
Regional Water Plan 2010	• Objective 9C • Policy 1A
Regional Effluent Land Application Plan 1998	• Objectives 4.1.4, 4.1.5 • Policies 4.2.4, 4.2.7,4.2.8, 4.2.9
Proposed Southland Water and Land Plan 2018	• Objectives 3, 4, 5, 15 • Policies 1, 2, 3
Te Tangi a Tauira:	• Whole Document

Tangata Whenua values have been considered when preparing this application including reference to Te Tangi a Tauira (Iwi Management Plan). The principles of protection of the mauri of the water and mana of the land while minimising adverse effects on mahinga kai will continue to be recognised and have regard to in the exercise of the consent. There are no known wahi tapu, ancestral sites, heritage sites or other taonga associated with the property.

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Table 3.2 Water Quality

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives A1, A2, B1, B2, B3, B4, • Policies A3, A4, B5, B6, B7
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2 • Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.2 • Policies 4.2.3, • Rule 5.4.5
Regional Water Plan 2010	• Objectives 3,4,8 • Policies 1, 4, 6, 7, 13
Proposed Southland Water and Land Plan 2018	• Objectives 1, 2, 6, 7, 8, 9, 13, 18 • Policies 5, 10, 13, 14, 15, 16, 17, 39, 39A, 40 • Rules 35, 35A
Te Tangi a Tauira	• Policies 1, 4, 5, 6, 11, 16, 17, 18

The wintering barn and supporting effluent management infrastructure were constructed and are operated according to best industry practice standards and Council rules and policies. The wintering barn has been sited and constructed to avoid the risk of stormwater flow or overland flow into or from the structure. Dung and urine from cows housed in the wintering barn is collected automatically into a concrete collection pit from where it is pumped to a large effluent storage pond, stored and applied to land according to best practice effluent management and consent conditions. Through the design, construction and operation of the wintering barn and supporting effluent management system, there is no loss of effluent to receiving surfacewaters, groundwater or adverse effects on soils.

Wintering barn effluent is discharged to land at very low depth in accordance with Rule 35 of the pSWLP. Wintering barn effluent forms a slurry due to its high DM content. Discharging wintering barn effluent (slurry) at very low depth to land when there is sufficient soil moisture deficit allows plants to take up nutrients and minimises the risk of contaminant loss to receiving waters via deep drainage, artificial drainage or overland

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flow. When there is insufficient soil moisture deficit to safely apply effluent to land without risk of drainage and contaminant loss, wintering barn effluent is stored in the pond.

Housing cows in the barn over winter and in the shoulders of the season reduces contaminant loss to water from intensive winter grazing practices and reduces soil damage such as pugging. This is in line with several key policies regarding maintaining and improving water quality.

Table 3.3 Soil Health and Effluent Management

Regulatory Document	Relevant Sections
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2 • Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.1 • Policies 4.2.1, 4.2.2
Regional Water Plan 2010	• Policy 41 • Rule 49
Proposed Southland Water and Land Plan 2018	• Objectives 13, 13A, 14, 15, 18 • Policies 5, 10, 17, 33 • Rule 32B, 35, 35A, 41
Te Tangi a Tauira	• Policies 4, 7, 8, 9, 11, 13, 14, 15

The applicants seek to ensure the life supporting capacity of the soil is safeguarded, along with the sustainability of the soil ecosystem by using land for an existing wintering barn without significant adverse effects. A maximum of 625 cows are housed in the barn over winter and in the shoulders of the season as required. Dung and urine from cows are collected, stored as a slurry in the effluent pond. Slurry effluent is be applied to land according to best practice management and relevant Council rules and policies. The soils are suitable to receive solids and for effluent irrigation. These activities follow current good management practice described in the Farm Environmental Management Plan. These include practices of a general nature and those specific to the key contaminant transport pathways for the physiographic zones (Central Plains and Oxidising).

This system is sustainable in the long term and allows slurry effluent to be used both as a fertiliser and a soil conditioner.

In addition to the matters in Section 104 of the Act, when considering an application for a land use consent for the use of land for a feed pad/lot a Consent Authority must also have regard to Section 105. As is

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discussed in the assessment under Section 7, it is considered that provided the activity is undertaken in accordance with the conditions of the consent and the best practice management techniques, the adverse effects of the activity should remain minor.

There are not considered to be any matters under Section 107 of the Act that would require the Consent Authority to decline the application for a land use consent for a feed pad/lot.

4. Notification

Section 95A of the Act requires that the Consent Authority must publicly notify an application if it decides under Section 95D of the Act that the activity will have or is likely to have adverse effects on the environment that are more than minor. The only exception to this is when a rule or NES precludes public notification of the application and that there are no special circumstances in relation to the application that would warrant such a rule or NES to be dispensed with. However, in this instance there is no rule or NES that precludes public notification of the application and therefore the 'more than minor effect on the environment' test provided by Section 95D of the Act applies. As is explained in Section 7/AEE, the use of land for WW1's wintering barn at WW1&2 dairy farm will have effects on the environment that are no more than minor. As such public notification is not required.

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5. Receiving Environment

The wintering barn is found in the Waimatuku surfacewater management zone. Table 5.1 summarises the receiving environment (i.e. soils, surfacewater and groundwater resources) in the vicinity of the wintering barn. *For a detailed description of the receiving environment, please see Section 5 of WW1&2's consent application.*

Table 5.1 Soils, surfacewater and groundwater resources in the vicinity of the wintering barn.

Soils	**Soil Type**	**Vulnerability Factors**		
		Structural Compaction	**Nutrient Leaching**	**Waterlogging**
	Drummond	Minimal	Moderate	Slight
	Glenelg	Slight	Very severe	Nil
	Braxton	Moderate	Slight	Severe
FDE land classification	A – artificial drainage or coarse soil structure E – other well drained but very stony flat land (Likely to be D – well drained flat land, but this is not mapped)			
Characteristics of FDE risk classification	A - high risk to surface water, low risk to groundwater D, E – low risk to groundwater using low depth application, low risk to surfacewater			
Topography	Flat			
Groundwater nitrate levels	3.5 - 8.5 g/m^3			
Groundwater zone	Waimatuku			
Surfacewater management zone	Waimatuku			

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Physiographic zones	Central Plains
	Oxidising
FMU	Aparima
Nearest downstream registered drinking water supply (downstream and is same catchment)	Heddon Bush School – 3 km due south of wintering barn
Downstream Regionally Significant Wetland/Sensitive Waterbody	Drummond Peat Swamp (>10 km to south east)
	Bayswater Bog (>10 km to south west)

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6. Proposal Details

Legal description

Table 6.1 Legal description

Infrastructure	Title	Legal description
Wintering barn site	SL168/127	Part Lot 18 DP 942
Effluent pond site	SL168/127	Part Lot 18 DP 942

Location

The barn is sited to the north of the dairy shed at (NZTM2000) E 1225139, N 4888995. Figure 6.1 below shows the location of the wintering barn and effluent pond. The barn location is sufficiently dry, elevated and has adequate drainage, to avoid the risk of overland flow of stormwater or surface runoff into or from the wintering barn at any time.

Figure 2. Lanes and stream (flowing to Waimatuku catchment) found to the west of the wintering barn at WW1.

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Wintering barn usage

Table 6.2 outlines how the wintering barn will generally be used. *Cow number, hours per day* and *days per month* are three variables that determine usage per month (not just *cow number*).

The wintering barn will house the maximum cow number (625) 24 hours per day over the entire month for June and July only. In May, August and September, cows being housed for part of the day/part of the month depending on soil and climatic conditions at the time.

Average usage in May, August and September is represented in the below table; e.g. the barn will be used for 50% of May. This can be achieved by housing 313 cows 24 hours per day for 31 days, or by housing 625 cows 12 hours per day for 31 days or by housing 625 cows for 24 hours per day for 15 days.

Cows are not calved in the barn.

Table 6.2 Wintering barn usage

Use of wintering barn				
Month	**Cow numbers**	**Hours/day**	**Days**	**Average 50% usage for month**
May	625	12	31	50
June	625	24	30	100
July	625	24	31	100
Aug	370	23	31	59
September	75	23	30	12

Wintering barn construction

The existing wintering barn is a sealed, concrete free-stall structure.

Barn dimensions: 29 m x 122 m

Construction of the barn was regulated by Southland District Council through a building consent. The structure was constructed by Bert's Engineering in 2006. The site was prepared by an earthwork's contractor, who carried out the required earthworks.

The barn has a sealed concrete floor surrounded by 200 mm high concrete nib walls. Effluent from the barn is automatically scraped into a concrete collection pit from where it is pumped to the storage pond, which also stores effluent from the dairy shed as required. The barn has a small uncovered concrete area (170 m^2),

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which has been included in the Massey DESC reports. A rainwater diversion is always used for rainwater collected on the barn roof.

Effluent storage

Effluent from the barn is primarily composed of dung and urine, given the lack washdown water and only source of rainwater from the small uncovered area. The effluent storage system has sufficient storage to meet the requirements of the wintering barn usage outlined in table 6.2 and has 4,281 metres cubed metres cubed of storage available, plus 0.5 metres freeboard. This is sufficient for effluent from the wintering barn (and other sources), according to the Massey DESC provided in the Appendix.

The effluent storage pond was upgraded in 2018 to install a synthetic liner and leak detection system to meet PN 21 requirements and to provide storage for effluent from 625 cows in the barn. It is described in detail in the replacement application for the discharge permit.

Effluent irrigation

As is explained in the discharge permit replacement application, wintering barn effluent is applied to land as follows:

I. The effluent flows by gravity and is scraped automatically approximately 8 times per day to the concrete effluent collection sump, from where it is pumped to WW1's storage pond.
II. The effluent is stored in the pond until soil moisture conditions allow for irrigation to occur.
III. The effluent is pumped from the pond to the slurry tanker with a trailing shoe (no more than 2.5 mm/application) or umbilical system (no more than 3 mm per application) and irrigated at very low depth to land; and
IV. A rainwater diversion is always in place for water collected on the roof.

Buffer distances

The wintering barn has buffer distances as outlined in table 6.3. These are mapped in the FEMP for WW1.

Table 6.3

Buffer distances from wintering barn	
Nearest subsurface drain (m)	450
Nearest surface waterway (m)	15
Microbial health protection zone of a drinking water supply site (Appendix J) etc.	None
Dwelling not on same landholding (m)	>1,000
Landholding boundary (m)	550
Critical source area (m)	750

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7. Assessment of Environmental Effects

Adverse environmental effects from the use of land for a feed pad/lot, including wintering barns, can occur where the feed pad/lot is poorly designed, located or managed. Adverse effects can occur where contaminants present in dung and urine from cows housed in the barn (nutrients N, P, sediment and faecal microbes) reach receiving ground and/or surfacewaters via pathways such as artificial drainage or overland flow. Adverse effects on soils can occur if soils are overloaded with nutrients from barn effluent.

Design, location and construction

WW1's wintering barn at WW1&2 dairy farm was designed and constructed according to a building consent granted and administered by Southland District Council. Construction of the barn was carried out by Bert's Engineering and authorised by a building consent (SDC). The earthworks and concrete work were carried out by experienced firms and trade's people under contract. The risk of flooding and overland flow were key considerations in choosing a suitable site for the barn and supporting effluent storage facilities (pond and concrete collection pit), as were distances to waterways, subsurface drainage, bores and critical source areas. The barn is sited to avoid the risk of stormwater or overland flow into or from the barn.

As shown in figure 2, the nearest waterway flows adjacent to the barn (15 metres to the west) with a cow lane in between. The barn is on an elevated site and has a fully sealed concrete floor surrounded by 200 mm high concrete nib walls. Effluent cannot escape from the barn due to the concrete nib walling. Effluent is scraped automatically to a concrete collection pit approximately 8 times per day when the barn is in use. Due its sealed concrete flooring and protection by concrete nib walls, the risk of effluent generated within the barn reaching the waterway is avoided.

There are no CSAs within the barn site that could potentially channel contaminants to surfacewater. The nearest subsurface drain is over 450 metres from the barn location, which minimises the risk of contaminant loss from the barn to subsurface drainage. The nearest bore (E45/0071) is over 150 metres to the south of the barn site.

Operation of the wintering barn depends on having an effective effluent management system, to collect, store and discharge effluent that is generated in the barn. The barn's effluent management system was designed and constructed according to the relevant Council rules to meet best industry practice (i.e. IPENZ Practice Note 21). CPEng and Council sign off was required for both the design and completion of the effluent storage facility, which was reconstructed in 2018. Project management will be overseen by Dairy Green Limited, who have over 30 years of experience in the design and construction of effluent management systems in Southland.

Through appropriate design, location and construction of the wintering barn, no contaminants will be lost to receiving surfacewaters or groundwater. Contaminants are collected, stored and utilised according to best practice management. The risk of adverse effects on water quality in the Waimatuku Surfacewater Management Zone, groundwater and soils is minor.

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Management of wintering barn and supporting effluent management system

The barn and supporting effluent system are managed according to best practice management and consent conditions. Barn usage per month is described in section 6, with a maximum authorised number of 625 cows housed in the barn at any one time. The supporting effluent infrastructure is designed to meet the needs of 625 cows in the barn. Raw effluent (slurry) is stored in the pond. Slurry is applied to land at very low depth according to best practice management and consent conditions. Effluent will only be applied to land when there is sufficient soil moisture deficit and no risk of drainage, and nutrients in effluent will be taken up by plants. Less than 150 kg N/hectare will be applied from pond slurry effluent at WW1&2 dairy farm, at less than 250 kg N/hectare at a support block used for cut and carry, and recommended buffers will be adhered to when discharging effluent. The effluent discharge activity is authorised by a discharge permit issued by Environment Southland, along with conditions that are met by the applicants when operating their effluent management system. This gives the Consent Authority certainty regarding the operation and management of effluent from the feed pad/lot.

Through appropriate management of the wintering barn and supporting effluent management infrastructure, the risks of adverse effects on water quality in the Waimatuku Surfacewater Management Zone, Waimatuku Groundwater Zone and soil health due to the use of land for a wintering barn, are considered as minor. In fact, the use of land for a wintering barn provides accommodation for up to 625 cows when otherwise they would be intensively winter grazed on fodder crop. It provides for a reduction in the number of cows being intensively winter grazed in the catchment and for less soil damage from pugging of soils over winter and in the shoulders of the season.

Conclusion

The use of land for an existing feed pad/lot has been considered in terms of key pSWLP policies and based on this assessment should be granted. Effects on the existing environment have been considered and are described in the above assessment. The feed pad/lot was designed, constructed, sited, and is operated to manage to avoid or mitigate risks to water quality and soil health. The assessment concludes that effects on receiving surfacewaters, groundwater and soils, including cumulatively, will be less than minor due to the use of land for the existing WW1 unit feed pad/lot at WW1&2 dairy farm.

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Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide One Limited and Woldwide Two Limited

Land use consent application for a feed pad/lot – Rule 35 A of pSWLP (2019)

Woldwide 2 unit – wintering barn

Farm Location: Heddon Bush

Application prepared on behalf of applicant by Dairy Green Ltd.

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26/03/2019 10:41:00 a.m.

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1. Overview

Woldwide One Limited (WW1) and Woldwide Two Limited (WW2) operate two adjoining dairy farms situated at Heddon Bush. Both dairy farms are under the same ownership structure. Each dairy farm has an existing wintering barn that requires consent under Rule 35A of the pSWLP.

WW1 currently operates under an effluent discharge permit (AUTH-301663) and water permit (AUTH-301664). WW2 currently operates under a land use consent for expanded dairy farming (AUTH-20171278-03), effluent discharge permit (AUTH-20171278-01) and water permit (AUTH-20171278-02). An application has been submitted to Environment Southland to bring the WW1 and WW2 dairy platforms under a single land use consent for dairy farming. Respective discharge permits will also be replaced to bring the discharge activities under a single discharge permit. The name of the new consent holder on the land use consent for dairy farming, the discharge and water permits will be "Woldwide One Limited and Woldwide Two Limited." Likewise, the name of the consent holder on the land use consent for the feedpad/lot located on the Woldwide 2 unit will be "Woldwide One Limited and Woldwide Two Limited."

This application is to obtain a land use consent under Rule 35A of the pSWLP (2018), authorising the use of land for an existing feed pad/lot at WW2 unit, WW1&2 dairy farm. In accordance with Rule 35A (b) the use of land for a feed pad/lot is a discretionary activity. The feed pad/lot is a sealed concrete wintering barn that will house a maximum of 625 cows over winter and in the shoulders of the season as required and has supporting effluent infrastructure in place.

The proposed use of land for a feed pad/lot has been considered in terms of key pSWLP policies and based on this assessment should be granted. Effects on the existing environment have been considered and are described in the assessment provided in Section 7. The existing feed pad/lot was designed, located and is managed to avoid or mitigate risks to water quality and soil health. The assessment concludes that effects on receiving surfacewaters, groundwater and soils, including cumulatively, will be less than minor due to the use of land for WW2's feed pad/lot at WW1&2 dairy farm.

Effluent generated in the barn is collected, stored and applied to land according to best practice management at a time when plants are actively growing, allowing nutrients to be taken up by plants. Construction of a wintering barn and supporting effluent management has been a significant investment by the applicants and demonstrates their commitment to environmental sustainability in the long term. *On this basis a term of 15 years is requested for the land use consent for a feed pad/lot.*

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Figure 1. Wintering barn at WW2 unit, WW1&2 dairy farm.

2. Consent required

The decisions version of the pSWLP was notified on 4 April 2018. In accordance with Section 86B(1)(a) and (3) of the Resource Management Act 1991, all provisions of the Proposed Plan have had legal effect since this date. Although the Southland Regional Water Plan (2010) and Regional Effluent Land Application Plan are still operative, they do not manage the use of land for feed pads/lots through specific rules.

Feed pad/lot

Under Rule 35A, the use of land for a feed pad/lot is a permitted activity, provided the conditions described in Rule 35A (a) are met. In this instance, Rule 35A (a) (i) is not met as the wintering barn houses more than 120 adult cattle at one time. Rule 35A (a) (ii) is not met as a small number of late calving cows will remain in the barn during September; some animals will remain on the feed pad/lot for longer than three continuous months. The use of land for the feedpad/lot meets the remaining conditions specified in Rule 35A.

In accordance with Rule 35A (b), the activity is a discretionary activity since it does not meet one or more conditions described in Rule 35A (a).

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3. Statutory considerations

Statutory considerations:

Environment Southland must consider the following matters when they consider an application. The application is consistent with all of these relevant plans and policies because effects on water quality and quantity and the soil resource should be less than minor.

Resource Management Act 1991:

- The provisions of section 104 of the Resource Management Act 1991;
- Part 2 of the Resource Management Act;
- The applicant's assessment of effects on the environment;
- The provisions of Sections 104B, 104C, 105 and 107 of the Resource Management Act 1991.

Part 2 of the RMA

The activity is considered to represent an efficient use of natural resources that will give rise to significant positive benefits in terms of providing for the social and economic wellbeing of the applicants and the wider regional economy. There is, however, the potential for adverse effects on the environment to arise, including on water quality. However, it is considered that the effects of the activities have been adequately identified and assessed in the Assessment of Environmental Effects in Section 7 below and that such effects will be no more than minor.

It is considered that the proposed use of land for a feed pad/lot will not impact directly on the coastal environment, wetlands, and lakes and rivers and their margins, although there is potential for adverse effects on the wider receiving environment which is inclusive of some of these features. However, as is discussed in Section 7 below, the actual and potential adverse effects of the activities are considered to be no more than minor.

Section 7 of the Act lists a number of other matters that a Consent Authority must have particular regard to when considering applications for resource consent. For the reasons discussed in Section 7 of this report below, the proposal is considered consistent with relevant provisions of Section 7 of the RMA.

Section 8 sets out a Consent Authority's responsibilities in relation to the Treaty of Waitangi. The proposal is considered consistent with the provisions of all regional planning documents, including Te Tangi oTauira, and Sections 6(c) and 7(a) of the Act. Therefore the proposal can also be considered consistent with Section 8 of the Act.

To avoid repetition, the following documents have been grouped together under common headings in the sections that follow.

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Table 3.1: Ngai Tahu Values

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives C1, D1 • Policies C1, D1
Southland Regional Policy Statement 2017	• Objectives TW.2, TW.3, TW.4 and TW.5 • Policies TW.3, TW.4 and TW.5
Regional Water Plan 2010	• Objective 9C • Policy 1A
Regional Effluent Land Application Plan 1998	• Objectives 4.1.4, 4.1.5 • Policies 4.2.4, 4.2.7,4.2.8, 4.2.9
Proposed Southland Water and Land Plan 2018	• Objectives 3, 4, 5, 15 • Policies 1, 2, 3
Te Tangi a Tauira:	• Whole Document

Tangata Whenua values have been considered when preparing this application including reference to Te Tangi a Tauira (Iwi Management Plan). The principles of protection of the mauri of the water and mana of the land while minimising adverse effects on mahinga kai will continue to be recognised and have regard to in the exercise of the consent. There are no known wahi tapu, ancestral sites, heritage sites or other taonga associated with the property.

Table 3.2 Water Quality

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives A1, A2, B1, B2, B3, B4, • Policies A3, A4, B5, B6, B7
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2

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	• Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.2 • Policies 4.2.3, • Rule 5.4.5
Regional Water Plan 2010	• Objectives 3,4,8 • Policies 1, 4, 6, 7, 13
Proposed Southland Water and Land Plan 2018	• Objectives 1, 2, 6, 7, 8, 9, 13, 18 • Policies 5, 10, 13, 14, 15, 16, 17, 39, 39A, 40 • Rules 35, 35A
Te Tangi a Tauira	• Policies 1, 4, 5, 6, 11, 16, 17, 18

The wintering barn and supporting effluent management infrastructure were constructed and are operated according to best industry practice standards and Council rules and policies. The wintering barn has been sited and constructed to avoid the risk of stormwater flow or overland flow into or from the structure. Dung and urine from cows housed in the wintering barn is collected automatically into a concrete collection pit from where it is pumped to a large effluent storage pond, stored and applied to land according to best practice effluent management and consent conditions. Through the design, construction and operation of the wintering barn and supporting effluent management system, there is no loss of effluent to receiving surfacewaters, groundwater or adverse effects on soils.

Wintering barn effluent is discharged to land at very low depth in accordance with Rule 35 of the pSWLP. Wintering barn effluent forms a slurry due to its high DM content. Discharging wintering barn effluent (slurry) at very low depth to land when there is sufficient soil moisture deficit allows plants to take up nutrients and minimises the risk of contaminant loss to receiving waters via deep drainage, artificial drainage or overland flow. When there is insufficient soil moisture deficit to safely apply effluent to land without risk of drainage and contaminant loss, wintering barn effluent is stored in the pond.

Housing cows in the barn over winter and in the shoulders of the season reduces contaminant loss to water from intensive winter grazing practices and reduces soil damage such as pugging. This is in line with several key policies regarding maintaining and improving water quality.

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Table 3.3 Soil Health and Effluent Management

Regulatory Document	Relevant Sections
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2 • Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.1 • Policies 4.2.1, 4.2.2
Regional Water Plan 2010	• Policy 41 • Rule 49
Proposed Southland Water and Land Plan 2018	• Objectives 13, 13A, 14, 15, 18 • Policies 5, 10, 17, 33 • Rule 32B, 35, 35A, 41
Te Tangi a Tauira	• Policies 4, 7, 8, 9, 11, 13, 14, 15

The applicants seek to ensure the life supporting capacity of the soil is safeguarded, along with the sustainability of the soil ecosystem by using land for an existing wintering barn without significant adverse effects. A maximum of 625 cows are housed in the barn over winter and in the shoulders of the season as required. Dung and urine from cows are collected, stored as a slurry in the effluent pond. Slurry effluent is be applied to land according to best practice management and relevant Council rules and policies. The soils are suitable to receive solids and for effluent irrigation. These activities follow current good management practices, are per the Farm Environmental Management Plan. These include practices of a general nature and those specific to the key contaminant transport pathways for the physiographic zones (Central Plains and Oxidising).

This system is sustainable in the long term and allows slurry effluent to be used both as a fertiliser and a soil conditioner.

In addition to the matters in Section 104 of the Act, when considering an application for a land use consent for the use of land for a feed pad/lot a Consent Authority must also have regard to Section 105. As is discussed in the assessment under Section 7, it is considered that provided the activity is undertaken in accordance with the conditions of the consent and the best practice management techniques, the adverse effects of the activity should remain minor.

There are not considered to be any matters under Section 107 of the Act that would require the Consent Authority to decline the application for a land use consent for a feed pad/lot.

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4. Notification

Section 95A of the Act requires that the Consent Authority must publicly notify an application if it decides under Section 95D of the Act that the activity will have or is likely to have adverse effects on the environment that are more than minor. The only exception to this is when a rule or NES precludes public notification of the application and that there are no special circumstances in relation to the application that would warrant such a rule or NES to be dispensed with. However, in this instance there is no rule or NES that precludes public notification of the application and therefore the 'more than minor effect on the environment' test provided by Section 95D of the Act applies. As is explained in Section 7/AEE, the use of land for WW2's wintering at WW1&2 dairy farm will have effects on the environment that are no more than minor. As such public notification is not required.

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5. Receiving Environment

The wintering barn is found in the Waimatuku surfacewater management zone. Table 5.1 summarises the receiving environment (i.e. soils, surfacewater and groundwater resources) in the vicinity of the wintering barn. *For a detailed description of the receiving environment, please see Section 5 of WW1&2's consent application.*

Table 5.1 Soils, surfacewater and groundwater resources in the vicinity of the wintering barn.

Soils	**Soil Type**	**Vulnerability Factors**		
		Structural Compaction	**Nutrient Leaching**	**Waterlogging**
	Drummond	Minimal	Moderate	Slight
	Glenelg	Slight	Very severe	Nil
	Braxton	Moderate	Slight	Severe
FDE land classification	A – artificial drainage or coarse soil structure E – other well drained but very stony flat land (Likely to be D – well drained flat land, but this is not mapped)			
Characteristics of FDE risk classification	A - high risk to surface water, low risk to groundwater D, E – low risk to groundwater using low depth application, low risk to surfacewater			
Topography	Flat			
Groundwater nitrate levels	3.5 - 8.5 g/m^3			
Groundwater zone	Waimatuku			
Surfacewater management zone	Waimatuku			

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Physiographic zones	Central Plains	
	Oxidising	
FMU	Aparima	
Nearest downstream registered drinking water supply (downstream and is same catchment)	Heddon Bush School – 3 km due south of wintering barn	
Downstream Regionally Significant Wetland/Sensitive Waterbody	Drummond Peat Swamp (>10 km to south east)	
	Bayswater Bog (>10 km to south west)	

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6. Proposal Details

Legal description

Table 6.1 Legal description

Infrastructure	Title	Legal description
Wintering barn site	SL221/92	Part Lot 2 DP 4092
Effluent pond site	SL221/92	Part Lot 2 DP 4092

Location

The barn is sited to the north of the dairy shed at (NZTM2000) E 1225126, N 4889736. Figure 1 shows the location of the wintering barn and effluent pond.

The barn location is sufficiently dry, elevated and has adequate drainage, to avoid the risk of overland flow of stormwater or surface runoff into or from the wintering barn at any time.

Wintering barn usage

Table 6.2 outlines how the wintering barn will generally be used. *Cow number*, *hours per day* and *days per month* are three variables that determine usage per month (not just *cow number*).

The wintering barn will house the maximum cow number (625) 24 hours per day over the entire month for June and July only. In May, August and September, cows being housed for part of the day/part of the month depending on soil and climatic conditions at the time.

Average usage in May, August and September is represented in the below table; e.g. the barn will be used for 50% of May. This can be achieved by housing 313 cows 24 hours per day for 31 days, or by housing 625 cows 12 hours per day for 31 days or by housing 625 cows for 24 hours per day for 15 days.

Cows are not calved in the barn.

Table 6.2 Wintering barn usage

Use of wintering barn				
Month	**Cow numbers**	**Hours/day**	**Days**	**Average 50% usage for month**
May	625	12	31	50

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June	625	24	30	100
July	625	24	31	100
Aug	370	23	31	59
September	75	23	30	12

Wintering barn construction

The existing wintering barn is a sealed, concrete free-stall structure.

Barn dimensions: 29 m x 120 m

Construction of the barn was regulated by Southland District Council through a building consent. The structure was constructed by Bert's Engineering in c.2005. The site was prepared by an earthwork's contractor, who carried out the required earthworks.

The barn has a sealed concrete floor surrounded by 200 mm high concrete nib walls. Effluent from the barn is automatically scraped into a concrete collection pit from where it is pumped to the storage pond, which also stores effluent from the dairy shed as required. The barn has a small uncovered concrete area (170 m^2), which has been included in the Massey DESC reports. A rainwater diversion is always used for rainwater collected on the barn roof.

Effluent storage

Effluent from the barn is primarily composed of dung and urine, given the lack washdown water and only source of rainwater from the small uncovered area. The effluent storage system has sufficient storage to meet the requirements of the wintering barn usage outlined in table 6.2 and has 3,715 metres cubed metres cubed of storage available, plus 0.5 metres freeboard. This is sufficient for effluent from the wintering barn (and other sources), according to the Massey DESC provided in the Appendix.

The effluent storage system at WW2 is described in detail in the replacement application for the discharge permit.

Effluent irrigation

As is explained in the discharge permit replacement application, wintering barn effluent is applied to land as follows:

I. The effluent flows by gravity and is scraped automatically approximately 8 times per day to the concrete effluent collection sump, from where it is pumped to WW2 effluent storage pond.
II. The effluent is stored in the pond until soil moisture conditions allow for irrigation to occur.

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III. The effluent is pumped from the pond to the slurry tanker with a trailing shoe (no more than 2.5 mm/application) or umbilical system (no more than 3 mm per application) and irrigated at very low depth to land; and

IV. A rainwater diversion is always in place for water collected on the roof.

Buffer distances

The wintering barn has buffer distances as outlined in table 6.3. These are mapped in the FEMP for WW2.

Table 6.3

Buffer distances from wintering barn	
Nearest subsurface drain (m)	300
Nearest surface waterway (m)	665
Microbial health protection zone of a drinking water supply site (Appendix J) etc.	None
Dwelling not on same landholding (m)	>1,000
Landholding boundary (m)	840
Critical source area (m)	850

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7. Assessment of Environmental Effects

Adverse environmental effects from the use of land for a feed pad/lot, including wintering barns, can occur where the feed pad/lot is poorly designed, located or managed. Adverse effects can occur where contaminants present in dung and urine from cows housed in the barn (nutrients N, P, sediment and faecal microbes) reach receiving ground and/or surfacewaters via pathways such as artificial drainage or overland flow. Adverse effects on soils can occur if soils are overloaded with nutrients from barn effluent.

Design, location and construction

WW2's wintering barn at WW1&2 dairy farm was designed and constructed according to a building consent granted and administered by Southland District Council. Construction of the barn was carried out by Bert's Engineering and authorised by a building consent (SDC). The earthworks and concrete work were carried out by experienced firms and trade's people under contract. The risk of flooding and overland flow were key considerations in choosing a suitable site for the barn and supporting effluent storage facilities (pond and concrete collection pit), as were distances to waterways, subsurface drainage, bores and critical source areas. The barn is sited to avoid the risk of stormwater or overland flow into or from the barn. There are no waterways, tile drains or CSAs that could potentially channel contaminants to surfacewater, in the vicinity of the barn. The barn is on an elevated site and has a fully sealed concrete floor surrounded by 200 mm high concrete nib walls. Effluent cannot escape from the barn due to the concrete nib walling. Effluent is scraped automatically to a concrete collection pit approximately 8 times per day when the barn is in use. Due to its distance from any waterways and the nature of the barn, the risk of effluent generated within the barn reaching any waterway is avoided.

The nearest bore (E45/0083) is over 90 metres to the west of the barn site, with the dairy shed in between. There is little or no risk to the bore due to the use of land for the wintering barn.

Operation of the wintering barn depends on having an effective effluent management system, to collect, store and discharge effluent that is generated in the barn. The barn's effluent management system was designed and constructed according to the relevant Council rules and policies to meet best industry practice at the time. Project management was overseen by Dairy Green Limited, who have over 30 years of experience in the design and construction of effluent management systems in Southland.

Through appropriate design, siting and construction of the wintering barn, no contaminants will be lost to receiving surfacewaters or groundwater. Contaminants are collected, stored and utilised according to best practice management. The risk of adverse effects on water quality in the Waimatuku Surfacewater Management Zone, groundwater and soils is less than minor.

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Management of wintering barn and supporting effluent management system

The barn and supporting effluent system are managed according to best practice management and consent conditions. Barn usage per month is described in section 6, with a maximum authorised number of 625 cows housed in the barn at any one time. The supporting effluent infrastructure is designed to meet the needs of 625 cows in the barn. Raw effluent (slurry) is stored in the pond. Slurry is applied to land at very low depth according to best practice management and consent conditions. Effluent will only be applied to land when there is sufficient soil moisture deficit and no risk of drainage, and nutrients in effluent will be taken up by plants. Less than 150 kg N/hectare will be applied from pond slurry effluent at WW1&2 dairy farm, at less than 250 kg N/hectare at a support block used for cut and carry, and recommended buffers will be adhered to when discharging effluent. The effluent discharge activity is authorised by a discharge permit issued by Environment Southland, along with conditions that are met by the applicants when operating their effluent management system. This gives the Consent Authority certainty regarding the operation and management of effluent from the feed pad/lot.

Through appropriate management of the wintering barn and supporting effluent management infrastructure, the risks of adverse effects on water quality in the Waimatuku Surfacewater Management Zone, Waimatuku Groundwater Zone and soil health due to the use of land for a wintering barn, are considered as minor. In fact, the use of land for a wintering barn provides accommodation for up to 625 cows when otherwise they would be intensively winter grazed on fodder crop. It provides for a reduction in the number of cows being intensively winter grazed in the catchment and for less soil damage from pugging of soils over winter and in the shoulders of the season.

Conclusion

The use of land for an existing feed pad/lot has been considered in terms of key pSWLP policies and based on this assessment should be granted. Effects on the existing environment have been considered and are described in the above assessment. The feed pad/lot has been designed, constructed, sited and is operated to avoid or mitigate risks to water quality and soil health. The assessment concludes that effects on receiving surfacewaters, groundwater and soils, including cumulatively, will be less than minor due to the use of land for the existing WW2 unit feed pad/lot at WW1&2 dairy farm.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843

Phone 03 215 4381, Fax 03 215 4391

Email: scandrettrural@xtra.co.nz

WW1&2 consent application

Appendix A

Application Appendix.

NEW ZEALAND

COMPANIES REGISTER

Certificate of Incorporation

WOLDWIDE ONE LIMITED

2158688

NZBN: 9429032629682

This is to certify that HILBRE INVESTMENTS NO 19 LIMITED was incorporated under the Companies Act 1993 on the 11th day of August 2008 and changed its name to WOLDWIDE ONE LIMITED on the 4th day of May 2009.

Registrar of Companies
31st day of July 2018

REGISTRAR OF COMPANIES NEW ZEALAND

Certificate generated 31 July 2018 10:15 AM NZST

NEW ZEALAND COMPANIES REGISTER

Certificate of Incorporation

WOLDWIDE TWO LIMITED

2200670

NZBN: 9429032432329

This is to certify that HILBRE INVESTMENTS NO 23 LIMITED was incorporated under the Companies Act 1993 on the 26th day of January 2009 and changed its name to WOLDWIDE TWO LIMITED on the 4th day of May 2009.

Registrar of Companies
31st day of July 2018

REGISTRAR OF COMPANIES NEW ZEALAND

Certificate generated 31 July 2018 10:16 AM NZST

NEW ZEALAND COMPANIES REGISTER

Certificate of Incorporation

WOLDWIDE FARM LIMITED

516389

NZBN: 9429039079978

This is to certify that NICO (NO.32) LIMITED was incorporated under the Companies Act 1955 on the 13th day of August 1991
and changed its name to WOLDWIDE FARM LIMITED on the 2nd day of December 1991
and was reregistered to become a company under the Companies Act 1993 on the 11th day of June 1997.

Registrar of Companies
31st day of July 2018

REGISTRAR OF COMPANIES NEW ZEALAND

Certificate generated 31 July 2018 10:16 AM NZST

NEW ZEALAND COMPANIES REGISTER

Certificate of Incorporation

WOLDWIDE RUN-OFF LIMITED

2200669

NZBN: 9429032432213

This is to certify that HILBRE INVESTMENTS NO 22 LIMITED was incorporated under the Companies Act 1993 on the 5th day of January 2009
and changed its name to WOLDWIDE RUN-OFF LIMITED on the 4th day of May 2009.

Registrar of Companies
7th day of August 2018

REGISTRAR OF COMPANIES NEW ZEALAND

Certificate generated 07 August 2018 09:54 AM NZST

Dairy Effluent Storage Calculator
Summary Report

Regional authority:	Environment Southland Regional Council
Authorised agent:	Dairy Green Ltd
Client:	WW1
Program version:	1.50
Report date:	Tuesday, 26 February 2019

General description:

WW1
700 milked at peak
640 in barn for contigency storage - actual max for barn is 625
Milk until 15 June
Yard diversion 16 June to 31 July
Pond capacity = 4,241 m3
Conservative estimate of 50 ha of low risk soils used.

Note there is a covered wintering shed on farm which has a small uncovered catchment of 170 sq m. The details are included under feedpad.

Climate

Rainfall site:	Drummond Marson Rd
Mean annual rainfall:	1061 mm/year

Effluent Block

Area of low risk soil:	50.0 hectares
Minimum area of high risk soil:	150.0 hectares
Surplus area of high risk soil:	0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 15 June

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	670	3.5	34.0
February	660	3.5	33.0
March	640	3.5	32.0
April	580	3.0	27.0
May	500	3.0	25.0
June	180	0.0	9.0
July	0	0.0	0.0
August	300	3.0	15.0
September	500	3.5	25.0
October	680	4.0	34.0
November	700	4.0	35.0
December	700	3.5	35.0

Feedpad wash:

Month	Number of Cows	Hours on Pad	Wash Volume (cubic metres)
January	0	0.0	0.0
February	0	0.0	0.0
March	0	0.0	0.0
April	0	0.0	0.0
May	640	12.0	0.0
June	640	24.0	0.0

July	640	24.0	0.0
August	370	23.0	0.0
September	75	23.0	0.0
October	0	0.0	0.0
November	0	0.0	0.0
December	0	0.0	0.0

Irrigation

Winter-spring depth:	2 mm
Spring-autumn depth:	4 mm
Winter-spring volume:	80 cubic metres
Spring-autumn volume:	160 cubic metres
Irrigate all year?	Yes

Catchments

Yard Area:	553 square metres
Diverted?	Yes
- diversion start:	16 June
- diversion end:	31 July
Shed Roof Area:	175 square metres
Diverted?	Yes
Feedpad Area:	170 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	Yes
Diverted?	No
Other Areas:	0 square metres

Storage

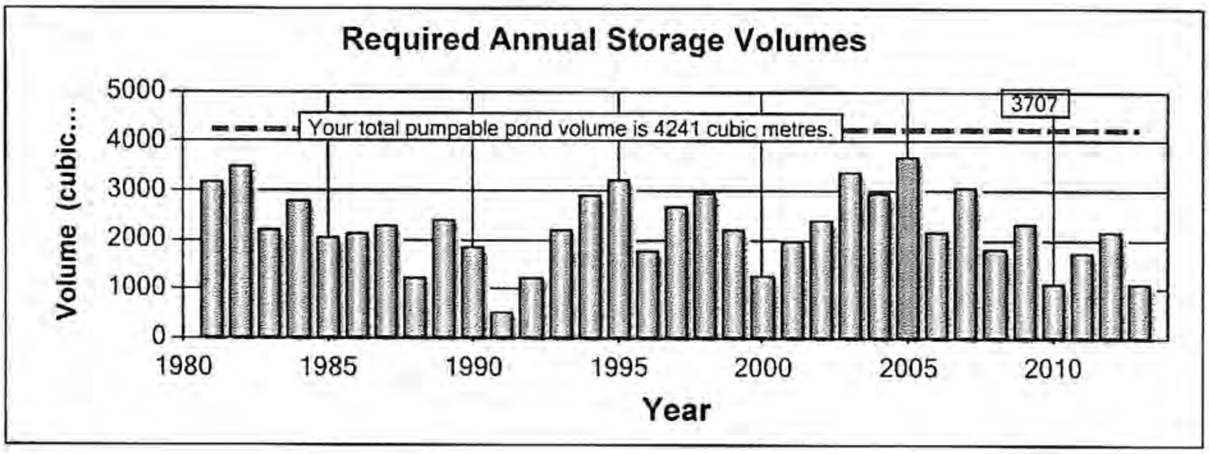
Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	5323 cubic metres
- pumpable volume:	4241 cubic metres
- surface area:	2282 square metres
- width:	46.1 metres
- length:	49.5 metres
- batter:	2.5:1
- total height:	3.4 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	0 days

Solids Separation

Solids separator/s present?	No

Outputs

Maximum required storage pond volume:	3707 cubic metres
90 % probability storage pond volume:	3257 cubic metres
During the period from:	01 July 1980
To:	30 June 2013



Dairy Effluent Storage Calculator
Summary Report

Regional authority:	Environment Southland Regional Council
Authorised agent:	Dairy Green Ltd
Client:	WW2
Program version:	1.50
Report date:	Tuesday, 26 February 2019

General description:

WW2 unit
800 milked
640 in barn for contigency storage - actual max for barn is 625
Split low risk (50 ha) and high risk (150 ha) soils
Silage pad catchment 800 m2

Note that there is a small uncovered catchment of 170 sq m at the dairy shed. The details for the shed use are under feedpad.

Climate

Rainfall site:	Drummond Marson Rd
Mean annual rainfall:	1061 mm/year

Effluent Block

Area of low risk soil:	50.0 hectares
Minimum area of high risk soil:	150.0 hectares
Surplus area of high risk soil:	0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 15 June

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	760	3.0	38.0
February	750	3.0	37.5
March	740	3.0	37.0
April	660	3.0	33.0
May	580	3.0	29.0
June	270	1.0	13.5
July	0	0.0	0.0
August	350	2.5	17.5
September	700	3.0	35.0
October	800	3.0	40.0
November	780	3.0	39.0
December	760	3.0	38.0

Feedpad wash:

Month	Number of Cows	Hours on Pad	Wash Volume (cubic metres)
January	0	0.0	0.0
February	0	0.0	0.0
March	0	0.0	0.0
April	0	0.0	0.0
May	640	12.0	0.0
June	640	24.0	0.0
July	640	24.0	0.0
August	375	23.0	0.0

September	75	23.0	0.0
October	0	0.0	0.0
November	0	0.0	0.0
December	0	0.0	0.0

Irrigation

Winter-spring depth:	2 mm
Spring-autumn depth:	4 mm
Winter-spring volume:	80 cubic metres
Spring-autumn volume:	160 cubic metres
Irrigate all year?	Yes

Catchments

Yard Area:	1126 square metres
Diverted?	Yes
- diversion start:	16 June
- diversion end:	01 August
Shed Roof Area:	175 square metres
Diverted?	Yes
Feedpad Area:	170 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	Yes
Diverted?	No
Other Areas:	800 square metres

Storage

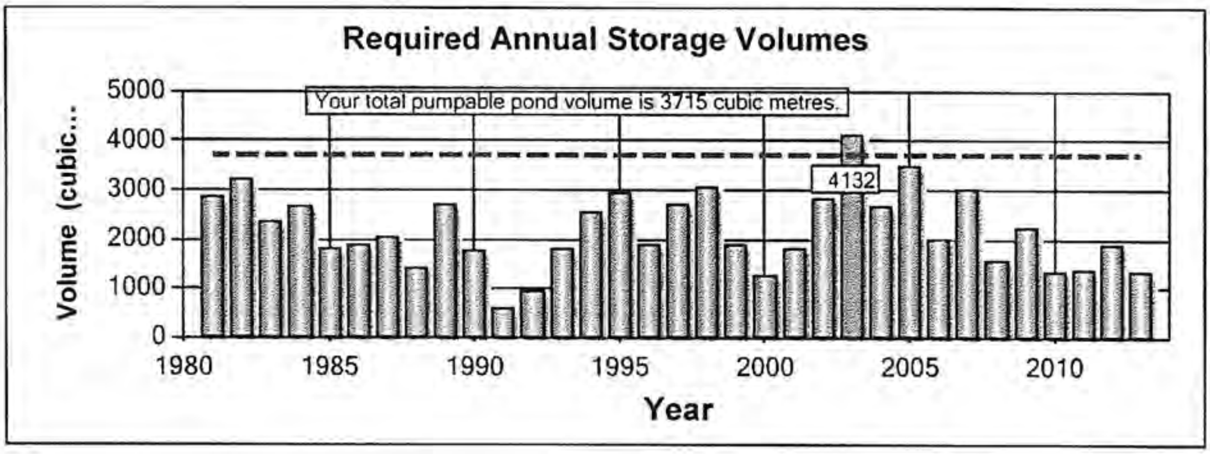
Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	4463 cubic metres
- pumpable volume:	3715 cubic metres
- surface area:	1516 square metres
- width:	37.9 metres
- length:	40.0 metres
- batter:	0.5:1
- total height:	3.2 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	0 days

Solids Separation

Solids separator/s present?	No

Outputs

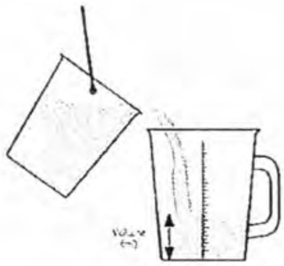
Maximum required storage pond volume:	4132 cubic metres
90 % probability storage pond volume:	3203 cubic metres
During the period from:	01 July 1980
To:	30 June 2013



WW 1 - travelling irrigator test.

How to calculate application and depth rates

Round buckets with SLOPED sides



Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.

Container 1 Container 2 etc ...

0 / 400	+	350 / 650	+	400 / 750	+	600 / 690	+	600 / 690	+	450 / 800	+	700 / 700	+	750 / 1150		TOTAL (ml) 800 / 750 11350

TOTAL (ml)		NUMBER OF CONTAINERS		AVERAGE VOLUME (ml)
11350	÷	18	=	630.56

CONTAINER WIDTH (mm)				CONTAINER RADIUS (mm)
290	÷	**2**	=	145

		CONTAINER RADIUS (mm)		CONTAINER RADIUS (mm)		CONTAINER AREA (mm^2)
3.14	X	145	X	145	=	66018

		AVERAGE VOLUME (ml)		CONTAINER AREA (mm^2)		AVERAGE APPLICATION DEPTH (mm)
1000	X	630.56	÷	66018	=	9.55

WW1.

AVERAGE APPLICATION DEPTH (mm)		TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)		AVERAGE APPLICATION RATE (mm/hr)
9.55	÷	1.25	=	7.64

NOTE: Maximum application depth = The CONTAINER with the deepest measurement.

Tip: To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

For assistance and advice on testing application depths and rates on pivot systems, please contact DairyNZ.

The maximum application depth and rate will be driven by a number of factors, such as the soil type, drainage, topography, the type of applicator being used and the soil moisture conditions. For more about how to identify the soil risk features on your farm, see Farmfact 6-61: How landscape and climate affect effluent management.

WW2 -

Environment Southland Te Taiao Tonga

Measuring Application Depth for Travelling Irrigators

Date	06/03/2017	Dairy Supply Number:	32651
Consent Number:	AUTH - 300626 - V2		
:			
GPS (Paddock number): 44	E - 46.049766 N 168.165085		
Diameter of irrigation:	29.5 metres		
Irrigator make/model:	Numedic ADCAM750		
Irrigator setting	2 Cams 6 teeth		
Time taken for full pass of irrigator:	90 minutes seconds		

Tray Number	Volume of Effluent in tray (ml)	Depth *(office use only)*
1	2	
2	6	
3	9	
4	13	
5	13	
6	13	
7	13	
8	13	
9	13	
10	10	
11	8	
12	4	
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
$\bar{x}$ *(office use only)*		

Rate *(office use only)*

NUMEDIC

superior dairy technology

IRRIGATOR TEST

Paddock Number 44 **Date:** 14/11/16

READ ALL THE INSTRUCTIONS BEFORE STARTING!! **There are two pages.**

Measurements to be taken:

- Depth in containers
- Time taken between pegs
- Spread of irrigator (m)
- Boom revolutions per minute

Container #	1	2	3	4	5	6	7	8	9	10	11	12
Depth (mm)	2	6	9	13	13	13	13	13	13	10	8	4

Measuring Application Depth in each container:

1. Place containers of the same size in a line across the path of the irrigator. Place them evenly and also ensure that you have enough containers to cover the total wetted width. Place them so that no effluent will be entering any container when the irrigator starts working. The table above is for 12 containers but you may use more. The more containers you use, the more accurate the results will be. The containers must have straight sides.

2. Once the irrigator has passed over the containers and no more effluent is going into any container, measure the depth in each container with a ruler and record them in the chart above.

Calculating the Average Application Depth:

The **average application depth(mm)** is the sum total of the depths in all the containers divided by the number of containers eg if using 8 containers and depths were 6, 8, 10, 12, 14, 9, 8, 7, the total is 74mm and 74 divided by 8 is 9.25mm. So the average depth is 9.25mm

1. Record the depth (mm) in each container in the boxes above
2. Add up the depths to give the Total 117 mm
3. Calculate the average application depth. 9.75 mm WW2.

Measuring the speed of the irrigator:

1. Place two pegs (fence standards are fine) in the ground 10 metres apart. Measure the time the irrigator takes to travel from one peg to the next. The speed is calculated as distance divided by the time. Eg if the time taken is 5 minutes for 10 metres, calculation is 10 divided by 5 = 2 metres/minute ________ time taken (minutes) for ________ distance (m)

Measuring the spread of the irrigator:

1. Measure the diameter of the wetted area of the irrigator. This measurement will be used when setting up your runs.
29.5 m

Measuring the boom rotations

1. Count how many full revolutions the boom makes in one minute ________ revs/minute

19th December 2017

Abe De Wolde
Woldwide Two
104 Shaws Trees Road
RD 3
Winton 9783

Dear Abe

Drop Test Results: Effluent Pond, 17 – 19 November 2017

1. Background
The current discharge consent for the property is 20171278-01

As required by Environment Southland, to confirm your effluent pond is not leaking, a drop down test was carried out between the 17 & 19 November 2017.

Site and Set Up
The farm is located at 1915 Winton-Wreys Bush Hwy

Effluent flows by gravity from the dairy shed to a sand trap sump. Whole effluent is then pumped to a clay lined storage pond if it is not pumped to the irrigator. The pond also services a wintering barn. Therefore, it stores thick slurry and a crust on the pond is inevitable, as can be seen by the photo below. The pond has been emptied in the last 12 months. The surface was not frozen during testing.

The pond was isolated by not allowing any inflow and by not pumping out during the test period.

The dimensions of the storage pond at the water level during the test period were:
North 36.0m
East 40.1m
South 37.0m
West 36.0m

The dimensions of the storage pond at the top bank level during the test period were:

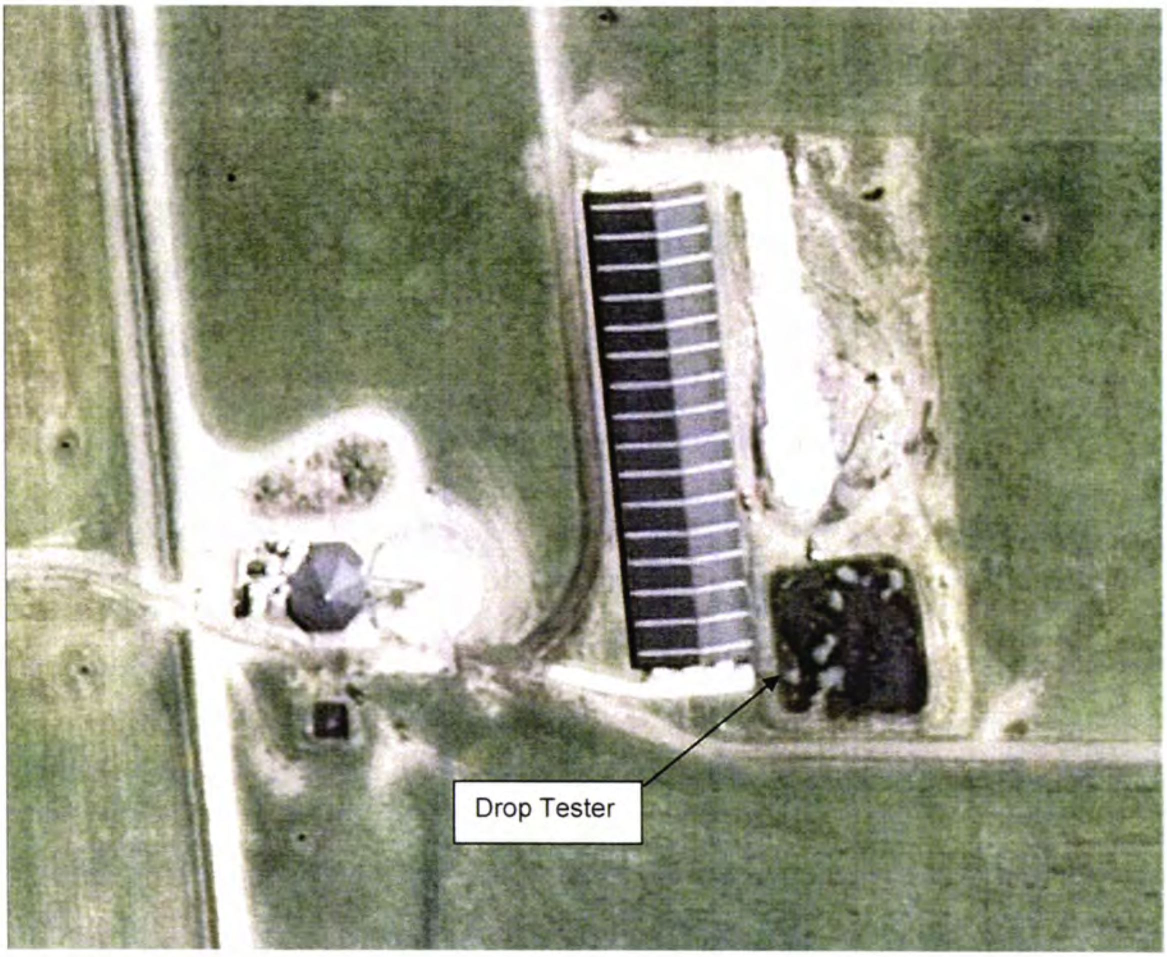
10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

North 38.0m
East 42.0m
South 37.6m
West 38.2m

The total pond catchment area was 9% greater than the wetted area during the test.

The maximum depth for the pond is 3.2m, this includes 0.5m of freeboard. At the time of the test the liquid level was 1.0m below design height, i.e.81% full.

Below is an aerial photo that shows the pond and dairy shed. The laser drop test unit was installed at the west side of the pond, as marked.



3. Test Methodology

You were notified when the test was to be run and confirmation was received that there would be no liquid inflow or outflow during the test period.

The monitoring equipment was set up at the pond by Evan Sanderson, as described below. The NIWA Neon website was checked to confirm that data was being recorded and sent to the website.

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

3.1. Water Level Monitoring Unit

A laser distance measuring unit was set up vertically over the pond surface. A reflective disc was placed on the pond surface to ensure constant, repeatable readings.
The laser was set up within a PVC pipe which acts as a stilling well.
Distance readings to the pond surface were taken at 10 second time intervals and sent to NIWA's Neon logging system.

3.2. Meteorological Station

A Vaisala weather station orientated to the North was also set up and the data it collected sent to NIWA's Neon system at 10 second intervals. It measured:

- Air Temperature
- Wind speed
- Wind direction
- Rainfall

3.3 Evaporation Loss Monitoring

A 10 litre bucket (evaporation pan) with a diameter of 250mm was installed on the pond bank to measure evaporation. The bucket was rinsed and then accurately filled with 9 litres of effluent and the volume monitored to determine evaporation.
To record evaporation in real time a second bucket was installed suspended from a strain gauge with 9.0L of effluent in it, on the pond bank.

4. Results Recording

Recording of results was carried out to comply with the Appendix P of the Environment Southland Land and Water Plan, recording details are summarised below:

- The minimum test period has to be 48 hours.
- Readings are to be taken every 10 seconds.
- For maximum accuracy the wind velocity has to be less than 1.0m/sec. This limit has been set because wind at the test site has been observed to have two affects, the first being to cause waves and the second to push water to one side of the pond from the other, (a seiche effect). The accuracy of the laser distance recorder is such it will detect changes as small as 0.2mm. To accurately determine the true pond level requires calm conditions at the start and end of the test period.

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

- Rainfall and the evaporation bucket liquid volume was measured at the start and end of the test period, the measurement cylinder was rinsed prior to the volume being measured.

- When a period of 48 hours or more has elapsed the information is down loaded and the results interpreted.

- The GPS location of the pond and equipment setup is recorded. For this test the equipment was located at **E**1225159, **N**4889662, at the west side of the pond.

Laser at the west side of the pond.

5. Results Summary

The results for the test are summarised in Table 1 and discussed below.

The plot of wind speed and pond height shows that at times wind caused waves on the pond surface, particularly during the day time of the 18th and again during the day time of 19th November.

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However a period was identified at the start and end of the test period when the pond surface was stable and accurate height readings were established.

The start time was assumed to be at 21:07:50 hours on the 17 November 2017.
The distance from the laser to the reflective disc on the pond surface was 233.1mm and the wind speed 0.6m/sec.

The finish time was assumed to be at 23:31:20 hours on the 19 November 2017.
The distance reading was 235.5mm and the wind speed 0.6m/sec.

The total time elapsed was 50 hours and 23 minutes, 30 seconds.

The laser measured a change in distance to the pond surface of a 2.4mm increase. Therefore the pond surface fell 2.4mm over the test period.

There was no rainfall during the test. The evaporation bucket was calculated to lose 9.3mm depth during the test period.

Theoretically the pond should have mimicked the evaporation bucket result, except evaporation from the pond will be much reduced because of the surface crust. It can be concluded the pond should have potentially fallen 9.3mm due to evaporation. The change in pond height was a fall of 2.4mm. This is not surprising and does not reflect a problem with the pond. The pond banks are constructed above ground level and the liquid level during the test was above the surrounding ground level. Groundwater could not have entered the pond during the test period. Rather it is a case of reduced evaporation resulting in the difference between the evaporation bucket and the pond level change.

TABLE 1 : DROP TEST RESULTS SUMMARY, Woldwide Two

Start Time	17 November, 21:07:50
Finish Time	19 November, 23:31:20
Total Time	50hrs, 23 minutes, 30 seconds
Start Depth (mm)	233.1
Finish depth (mm)	235.5
Change in depth (mm)	-2.4
Rainfall (mm)	0
Evaporation (mm)	-9.3
Net Change in Depth After	
Rain and Evaporation (mm)	+6.9
Net Change per 24 Hours (mm)	+3.3
Pond Level, % of Design Depth	81%
Net Change if Pond at 75% of	
Design Height. (mm/24hrs)	

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

6. Conclusion

The pond complies with the requirement of the Environment Southland Land and Water Regional Plan for effluent discharge (Rule 35 b. iii.), with a leakage rate of less than 2mm/day. The pond is suitable for storing effluent as the infiltration rate from the pond is less than 2mm per 24 hours.

Yours faithfully

John Scandrett

JOHN SCANDRETT
Agricultural & Engineering Consultant

Appended

Depth and wind speed graph for the test period.
Depth and evaporation graph for the test period.
Depth and wind speed for the start of the test period.
Depth and wind speed for the end of the test period.

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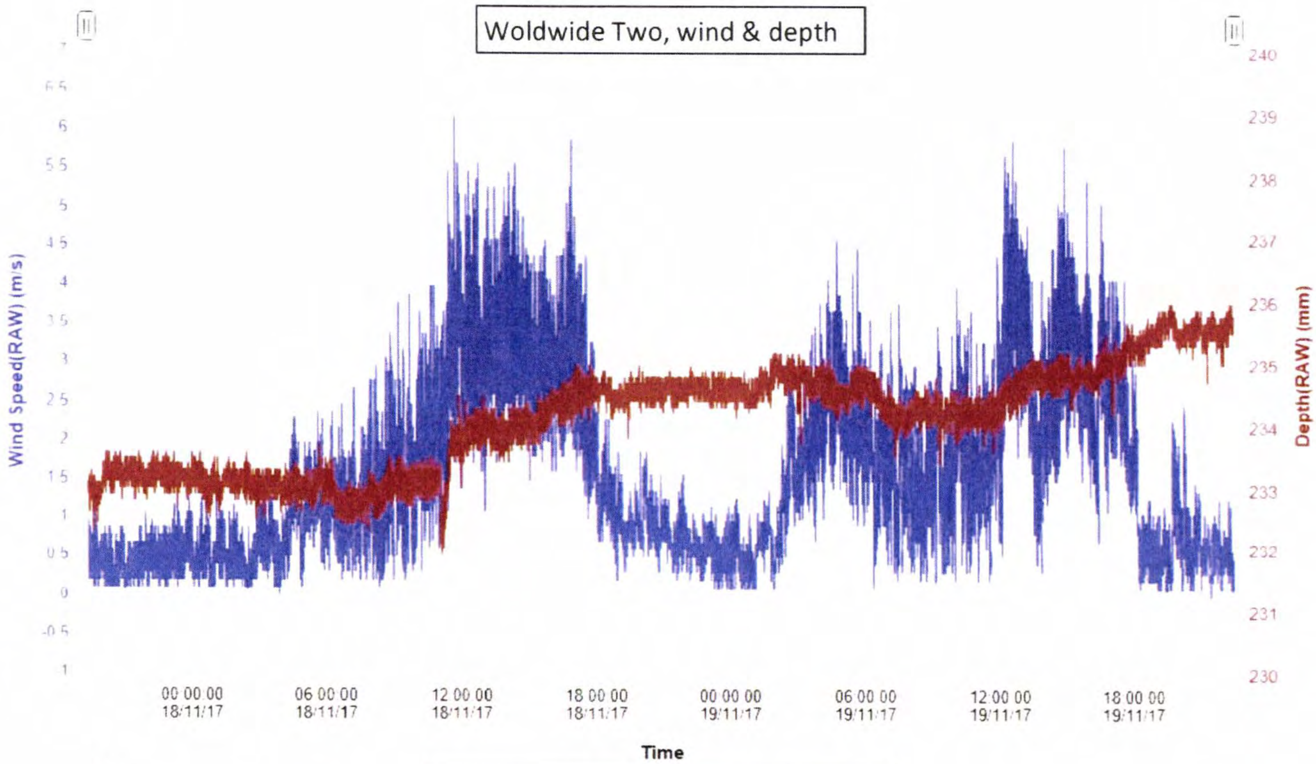
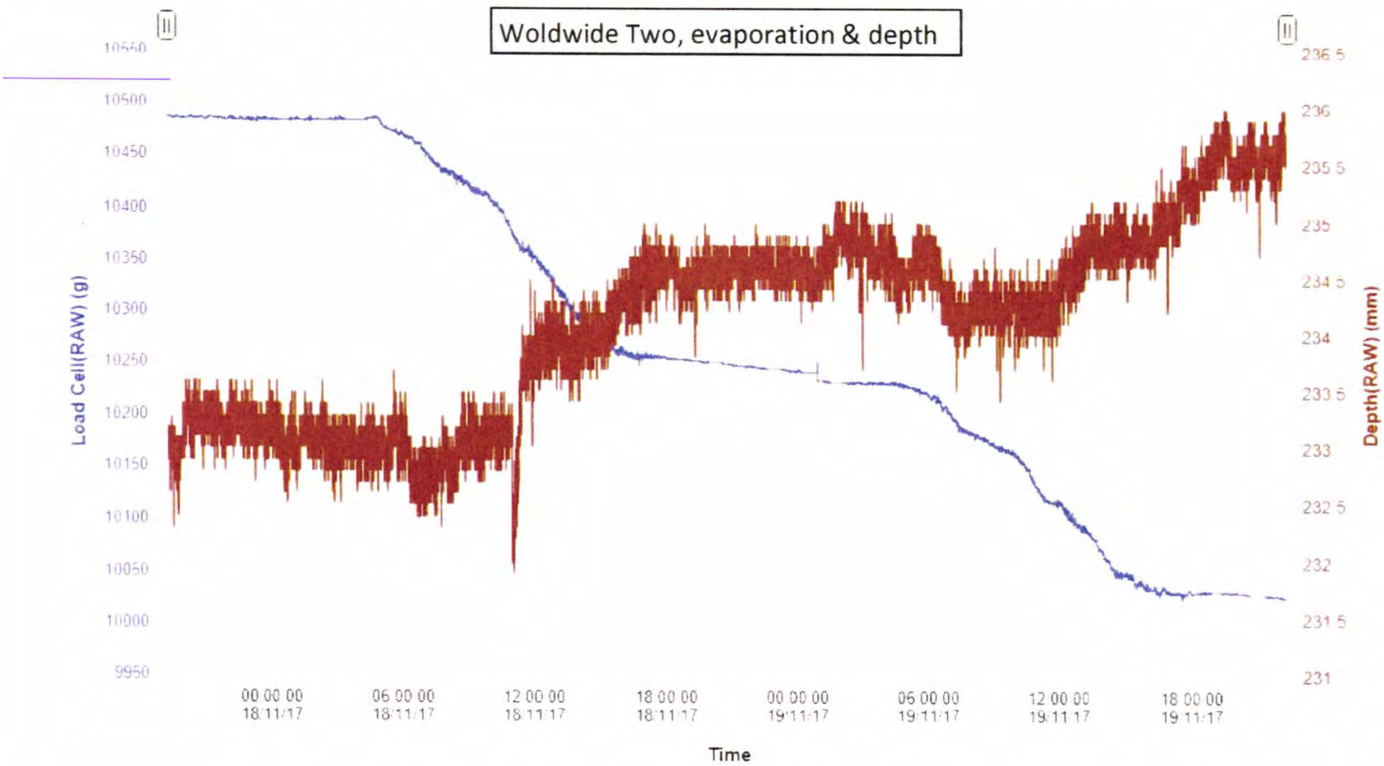
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz



Woldwide Two, wind & depth
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
240
239
238
237
236
235
234
233
232
231
230
00:00:00 18/11/17
06:00:00 18/11/17
12:00:00 18/11/17
18:00:00 18/11/17
00:00:00 19/11/17
06:00:00 19/11/17
12:00:00 19/11/17
18:00:00 19/11/17
Time



Woldwide Two, evaporation & depth
Load Cell(RAW) (g)
Depth(RAW) (mm)
10500
10450
10400
10350
10300
10250
10200
10150
10100
10050
10000
9950
236.5
236
235.5
235
234.5
234
233.5
233
232.5
232
231.5
231
00:00:00 18/11/17
06:00:00 18/11/17
12:00:00 18/11/17
18:00:00 18/11/17
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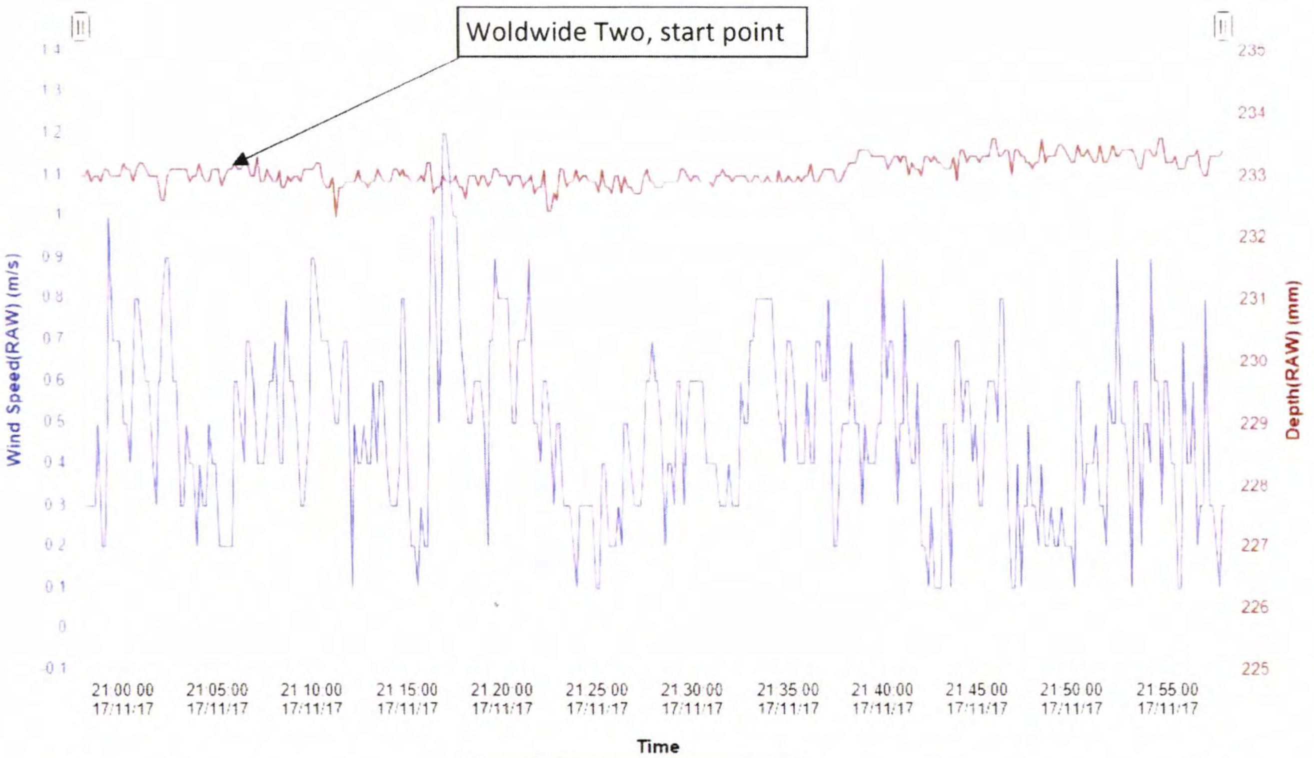
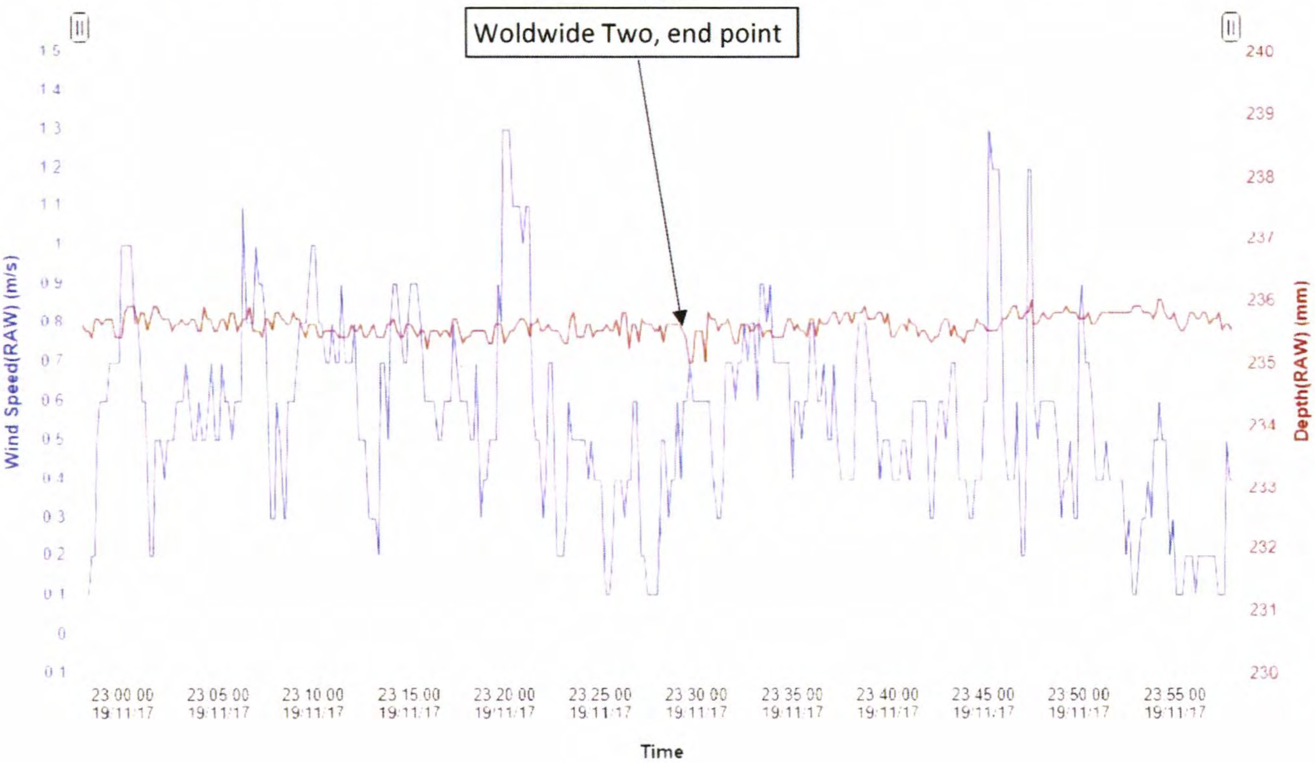
06:00:00 19/11/17
12:00:00 19/11/17
18:00:00 19/11/17
Time



Woldwide Two, start point
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
Time



Woldwide Two, end point
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
Time

GEOSOLVE

GeoSolve Ref: 170417Wolde
13 February 2018

Consents Section
Environment Southland
Private Bag 90116
Invercargill 9840

Effluent Pond Drop Test – A De Wolde
Woldwide Two, 1915 Winton-Wreys Bush Hwy

GeoSolve Ltd have been engaged by Dairy Green Ltd to review a drop test undertaken on 17 - 19 November 2017 at the above effluent pond.

I have reviewed the background information, test procedure, and results as reported by Dairy Green Ltd, together with the data audit provided by NIWA as a party independent from the equipment installer.

A significant crust was present at the time of testing, and therefore this test does not satisfy Appendix P of the Proposed Southland Land and Water Plan in respect of the requirement that "*... there shall be no sludge or crust on the pond surface during the test*". The crust has reduced the pond surface evaporation compared to the bankside measurement, and the pond has therefore fallen by less than predicted. There was no rain and no possibility of other inflows into the pond, and no suggestion of any leakage which would have tended to increase the drop in pond level. Therefore I do not consider that a significant unaccounted factor is present in the analysis, and I consider the results to be valid in terms of the conclusion that leakage rate is within the permitted limit.

In all other respects the test was compliant with relevant requirements of Appendix P.

I consider that the pond has a leakage rate of less than 2.0 mm per 24 hours and is therefore compliant with Rule 35 (b)(iii)(2) of the Proposed Southland Land and Water Plan for a pond of this depth.

This report has been prepared for the benefit of Dairy Green Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Yours faithfully,

HStocker

Hank Stocker
Senior Engineer – Water
CPEng 85136

Taihoro Nukurangi

5 February 2018

John Scandrett
Dairy Green Ltd.
10 Kinloch Street
PO Box 5003
Waikiwi
INVERCARGILL

RE: Woldwide 2 Drop Test, November 2017

Dear John

At your request, we have reviewed the data collected for the above test. From this we confirm that:

1. The raw data collected via our Neon data collection system is as you have stated.
2. The only significant complicating factor during this period was the surface crust. Your conclusion that this would significantly reduce the rate of evaporation, compared with a crust-free pond surface, seems reasonable in lieu of a crust-free retest.
3. Your conclusion that leakage from the pond complies with the Council's effluent discharge rule appears to be correct.

Yours faithfully

Jeremy Bulleid
NIWA Instrument Systems

Dairy Green Ltd
Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation
Irrigation NZ Accredited Designer

WOLDWIDE 1&2

EFFLUENT STORAGE AND TREATMENT STRUCTURES VISUAL INSPECTION

October 2018

J SCANDRETT
DAIRY GREEN LTD

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381, Gore 03 208 8443
Email: scandrettrural@xtra.co.nz

Visual Pond and Treatment System Inspection

Introduction

This report shows that the various structures associated with the effluent systems meet the permitted activity status under rule 32 D in the pSWLP. This requires existing agricultural effluent storage facilities to be "certified by a Suitably Qualified Person in accordance with Appendix P within the last three years as: (a), having no visible cracks, holes or defects that would allow effluent to leak from the effluent storage facility".

Methodology

The methodology used for ponds, as follows, will be adapted as appropriate when looking at associated infrastructure. The methodology used is aimed at detecting obvious physical defects that are causing or could cause leakage.

It involves a physical inspection of the lining material above the liquid height, the crest and external batters, if any. It also considers the likely failure mode for the type of containment structure being inspected. If there is a drop test report available, it will be assumed that this report confirms the performance of batters and floor surfaces below liquid level since these surfaces cannot be observed unless the structure is empty.

For clay lined ponds the internal batters will be checked for cracking, erosion and to determine the material that has been used with a view to determine its likely physical properties. The condition of the crest and external batter will be recorded along with any maintenance requirements.

For concrete or concrete block structures checks are made for settlement and cracking and corrosion of the concrete.

A visual inspection cannot record faults that are not observable which could include unsatisfactory material below the liquid level or underneath a synthetic liner or in the core of a pond bank. It does not include an assessment of bank performance in an earthquake scenario or any calculated internal and external batter performance factors of safety under the normal range of operating conditions that a pond may have to perform under, such as rapid drawdown.

Woldwide One

Dairy Shed

Sand Trap

Effluent is collected in the dairy yard and shed and flows to a concrete block sand trap 0.9 m wide and 6 m long. It is 1.2 m deep with an outlet approximately 0.3 m above floor height.

There was no sign of settlement or differential settlement or cracking. Grouted joins that could be observed appeared to be sound although there was one join in the top course of blocks that had lost some material. This was above the maximum operating height; the surrounding ground would be flooded for this join to be flooded.

The sand trap appeared to meet the criteria of not causing defects that would allow leakage.

Below are photos showing the sand trap lengthwise and looking at the internal concrete block wall.

Pump Sump

The pump sump at the end of the sand trap is formed from a precast $22.5m^3$ concrete tank. It has an inlet from the sand trap and one from a pipe crossing a race at a higher level. There were no obvious cracks in the concrete. A small area of concrete had been removed to facilitate the placement of the discharge pipe in a conduit under the race.

The sump appeared to meet the criteria of not causing defects that would allow leakage. It is pictured below with the end of the stone trap in the background.

Wintering Barn

The wintering barn has a collection sump at the north end where scraped effluent is deposited prior to being pumped into the storage pond. The sump is 1.9m wide and 26m long. It appeared to be in sound order with no obvious corrosion of concrete.

Conclusion

In accordance with Rule 32D of the pSWLP, the ancillary effluent structures at Woldwide One have been assessed by a SQP and are certified as having no visible cracks, holes or defects that would allow effluent to leak.

WW1 POND

The pond was built in April/May 2018 and signed off by a CPEng from Geosolve Ltd. In accordance with PN21 it has a leak detection drain installed around the perimeter of the floor as per CPEng instruction.

From PN21, section 5.10.1. Drainage Control and Leak Detection Systems. "For smaller ponds a ring drain placed at the foot of the batter slope should suffice".

On the 18 October 2018 the water level in the leak detection drain piezo was 1.1m deep. The pond level was into the freeboard space, i.e. full. The piezo pipe is 4.6m long. The water was clear in appearance and would be expected to be groundwater considering the recent rainfall. There was no obvious sign of effluent in the water, such as discoloration or odour, in the piezo.

Woldwide Two

Dairy Shed

Sand Trap

Effluent from the dairy shed and yard flows to a conventional sand trap on the south side of the dairy shed. It is emptied by front end loader. The structure didn't show any visible signs of settling or cracking. There was no cracking of the concrete where tractor tyres enter the trap or along the back wall where the front-end loader bucket may contact the wall.

The sand trap appeared to meet the criteria of not causing defects that would allow leakage.

Below is a photograph of the sand trap.

Pump Sump

The pump sump adjacent to the sand trap is formed from a shotcrete concrete tank in the order of 9.2 m x 9.2 m. It has an inlet from the sand trap. There were no obvious cracks in the concrete for the area of concrete that was visible.

The pump sump appeared to meet the criteria of not having defects that would allow leakage. It is pictured below with a section of the freeboard batter slope exposed in the background and then close up.

Wintering Barn

The wintering barn has a collection sump at the south end where scraped effluent is deposited prior to being pumped into the storage pond. The sump is 1.9 m wide and 30 m long. It had been poured in situ. It appeared to be in sound order with no obvious corrosion of concrete.

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Phone Invercargill 03 215 4381, Gore 03 208 8443
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Conclusion
In accordance with Rule 32D of the pSWLP, the ancillary effluent structures at Woldwide Two have been assessed by a SQP and are certified as having no visible cracks, holes or defects that would allow effluent to leak.

WTL POND

The pond is close to square with approximate dimensions of 40 m x 38 m at top bank level.
It was tested by a drop test in November 2017 and found to have a leakage rate of less than 2 mm per day. Based on the drop test result of less than 12 months ago it is assumed the pond liner is still performing satisfactorily.

On the 18 October 2018 the pond was found to be full, with the effluent level into the freeboard space.

Soils
Subsoil from the local area was harvested to line the internal batters. This soil isn't dispersive. The banks are largely made of gravel and silt in varying proportions.

Banks
The bank crests were covered in long grass and appeared quite stable.
The bank crests are generally 3.6m wide.

Batters

The internal batters were constructed on a 2H:1V gradient. There was no indication of internal batter slumping at crest level. The external batters are on a 1:1 gradient. They are covered in grass and appeared to be stable.

Photos of each bank crest appear below.

South Bank.

The East Bank

North Bank

West Bank

Conclusion

In accordance with Rule 32D of the pSWLP, the effluent storage pond at Woldwide Two has been assessed by a SQP and is certified as having no visible cracks, holes or defects that would allow effluent to leak from the effluent storage facility.

J S Scandrett
Agricultural & Engineering Consultant
Dairy Green Ltd

18 October 2018

Environment Southland
Corner of North Road and Price Street
Waikiwi
Invercargill 9810
New Zealand

Telephone (03) 211 5115
Fax (03) 211 5252
Email service@es.govt.nz
Website http://www.es.govt.nz/

Compliance Monitoring

Form:	Compliance Monitoring
Reference Number:	REF180712284
Completed On:	18/07/2018 14:07
Completed By:	Michelle Te Maro

Authorisation IRIS ID:	AUTH-300626-V2
Inspection Date:	**18/07/2018**
Inspection Time:	**12:05 p.m.**
Observation Type:	**Wintering Pad Inspection**

Overall Performance Rating: **1: Fully compliant**

ObjectTypeREF:	**RegimeActivity**
Person In Charge:	

Discharge Inspection Charges

Standard Fee:	**Wintering Pad Inspection $415**
Work Order:	**W79.12.72**
Generate Invoice:	**Yes**

Additional Charges

Additional Charges:	**No**

Authorisation Conditions

Condition Number:	**1**
Condition Text:	This consent is granted for a period of 10 years and shall commence on the surrender or expiry of Resource Consent 200870 Note: Pursuant to Sections 123 and 124 of the Resource Management Act 1991, a new consent will be required at the expiration of this consent. The application will be considered in accordance with the plans in effect at that time, and the adverse effects of the proposed activity.
Compliance Status:	**Full compliance**

Condition Number:	**2**

Condition Text:	This consent authorises the discharge of dairy shed and wintering barn effluent onto land, via a land disposal system, as described in the application, on land known as Lot 1 DP 14660, Lot 1 DP 9925, Lot 1 DP 10885, Pt Lot 1 DP 4092, Pt Lot 2 DP 4092, Pt Lot 18 DP 942, Lot 1 DP 5610, Lot 3 DP 5610, Pt Section 417 Taringatura SD, Section 419 Taringatura SD and Lot 1 DP 14661. Note:The effluent disposal area shown in Appendix 1 can be altered and/or extended, subject to the approval of the Director of Environmental Management, if the consent holder submits a new plan showing the new effluent disposal area, and providing the written approval(s) of any person whose property boundary will be closer to that area. In the event that written approval cannot be obtained, the effluent disposal area can only be amended by way of limited notification.
Compliance Status:	**Full compliance**

Condition Number:	**3**
Condition Text:	(a) No dairy shed or wintering barn effluent shall be discharged to any surface watercourse by overland flow, run-off, or via a pipe, nor shall there be any surface run-off/overland flow, ponding or contamination of water resulting from the exercise of this consent. See Best Practice Notes 1, 2 &3. (b) The land disposal system shall be operated and maintained to ensure that there is no offensive or objectionable odour beyond the property boundary, or any spray drift into or beyond the buffer zones specified in Condition 5. (c) The consent holder shall install and maintain an alarm and automatic switch-off system as a contingency measure in the event of an effluent system failure such as a sudden pressure drop, irrigator stoppage or breakdown. See Best Practice Note 4.
Compliance Status:	**Full compliance**

Condition Number:	**4**
Condition Text:	(a) Subject to Condition 3(a), the land disposal system is limited to the following: a maximum depth of application of 10 mm for each individual application; Note: The application depth needs to be less than the soil-water deficit (i.e. the depths above are maximum depths and as soil moisture levels approach field capacity, smaller depths will be necessary to avoid losses of contaminants from the root zone. When soil moisture levels reach field capacity, irrigation will need to cease completely to prevent these losses.) the maximum loading rate of nitrogen onto any land area shall not exceed 150 kg of nitrogen per hectare per year from dairy shed and wintering barn effluent. See Best Practice Note 5. Before this consent is exercised, the consent holder shall measure the application rate of the irrigator as installed to confirm the operating conditions required to ensure compliance with condition 4(a). The consent holder shall notify the Council's Compliance Manager in advance of the measurement; (escompliance@es.govt.nz) The Council may audit the measurement of the application rate to ensure accuracy. The consent holder shall pay the costs of auditing the measurement in accordance with Section 36 of the Resource Management Act. The result of the measurement shall be forwarded to the Council's Compliance Manager; (escompliance@es.govt.nz) within 10 working days of the measurement being completed.
Compliance Status:	**Full compliance**

Condition Number:	**5**

Condition Text:	Effluent may be applied to the land as described in the application and generally as shown in Appendix 1, but the following specific buffers shall be observed: (a) 20 metres of any surface watercourse; (b) 100 metres of any potable water abstraction point; (c) 20 metres of any property boundary (unless the adjoining landowner's consent is obtained to do otherwise); and (d) 100 metres of any residential dwelling other than residential dwellings on the property. Where there is conflict between Appendix 1 and these specified buffers, the latter shall apply.
Compliance Status:	**Full compliance**

Condition Number:	**6**
Condition Text:	(a) The amount of dairy shed effluent disposed of onto land shall not exceed that from 800 cows. (b) The amount of wintering barn effluent disposed of onto land shall not exceed that from 600 cows
Compliance Status:	**Full compliance**

Condition Number:	**7**
Condition Text:	Prior to exercising this consent the consent holder shall provide at least 3,282 m3 of effluent storage for the purpose of: avoiding irrigation of effluent when soils are at or above field capacity – see Best Practice Note 8; providing a contingency measure when the irrigation system is inoperative; and/or for primary treatment when it is necessary for the proper operation of the effluent disposal system. Note:The storage volume is equivalent to 90 days of effluent based on 50 litres/cow/day.
Compliance Status:	**Full compliance**

Condition Number:	**8**
Condition Text:	The consent holder shall notify the Council, by 1 February 2012, of the person who is in charge of the operation of the effluent disposal system. If the person in charge of the effluent system changes during the term of this consent, the consent holder shall notify the Council of the new operator no later than five working days after that person takes responsibility. See Best Practice Note 6 &7. Note:The person identified by condition 8 will be the primary contact for Council staff for monitoring purposes and/or in the event of an incident. Nothing in this condition removes or limits the consent holder's liability to ensure compliance with the consent and its conditions.
Compliance Status:	**Full compliance**

Condition Number:	**9**

Condition Text:

By 31 January 2015 the consent holder shall drill or access a bore (or well) for the purposes of monitoring groundwater quality. Unless otherwise agreed in writing by Environment Southland's Compliance Manager the bore shall conform with the following requirements: (a) the bore shall be located within the south eastern corner of the effluent disposal field, at least 500m from the dairy shed and 200m from the south eastern farm boundary. (b) The depth of the bore shall be between 2 and 4 metres below the static groundwater level, and no more than 12 metres deep in total; (c) The internal diameter of the bore shall be between 50 and 100 mm. (d) The bore is to be used solely for monitoring purposes. This may include abstraction to take samples or to flush the bore prior to sampling, but excludes abstraction of water for domestic or farm supply. Note 1: Construction of a bore will require a separate land use consent. However the land use consent is a controlled activity and should not pose an impediment to the exercise of the discharge permit. A guideline on monitoring bore construction is available Note 2: If a bore cannot be established in accordance with this condition, the consent holder may seek the Compliance Manager's agreement for an alternative monitoring bore, or may seek amendment to the resource consent. Note 3: If it is necessary to draw water supply from the monitoring bore it may be necessary to install a new monitoring bore.

Compliance Status:

Full compliance

Condition Number:

10

Condition Text:

The Southland Regional Council may serve notice of its intention to review the conditions of this consent, in accordance with the conditions of this resource consent and Sections 128 and 129 of the Resource Management Act 1991, during the period 1 February to 30 September each year, or within two calendar months of the completion of any enforcement action (prosecution or infringement notice), for the purposes of: (a) dealing with any adverse or cumulative effects, including the adverse effects of high stocking rates, on the environment which may arise from the exercise of this consent; (b) considering any changes to information on the effects of land disposal of dairy shed or wintering barn effluent; or (c) complying with the requirements of a regional plan; or (d) amending monitoring requirements; or (e) imposing a notification requirement for potential effects on registered drinking water supplies.

Compliance Status:

Not Assessed

Condition Number:

11

Condition Text:	The consent holder shall pay an annual administration and monitoring charge to the Southland Regional Council, collected in accordance with Section 36 of the Resource Management Act. This charge may include the costs of inspecting the site three times each year (or otherwise as set by the Council's Annual Plan), and: From 1 February 2015 monitoring the effects of the discharge on groundwater by taking representative samples from the monitoring bore or well to be established under Condition 9 once every six months and analysing for: chloride electrical conductivity nitrate nitrogen concentration E. coli concentration Except that the first sample shall also be analysed for Dissolved Iron concentration. (b) monitoring the effects of the discharge on surface water, as follows: monitoring of watercourses may be undertaken up to three times each year; representative samples will be taken from the watercourse near the effluent disposal field, upstream and downstream of the discharge area, at points approved by the Council's Compliance Manager. the samples will be analysed for: pH electrical conductivity ammoniacal nitrogen concentration nitrate nitrogen concentration dissolved reactive phosphorous concentration E. coli concentration
Compliance Status:	**Not Assessed**

Condition Number:	**Best Prac**

Condition Text:

Best Practice and Explanatory Notes 1. Dairy shed or wintering barn effluent should not be discharged onto any land area that has been grazed within the previous 5-10 days. Where there has been significant damage to soil during grazing, it is recommended that effluent not be applied until that damage has been repaired. 2. To avoid contaminating water directly or indirectly, the consent holder should not apply effluent to land when the soils are at or above field capacity. Moisture content is to be determined by either actual monitoring on site or by reference to the appropriate Council monitoring site. The Council's soil moisture monitoring sites can be viewed at http://www.es.govt.nz and following the "Farming", "Dairy Advisor" and "Soil Moisture Map" links. 3. For the purposes of this condition, ponding is the accumulation of effluent on the soil surface resulting from the application of effluent to saturated soils, or the application of effluent inducing saturated soil conditions. It does not refer to the temporary accumulation of effluent on the soil surface resulting from the application of effluent at a rate that exceeds the soil infiltration rate. 4. Where the effluent reticulation system is installed in such a way that effluent can be siphoned when pumping ceases, the consent holder should install and maintain an anti-siphon device in the effluent pipe line. 5. A loading of 150 kg N/ha/year is approximately equivalent to a loading of dairy shed and wintering barn effluent to land of 4 ha/100 cows. However, there are significant benefits to having a larger effluent disposal area in terms of managing potassium. Further, scientific research has highlighted decreased nitrogen use efficiency and increased nitrogen leaching losses at annual nitrogen loading rates (from combined fertiliser and effluent N) greater than 150 kg/N/ha/yr. Extreme caution should therefore be taken when applying nitrogen fertiliser to the effluent disposal area. It is recommended that a nutrient budget is used to check that nitrogen and potassium application rates to the effluent disposal area are not excessive. 6. The consent holder should prepare and comply with a Farm Environmental Management Plan. The plan should: specify and implement a nutrient budgeting system for the property; provide for the management of effluent disposal to avoid applications when soils are at or above field capacity; identify, as far as is practicable, the drains in the effluent disposal area, so that appropriate management procedures can be taken to avoid contamination of the drains by effluent; if relevant, provide for the operation and management of any feedlot and/or wintering pad; include the provision for monitoring application rates to ensure the consent requirements are being met; include the monitoring requirements specified in this consent; and address ancillary matters such as protecting well-head(s) from contamination; preventing leachate from any silage pits entering water, including groundwater; preventing soil damage; controlling runoff from lanes; and preventing stock access to and maintaining the riparian margins of any watercourses on the property. A template may be viewed at: http://www.es.govt.nz/media/4831/dairy-farm-plan-consent-template.pdf 7. The consent holder should display, in a prominent place in the dairy shed, a copy of the resource consent and relevant limits about the operation of the effluent disposal system that must be complied with. The material to be displayed will be provided by the Council on laminated sheets suitable for display purposes. 8. Storage ponds should be operated at low levels when conditions for effluent disposal are suitable in order to maintain storage for wet weather periods. In particular, storage ponds should be emptied in late summer/early autumn to ensure sufficient storage capacity for the following late winter/early spring period. 9. Storage ponds should not, for practical purposes, leak. This resource consent does not authorise the discharge of contaminants due to leaks or failure of the storage ponds. If an existing storage pond is modified (such as by increasing the embankment height to increase storage), the modification will require resource consent.

Compliance Status:

Not Assessed

Discharge Inspection – Application Method

Application Method:	**Travelling**
Low Rate On (minutes):	
Low Rate Off (minutes):	
Low Rate Period (hours):	
Travelling (cams):	**2**
Travelling (teeth):	**4**
Travelling (other):	
Automatic Switch Off System:	**Yes**
Nozzles OK:	**Yes**

Discharge Inspection – Disposal System

Effluent Storage:	**Freeboard**
Effluent Storage (%):	**20**
Sump:	**OK**
Stone Trap:	**OK**
Weeping Wall:	

Discharge Inspection – Disposal Area

Currently Disposing:	**No**
Odour Beyond Boundary:	**No**
Sludge Over Application:	**No**
Soil Moisture At Field Capacity:	**No**
Soil Moisture Rating:	**Orange (pulse irrigation)**

Peak Cow Number:	**540**
Comments:	**Not irrigating but rather using storage. Lanes at the approach of the milking platform are being cleaned up. Systems are tidy. No issues on site.**

WW1&2 consent application

Appendix B

Soil type assessment of soils at Woldwide 1 & 2 dairy farms

Introduction

The soil assessment was carried out by Mr. John Scandrett at Woldwide 1&2 dairy farms in 2017. Mr. Scandrett is a farm consultant experienced in all aspects of sheep and beef management and agricultural engineering including drainage, effluent management, irrigation and machinery management and water scheme design.

Mr. Scandrett holds a Bachelor of Agricultural Science degree with honours. Practical experience gained since receiving his qualification in 1981 includes the digging of hundreds if not thousands of holes for soil profile assessment for farm management and drainage reasons. This includes checking the soil profile to determine if it is true to type and its physical properties, including drainage status and properties. Mr. Scandrett worked closely with the late Bill Risk, soil scientist between 2008 and 2012 who assessed the physical properties of in excess of 300 subsoil samples on his behalf.

The investigation of the spatial variation in soil properties at the property was undertaken because Mr. de Wolde believed the soil and description provided in Topoclimate did not accurately portray the soil types and boundaries at the property.

Mr de Wolde's description of the soil properties was in line with Mr Scandrett's knowledge of the soils in the area, which in that area, are largely considered to be free draining. Topoclimate has most of the area mapped as primarily a Braxton soil, which is a poorly drained soil. Mr de Wolde confirmed that most of the property doesn't have tile drains installed and is free draining. Only a few paddocks in the south west corner of the property have tile drains installed.

The free draining soil that Topoclimate has mapped along the eastern boundary of the property is the Glenelg soil. This is described in the Topoclimate data sheets as stony in both the topsoil and subsoil. Mr de Wolde's experience was the topsoil was largely stone free and the subsoil, while varying in depth to gravel, was also largely stone free, such that the profile was typically stone free to a depth of up to 0.5 m or more.

Prior to Topoclimate remapping the soils in the area covered by the farm, the Soil Bureau Division of the DSIR had mapped the soils as being of the Drummond type, as reported in Soil Bureau Bulletin 27, General Survey of the Soils of South Island, New Zealand, 1968.

The Drummond soil is described as a silt loam soil, 0.5 m deep overlaying sandy gravels in Soil Bureau Bulletin 27. This description was a good fit with Mr de Wolde's local knowledge of the property.

Further, a study of the Topoclimate soil map for the farm area shows that no test pits were excavated on either Woldwide one or two to confirm soil types. Presumably mapping was based on auger holes and an assessment of the topography.

Method

Mr de Wolde provided farm maps showing the paddock boundaries for Woldwide 1 and 2 and on these he marked in the soil boundaries based on his farming experience of the land. This includes where tile drains are located, the location of heavy versus free draining soils, areas sensitive to dry spells/drought etc.

Mr. Scandrett researched soil information available for the area using:

- Soil Map of The South Island New Zealand sheet 12;
- General Survey of the Soils of South Island New Zealand, Soil Bureau Bulletin 27, which gave descriptions of Drummond, Glenelg and Makarewa soils; and
- Soil technical data sheets from Topoclimate for Braxton, Drummond, Glenelg and Pukemutu soils.

Mr. Scandrett carried out an on-site investigation in February 2017. See the Appendix for location of test holes. Mr. de Wolde's revised soil boundary was used as a guide to the digging of 28 test holes.

The aim of digging the test holes was to confirm the actual soil type at each point, how it compared to Mr de Wolde's assessment and if the Topoclimate soil boundary was correctly located.

For each test hole, the soil profile was inspected and characterised compared to Topoclimate. A spear was also used to check for soil depth to gravel in the vicinity of the test hole. This confirmed whether the points at which test holes were dug were representative for the area.

Results

See the Appendix for revised soil maps based on Mr. Scandrett's investigation of soils, including the digging and inspection of 28 test holes.

The following is a report on the soil investigation at Woldwide 1.

Woldwide One Soils

The following photographs and comments refer to various paddocks across Woldwide One using paddock numbers provided on a farm plan as at January 2017, which is appended.

Holes were dug on the 7 February 2017 to check the depth of topsoil, stone content and drainage properties. The topsoil and subsoil were checked for texture using field methods and for the drainage properties mottling was taken as an indication of impeded drainage.

The profile at each site was compared to the Topoclimate South soil map to determine if the soils were true to type as described in the Topoclimate soil information sheets.

It was found the Topoclimate map was not particularly accurate with actual soil profiles generally better than stated by Topoclimate.

Two test holes in paddock 23 plus checking with a spear indicated the soil profile was not a Glenelg or Braxton as Topoclimate indicated, but a Drummond soil type. Two test holes in paddock 24 indicated the soil was free draining and had a stone free topsoil overlying a stoney subsoil. This soil was mapped as a Braxton on Topoclimate, but in reality is a Glenelg – Drummond intergrade.

The test holes in paddock 21 indicated an intergrade soil with the Drummond type tending towards the Braxton soil type in the subsoil. The holes were excavated in the vicinity of the soil boundary Mr de Wolde had indicated between Braxton and Drummond soils and the soil profile appearance supports this observation.

Paddocks 3 and 5 to 14 on Woldwide one were considered to be typical of the Braxton or Pukemutu type based on Mr de Wolde's experience and 5 test holes were dug to check the soil profile.

The Braxton and Pukemutu soils are less extensive than shown in Topoclimate. The Glenelg soil is also less extensive than Topoclimate suggests.

Prior to Topoclimate maps being produced most of the block was depicted as being of the Drummond soil type in DSIR Soil Bureau Bulletin 27. Makarewa soils were shown to cover the west end of the farm. Makarewa soils are inherently poorly drained. Topoclimate has redefined the area covered by the Makarewa type as being a Braxton or Pukemutu soil type, both of which are poorly drained. Topoclimate has also extended the area of poorly drained soil to cover approximately 90% of Woldwide One.

Based on field work at the Woldwide 1 property, Mr. Scandrett concluded that shallow to moderately deep Drummond soils cover much of the area shown as the Braxton type, other than for the west end of the property.

Paddock 23

Topoclimate suggests a Glenelg soil type for this area. However, there was no stone in the topsoil and there was a well-developed subsoil. The subsoil was free draining with no mottling to the bottom of the subsoil level at 0.5 m. This profile is more characteristic of a Drummond soil type. The sample site was on a broad ridge. The paddock had recently been cultivated and the profile was reported as being uniform to plough depth across it, i.e. no stones in the topsoil.

Paddock 24

Topoclimate suggests a Braxton soil type for this paddock. There was 250 mm depth of soil overlying stone. The profile was better than a typical Glenelg soil which has stone throughout all horizons. The south west corner where this hole was dug is the lightest part of the paddock according to Mr de Wolde.

Paddock 21

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The profile was 250 mm depth of topsoil, no mottles present, well-structured, overlying a heavier textured subsoil. There were some mottles present in the subsoil and no stone with 0.5 m of the surface. This profile is tending towards the Braxton soil type. The sample site was in a slight but distinct hollow and would be expected to have a wetter profile compared to the higher adjoining ground.

Paddock 7

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The topsoil depth was 200 mm, overlying a 50 mm thick intergrade layer between the topsoil and subsoil overlying a heavy and mottled subsoil. This profile showed poorer drainage than the profile in paddock 21 and is more characteristic of a Braxton soil type.

Woldwide One Ltd

1354 Hundred Line Rd, Dunearn 9783

LEGEND

Quarry/Gravel Pit	Shed
Creak/Duck Ponds	Public Road
Trees	Slurry Pit
Flood Bank	Tanker Track
Pilones/Powerline	Cow Yards
Effluent Paddocks	Waste Area
Houses	Bridge/Culvert
Water Bore	HNSO Chemical Storage
Under Pass	Fuel Tank
OFFAL Pit	Water Trough

Woldwide Two Soils

The following photographs and comments refer to various paddocks across Woldwide Two and the support block on the north side of SH96, now incorporated into Woldwide Two. A farm plan is appended.

Holes were dug to check the depth of topsoil, stone content and drainage properties. The topsoil and subsoil were checked for their texture using field methods and their drainage properties with mottling taken as an indication of impeded drainage.

The profile at each site was compared to the Topoclimate South soil map to determine if the soils were true to type as described in the Topoclimate soil information sheets.

Paddock 10 had a well structured, well drained topsoil overlying a well structured subsoil with no indication of impeded drainage until 0.5 m depth where some mottles occurred. Topoclimate maps this paddock as being of the Braxton type where as it is more characteristic of the Drummond type.

Two paddocks to the west of paddock 10 paddock 8 had the properties of an intergrade between Drummond and Braxton soils.

Four paddocks to the north of paddock 8 is paddock 16 which was mapped by Topoclimate as being predominantly of the Braxton soil type. Five test holes in this paddock revealed that the soil is typical of a shallow Drummond soil.

To the north of SH96 test holes in paddock Marcel 1, SH2 and SH1 indicated a Drummond soil or the shallow variant of it. Topoclimate mapped the area as being of the Braxton type. To the east and far north of this block Topoclimate has mapped the soils as being of the Glenelg type. Test holes in paddock 12 confirm that the profile is stoney in all horizons, typical of a Glenelg soil.

WOLDWIDE 2

Paddock 10

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The topsoil was well structured with no mottles to a depth of 250 mm, overlying a well structured subsoil. Mottles didn't occur in the subsoil until 0.5 m depth. This soil is more characteristic of the Drummond soil type.

Paddock 8, East side

Topoclimate suggests Braxton and Pukemutu soil types cover this area. The topsoil was 200 mm deep and free of mottles. The subsoil had increasing mottling with depth, and was heavily mottled at 450 mm depth. Braxton soils are mottled in all horizons, this soil was representative of an intergrade between Braxton and Drummond soils.

Paddock 16

Topoclimate suggests Braxton and Pukemutu soils cover this area. Several holes were checked in this paddock. In a shallow hollow running through the paddock there was faint mottling in the topsoil tending to heavy mottling at 0.5 m deep in the subsoil. The majority of the paddock is a broad ridge with 250 mm depth of topsoil, no mottling, over a subsoil with variable stone content. Mottles were absent from the subsoil. This soil is not of the Braxton type but more like a shallow Drummond soil or Drummond Glenelg intergrade.

Support Block, to be part of Woldwide Two
Paddock SH2

Topoclimate suggests Braxton and Pukemutu soils. This paddock has a shallow hollow running through it. In the hollow the profile was mottled in all horizons. The paddock had been used for wintering stock and was showing signs of soil compaction. The profile in this hollow was characteristic of the Braxton type. Holes either side of the hollow showed a much lighter and better drained profile.

Paddock SH1

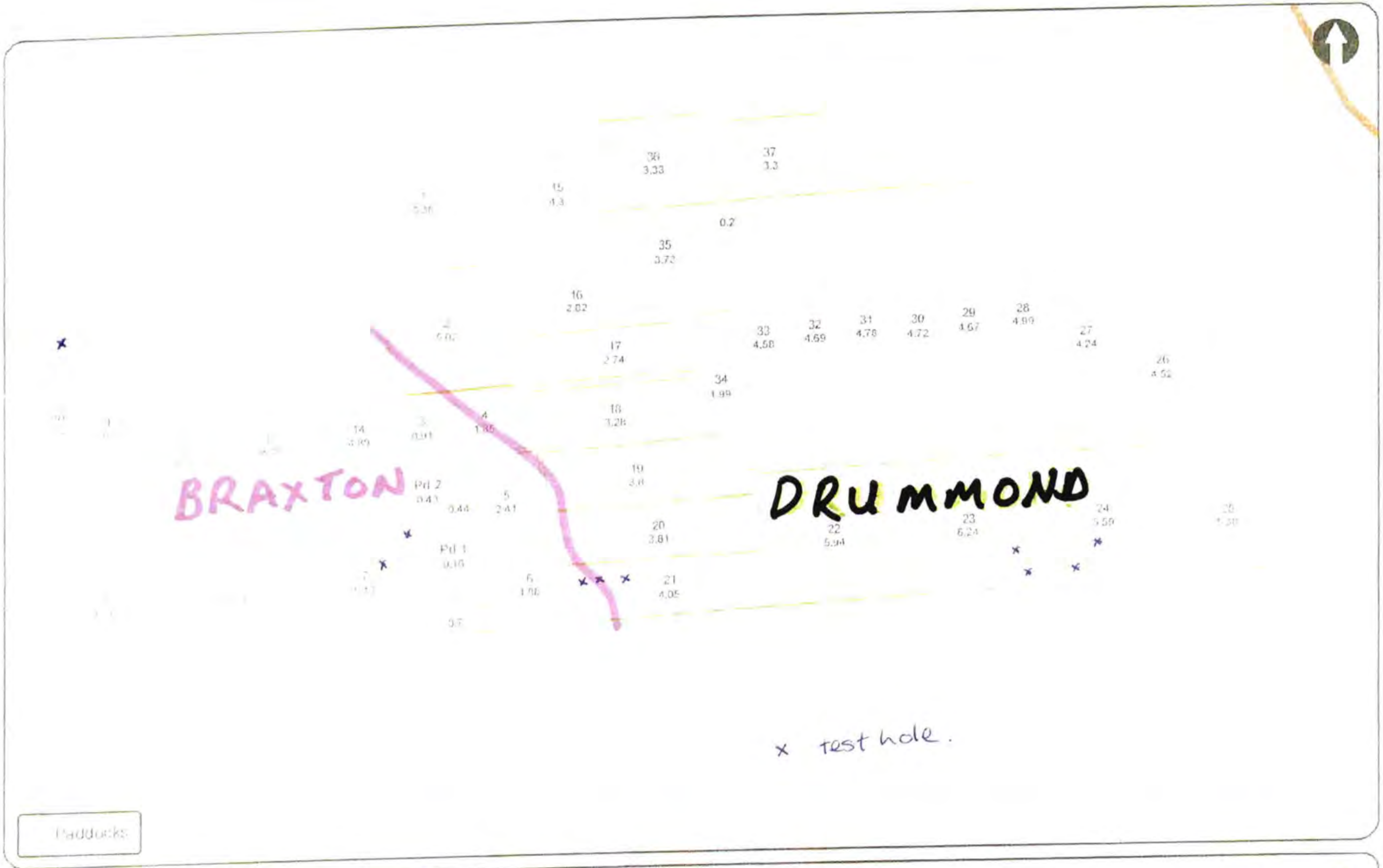
Topoclimate suggests Braxton and Pukemutu soil types. The profile was free draining with an absence of mottles in the topsoil and subsoil. The topsoil was 250 mm deep to a stoney subsoil. This profile is similar to that observed in paddock 16 and is not of the Braxton type.

Paddock 12

Topoclimate suggests Glenelg soils. This paddock had been cultivated and was in winter crop. The profile was stoney in all horizons, typical of the Glenelg soil type.

Appendix

Appendix



Woldwide One Ltd

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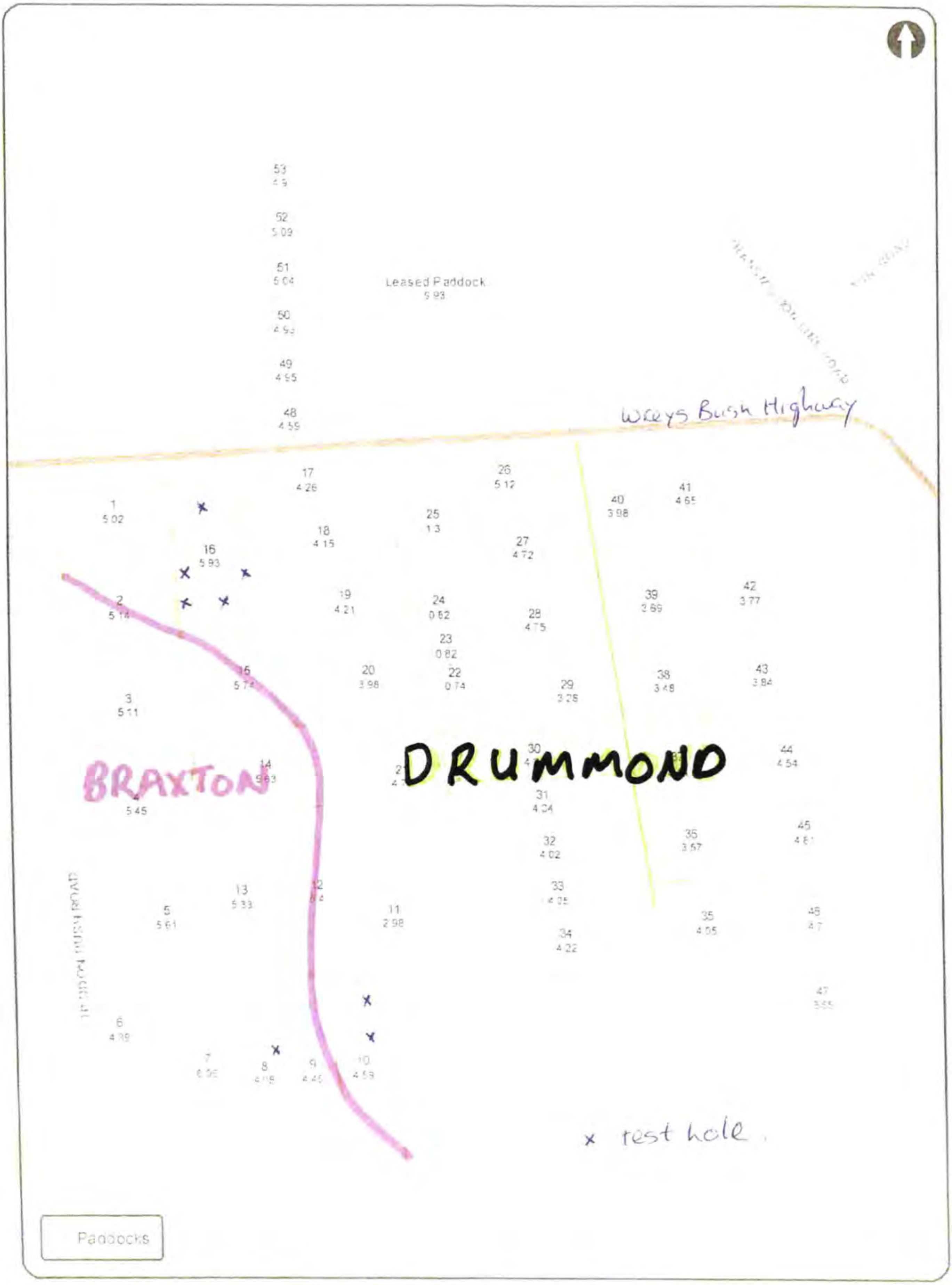
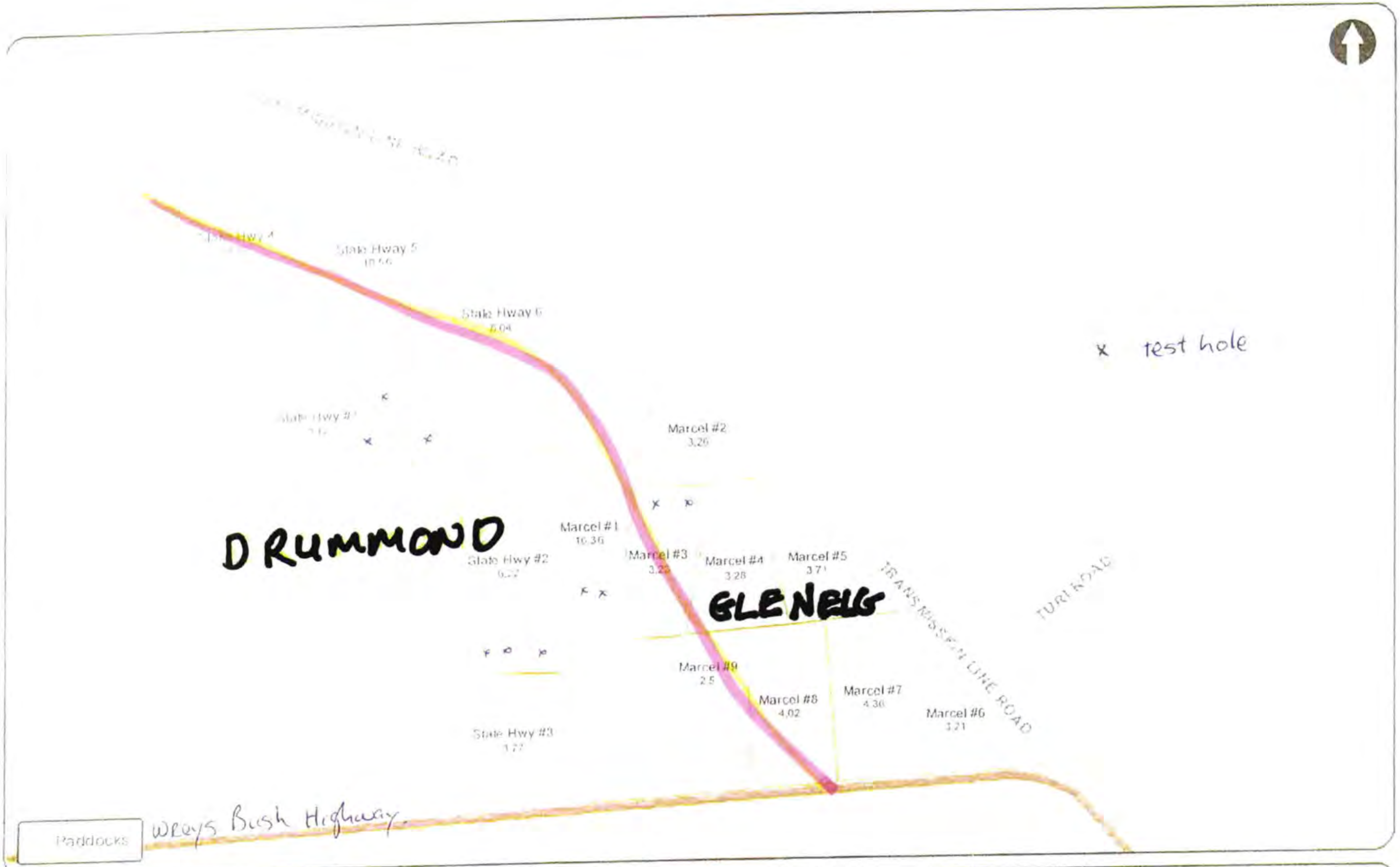


My Ravensdown Smart Maps

Woldwide Two

ravensdown



My Ravensdown Smart Maps

Highway 96 Support / Worldwide Two.

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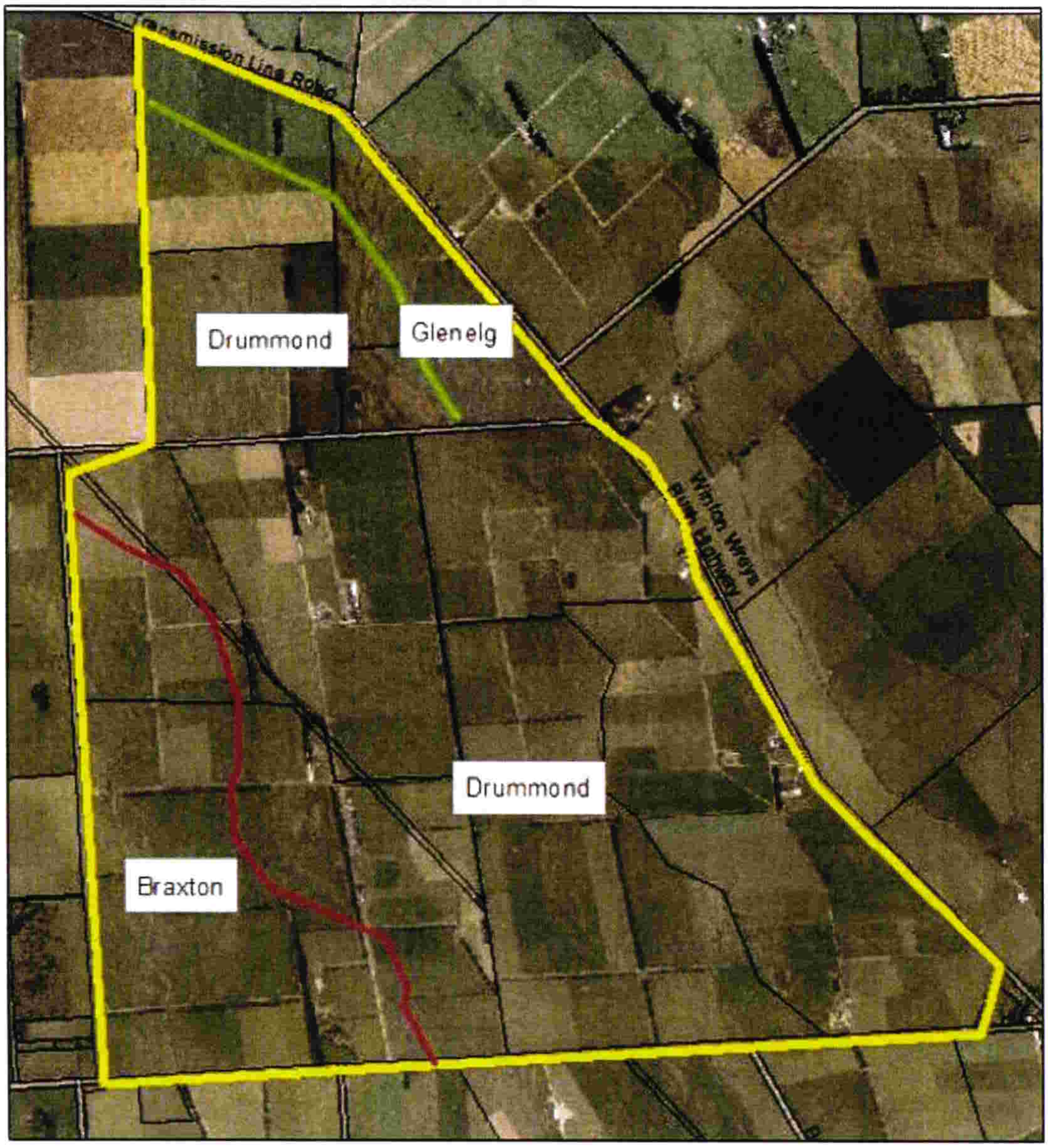

ransmission Line Road
Drummond
Glenelg
Winton Wreys
Drummond
Braxton

Investigation of cracking soils: Heddon Bush, January 2018.
Michael Killick, Technical Specialist (Soils and Groundwater Quantity)

On January 30, 2018, I visited dairy farms of the Woldwide group with the owner, Abe de Wolde, in the area of Heddon Bush, to see if we could observe soil cracking as is described for the Central Plains physiographic unit. We looked at a paddock ('Site 1') on the corner of Hundred Line Road and Drummond Heddon Bush Road which in the Topoclimate survey is mapped as Braxton + Pukemutu soils. There were noticeable cracks in the soil at this site, 3-10mm wide, less than 150mm long, 5-10m apart. It was not clear how many cracks might be hidden by pasture, but there were areas of sparse pasture which had no cracks.

A shallow hole (~15cm deep) at the site showed the soil was friable with many small to medium well-formed peds. A creek on the west side of the paddock which is a small tributary of Middle Creek was dry at the culvert where the bed was a metre or so below ground level. Site 1 was described by Abe as wet in winter with areas of standing water, the effects of which could still be observed in the dry conditions of our visit (re-sowing with new pasture had been prevented in one place due to previous muddy conditions). See figures 1-5.

Figure 1. Cracked soil at Site 1.

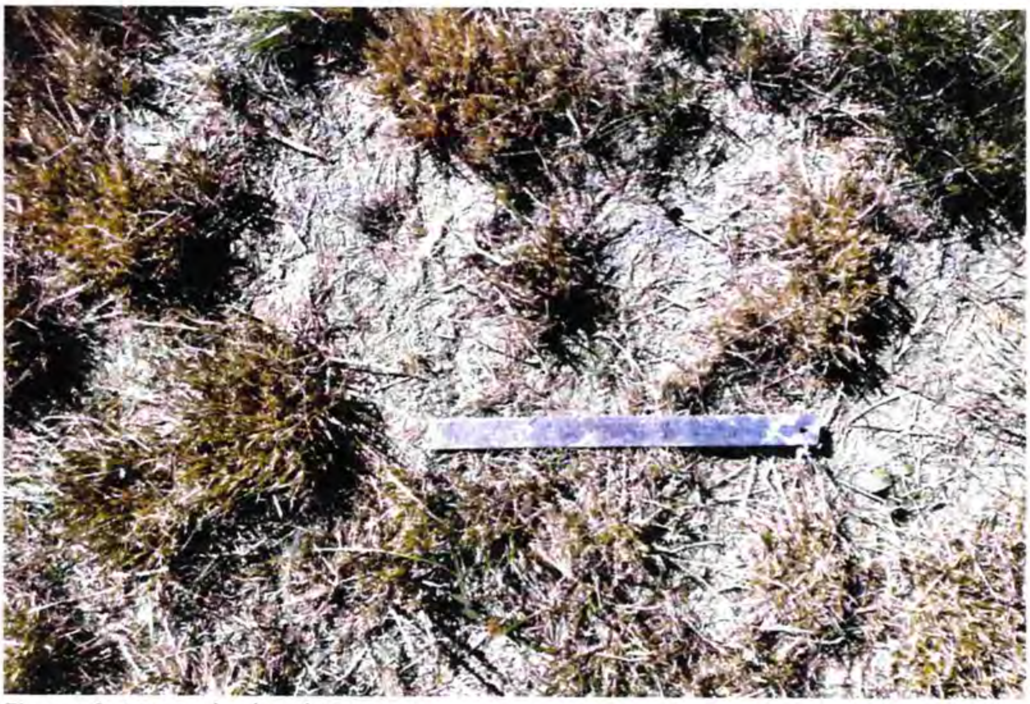


Figure 2. Uncracked soil at Site 1.

Figure 3. Creek bed at Site 1.

Figure 4. Site 1 locations.


Figure 5. Soil at Site 1.

We also looked at a site ('Site 2') on the north side of Hundred Line Rd mapped as Glenelg soils. This soil did not appear cracked although the soil surface was disrupted by the remains of past pugging so it was not easy to observe. A hole dug to about 15cm depth at this site brought up a number of stones supporting the mapped classification as Glenelg soil.

We walked a transect of approximately 50m at a third site ('Site 3', Figure 7) mapped as Glenelg + Drummond soils (close to the boundary of Braxton + Pukemutu soils). Cracks in this soil were observed at a density of at least one in the region of each stride i.e. $1/m^2$. The cracks were smaller than at Site 1, 2-4mm wide and less than 100mm long (see Figure 6). A hole dug to about 15cm depth at this site brought up two large stones (~90mm) and a number of small stones. A steel ruler was inserted easily into a crack to a depth of ~20cm, but could be inserted with similar ease to similar depth in soil without cracks at the site. (The depth of the cracks could not otherwise be ascertained as it was not visible from the surface and the soil structure and cracks collapsed easily with digging.)

Figure 6. Cracking at Site 3. These cracks do not show up well in the photo because of their smaller size and the high contrast shadows but were easily visible at the time.

A fourth site ('Site 4') on Braxton + Pukemutu soils with heavier pasture cover than sites 1 and 3 showed no cracking although the soil surface was difficult to see beneath the pasture. Large cracks would have been visible if a reasonable number had been there, but possibly smaller cracks such as those at Site 3 might have been present but not seen.

A site mapped as Tuatapere soils on Bayswater Road showed cracking at similar or somewhat greater density than Site 3 and the cracks were a similar or somewhat smaller size. There were frequent small stones on the surface of this soil. Tuatapere soil is described

Figure 7. Site 3 location.

as having stones at greater than 45cm depth, but it is contiguous in this area with stonier soils (Waiau and Glenelg) and may also have been modified by cultivation at some point.

Following the field observations on 30 January, sustained rainfall occurred on the properties and across the region beginning late January 31 and continuing through February 1. At Site 1 further observations were made by Abe to see how it responded to rainfall. At the location described above which was muddy in winter (i.e. where re-sowing had been prevented) no surface ponding occurred after 30mm rainfall or after 60mm rainfall. As this location was a slight depression, prone to ponding in winter, it is not thought that the rainfall was shed in runoff.

At the Environment Southland site, Central Plains Aquifer at Heddon Bush, about 2.7 km from Site 1, rise in the groundwater level in the 6m deep bore occurred within 12 hours of the onset of rainfall. The location of this site is mapped as Braxton and Pukemutu soils but it was found at installation to be stony, so the site description was changed to Glenelg soils. Earlier, lesser rainfall events in January had little effect on groundwater level. See Figure 8.

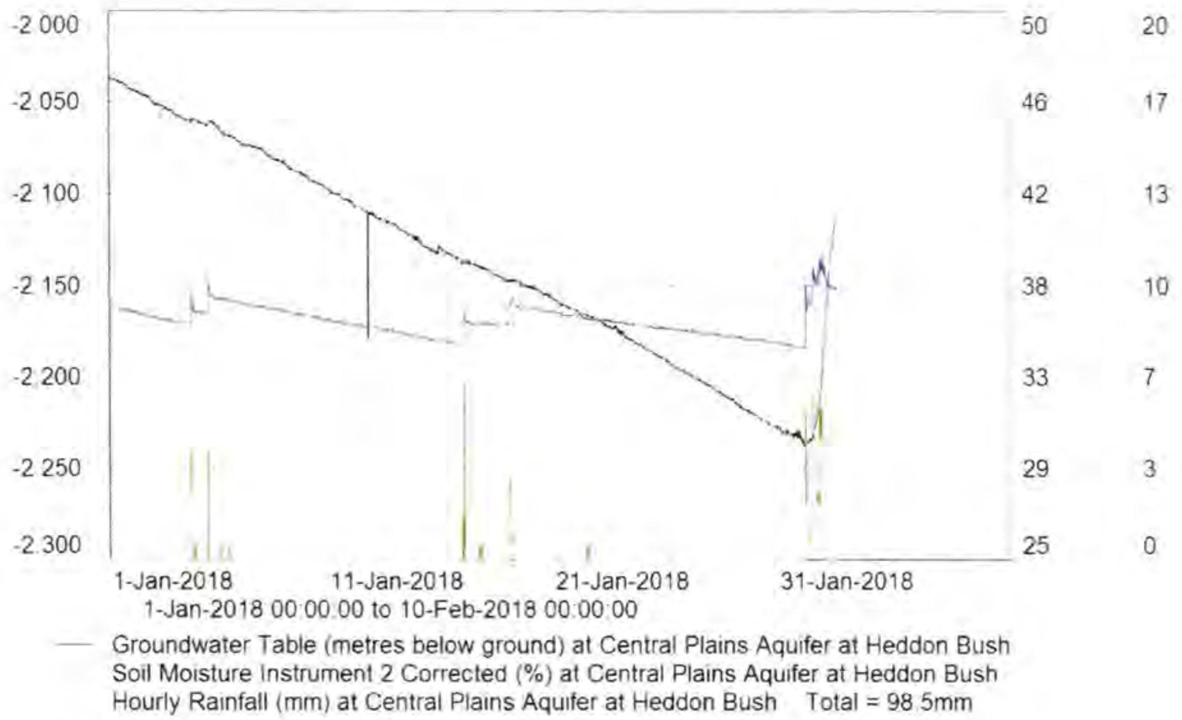


Figure 8. Groundwater level, soil moisture and rainfall at the Environment Southland Heddon Bush monitoring site.

Discussion

All the soils observed were dry and pasture was stressed and sparse to varying degrees. Some soils mapped as Braxton + Pukemutu showed cracks, while other soils with this mapped description did not. Likewise, some stony soils (mapped as Glenelg and Tuatapere) in the area were cracked and some not. It is not surprising that some stony soils were cracked as the fine matrix material in these soils is sourced from the same mafic parent materials in the Takitimu Mountains as the Braxton and Pukemutu soils, and so may also contain clays prone to shrink-swell behaviour. Cracking in stony soils may, however, have drawn less attention in studies of soil behaviour as it would not greatly alter the soil properties from those they are already thought to possess i.e. free drainage with risk of nutrient leaching.

The largest cracks seen were ~10mm wide. Most were 2-5mm wide. As discussed above, some Braxton/Pukemutu soils or variants were not cracked. Glenelg soils at the nearby Environment Southland monitoring site (Central Plains Aquifer at Heddon Bush) had volumetric soil moisture <35% throughout December 2017-January 2018 and <30% for two weeks prior to the observations[1] (and were not visibly cracked). Soil moisture at comparable sustained, low levels was last recorded at the Heddon Bush site in January-February 2008 which was recognized as a drought year. Soil temperature in the two weeks prior to the current observations was 18-27°C. In these conditions further drying of the soil occurs only slowly as the residual moisture is tightly held in fine pores, hence it would take a significant

[1] These soil moisture figures are the average of two calibrated soil moisture sensors at the Heddon Bush site. Calibration is against periodic neutron probe measurements.

continuation or intensification of the conditions then current to make the soils significantly drier with whatever structural changes might accompany that.

It seems reasonable to conclude that the occurrence of very large cracks such as feature in some anecdotes about the soils (e.g. 'to reach your arm into') would now be rare in the soils observed for this investigation, and might not occur. Continued development or changes in management of the soils e.g. the ongoing effects of drainage, or conversion from sheep to dairy, may have influenced the historical pattern of soil behaviour. Or it may be that occurrences of Braxton soils other than those described here, crack more.

The strong, friable structure of the Braxton/Pukemutu soils observed raises the prospect that they may behave as free draining soils when very dry, with or without visible cracking. This behaviour of the dry soils with regard to drainage, and the effects of cracks where present, has not been quantified, but is described in the literature relating to the Central Plains physiographic zone (see following link).

http://eswaterandland.datacomsphere.com.au/southland-science/physiographic-zones/physiographics-and-farm-management

The potential for Braxton and related soils to crack when dry – as was observed for some soils in the investigation described above - has perhaps attracted more attention than the general capacity of these soils for 'bi-modal' transport of leachate and contaminants, as described in the physiographic zone technical sheet, via more general structural changes which may include visible cracking. Understanding the transition from the 'summer soil' to the 'winter soil' – when wetting of dry soils occurs - could help further explain nutrient loss processes in the Central Plains physiographic unit where the observations described above were made.

During the investigation there was some discussion of the possible influence of different pasture conditions, or variations in soil type, on the prevalence or absence of cracking. Some soils in the area are thought to have been mapped previously as Makarewa soils (now Braxton). The distinction between these soils apparently relates to the geomorphic setting with Braxton soils on terraces and Makarewa soils on flood plains (because of this, Makarewa soils may also be younger). It was seen, however, that cracking could occur in a variety of soils in the area. Further investigations could shed light on the influence of pasture condition, soil type and moisture content on the drainage capacities of soils and thresholds of dryness and rainfall associated with deep drainage.

Further pictures of soil cracks follow, at the risk of emphasizing these at the expense of areas where cracks were few or absent. As there are not many pictures of the cracks, however, they are included here for interest.

See points 33-39. Findings by Mr John Scandrett regarding soil cracking

A HEARING BEFORE
ENVIRONMENT SOUTHLAND

Under An application under the Resource Management Act
APP-20171445

Applicant **WOLDWIDE ONE LIMITED**
ABE AND ANITA DE WOLDE

BRIEF OF EVIDENCE OF JOHN SCANDRETT
20 March 2018

29 To better understand the soil types and soil boundaries on Woldwide One and Two I made an inspection of the property on the 7 February 2017 and checked the soil profile in numerous paddocks. Comments and photographs and a farm map showing paddock numbers are appended.

30 My investigation showed much of the middle of Woldwide One had a soil profile better described as a Drummond soil than Braxton or Pukemutu or Glenelg

31 Further evidence of this can be obtained from looking at the drainage map supplied in the FEMP page 5, which shows open drains, tile drains and critical source areas. There are no known tile drains east of the tanker track to the Woldwide One dairy shed. Tile drains are only found in the south west corner of the farm which is correctly mapped as Braxton and Pukemutu soil. Drummond soils are free draining and would not normally have tile drainage installed.

32 As a consequence of this inspection the map of soil boundaries and soil types was redrawn and submitted with the consent application, section 6.2, Soil Types. These findings are important as the Council's information is that 90% of the property is on poorly drained soil.

Soil Drainage Properties and Potential for Cracking

33 My experience is that silt loam soils that have dried out such that the soil moisture content is close to wilting point may exhibit cracking but the degree and size of surface cracking is highly related to the soil cover. A well established pasture with good grass content is unlikely to show large soil cracks, i.e. no greater than 1 – 2 mm in breadth and of limited depth. That is because grass, particular ryegrass has a strong fibrous root system which provides significant soil strength and controls shrinkage.

34 By comparison soils with a sparse cover or newly establishing pasture will be much more prone to significant shrinkage cracks which could easily be 5mm wide or more.

35 These points are illustrated in the following photographs taken on the 5 December 2017

36 The first is on a well-established pasture on a Drummond soil type on Woldwide One

The second is on a newly establishing pasture on a Braxton soil type.

37 A knowledge of these properties can be incorporated into good farm management practices in regard to residual pasture length after grazing and effluent application. Effluent should not be applied to soil which exhibits severe cracking. Effluent receiving paddocks could be selected based on better pasture cover and a visual inspection to ensure minimal cracking. Limiting the depth of application will also reduce any potential risk of contaminants being lost below the root zone.

38 I have also frequently observed an increase in macroporosity in soils that approach wilting point at least in the topsoil as subsequent pasture growth after the dry period stabilises the increased porosity in the profile. Therefore natural drainage properties are enhanced.

39 It is also my experience that dry soils have a significant ability to retain rainfall and drainage doesn't occur until the soil moisture content is at or above field capacity. The exception would be prolonged or high intensity rainfall which leads to soil surface ponding and by pass flow down the soil profile. Southland generally receives low intensity rainfall so a combination of free draining soil and a limited area of soil prone to cracking and a low incidence of high intensity rainfall should lower the risk of contaminant risk for this property

Soil Properties and Effluent Application and Storage

40 The Massey University Dairy Effluent Storage Calculator (DESC) categorises soils as being either high risk or low risk when it comes to effluent application.

41 The low risk soils, which are free draining, don't have the large continuous vertical macropores down the soil profile that are common to high risk soils. It is these large macropores that are created through either artificial drainage processes or natural processes, particularly changes in soil moisture content, that allow approx 90 % of the drainage water that passes down the profile to drop below the root zone.

42 Low risk soils exhibit what is termed by soil scientists as matrix flow, or piston flow when liquid is applied to them. The liquid moves uniformly down the profile displacing the moisture already in the profile. For this reason having a soil moisture deficit greater than the effluent irrigation depth is less crucial. Consequently there are more irrigation days available with low risk soils and less effluent storage is needed compared to high risk soils.

43 The risks of applying dairy shed effluent to land with a travelling irrigator are therefore lower when applying to low risk soils compared to high risk soils. Limiting the application depth to a maximum depth of 10 mm also helps control any potential loss of contaminants below the root zone. The travelling irrigator on Woldwide One has been checked in March 2018 and was found to have an average application depth across its wetted diameter of 6.2mm. This relatively low depth of application allows a reduced risk of loss of contaminants from the root zone, especially at higher soil moisture contents.

44 The availability of the wintering barn allows manure from the cows to be collected and applied to the land uniformly at a later date when there is active pasture growth. This greatly reduces the risk of nutrients being lost below the root zone. The even application from a slurry tanker is in contrast to how cows deposit dung and urine in a very patchy manner when grazing pasture or winter crop.

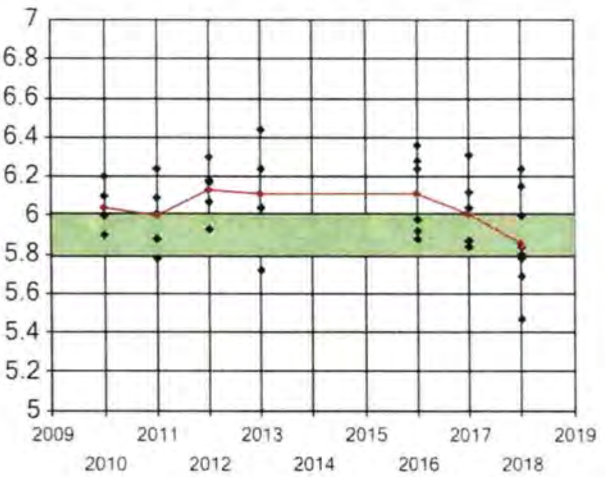
45 Mr de Wolde uses a trailing shoe slurry tanker which is used to take effluent from the storage pond and apply it to land at low depths. The actual depth of application is controlled by the

WOL dairy unit / WW1.

Soil Fertility Trends

Farm

pH



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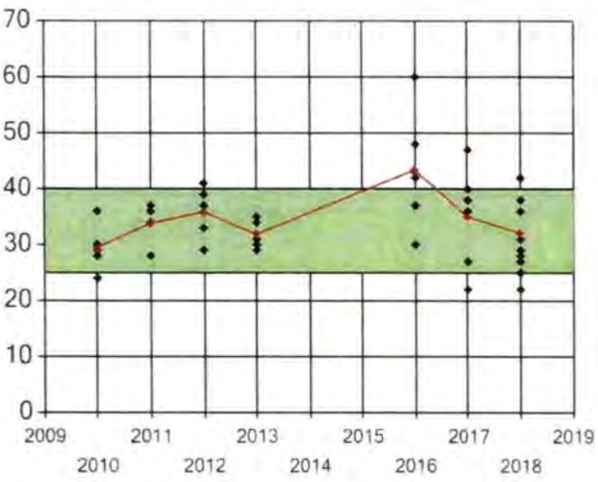

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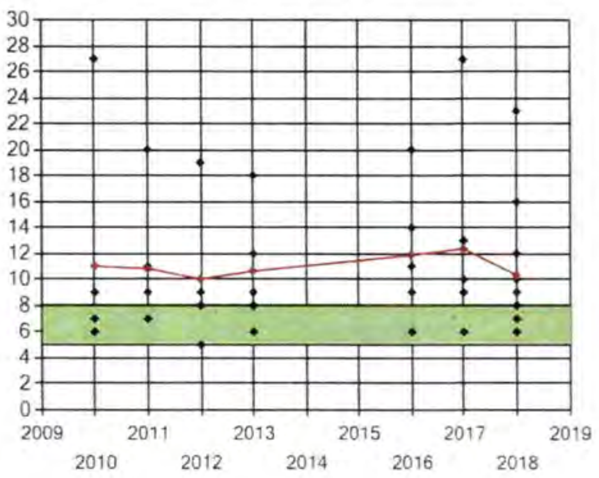

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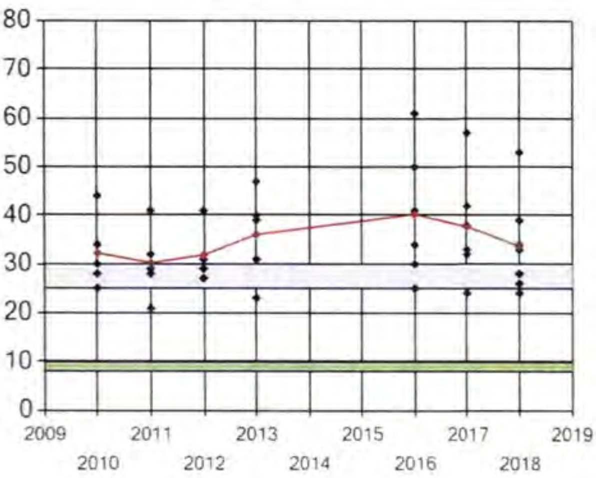

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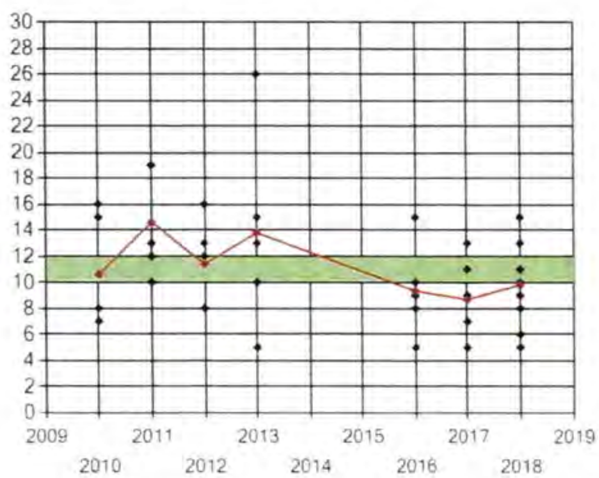

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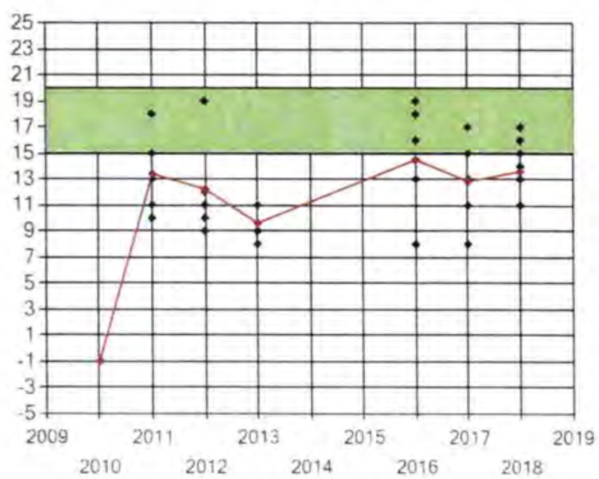

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Note: Areas are in hectares
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Woldwide 1 Olsen P

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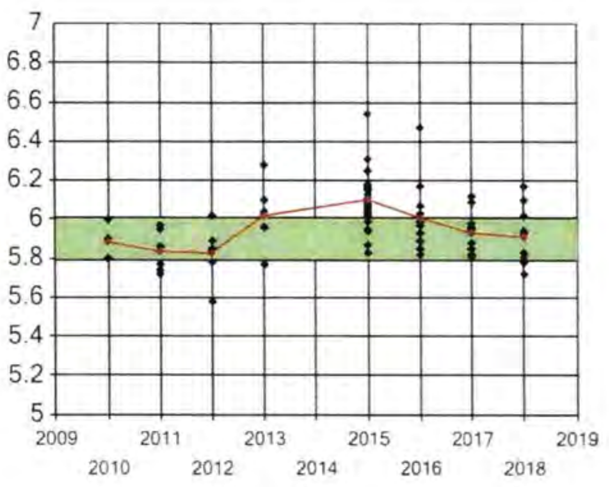
WTL dairy unit | WW2

Soil Fertility Trends

Farm



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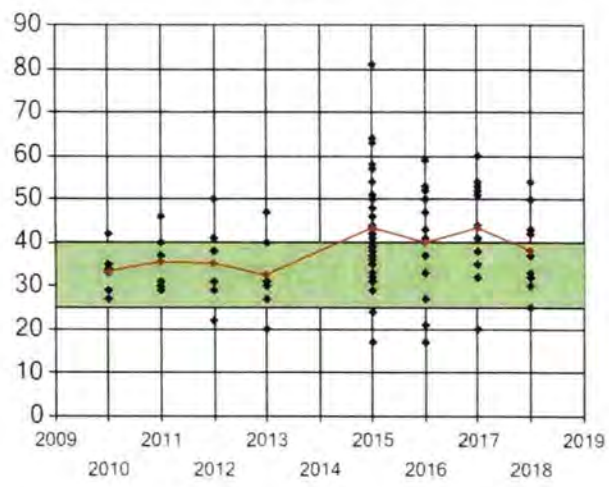

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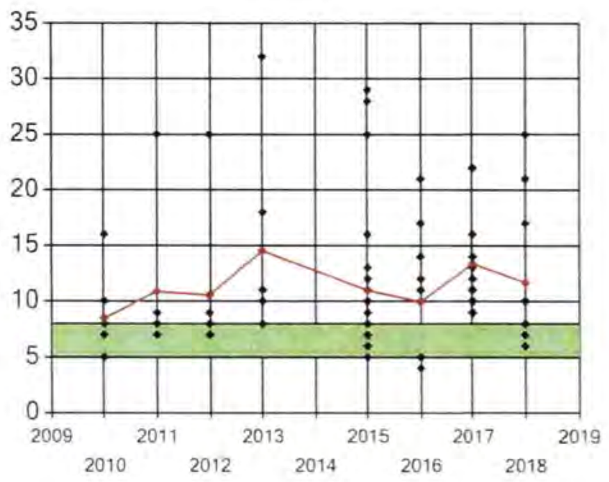

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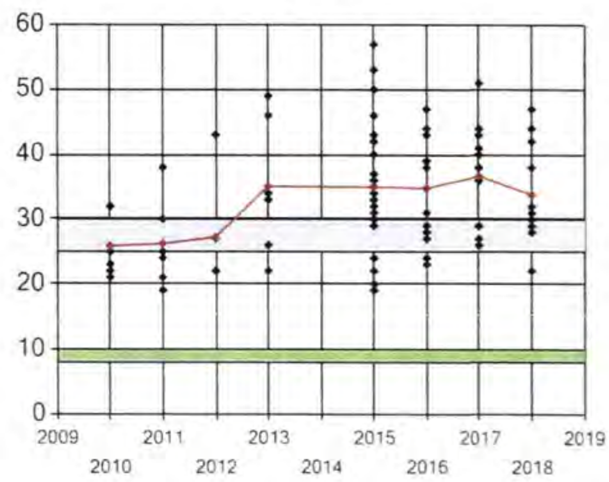

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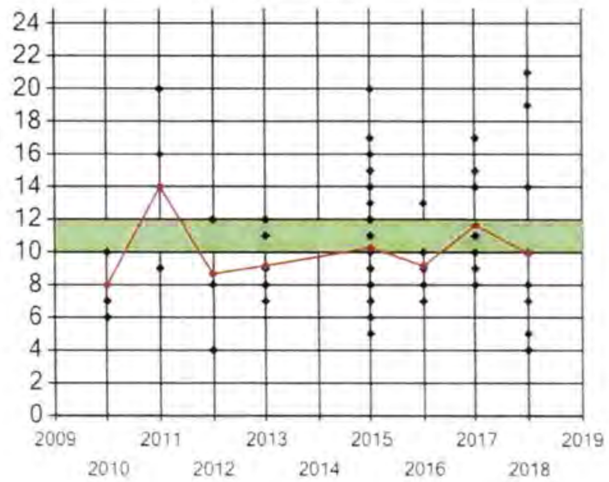

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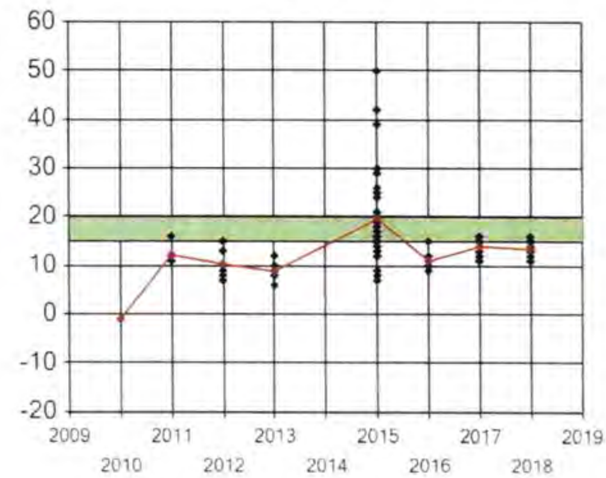

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Note: Areas are in hectares

Woldwide two Olsen P

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Agronomy Plan

Horner 2018/2019

for WOLDWIDE FARM LTD

Prepared by Senior Agri Manager

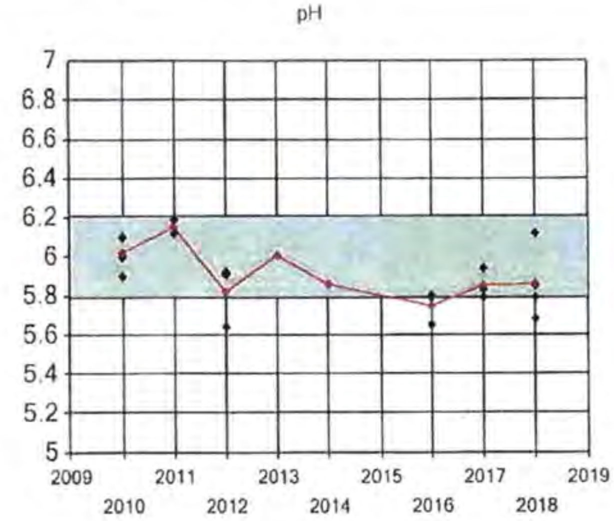
Kieran Anderson

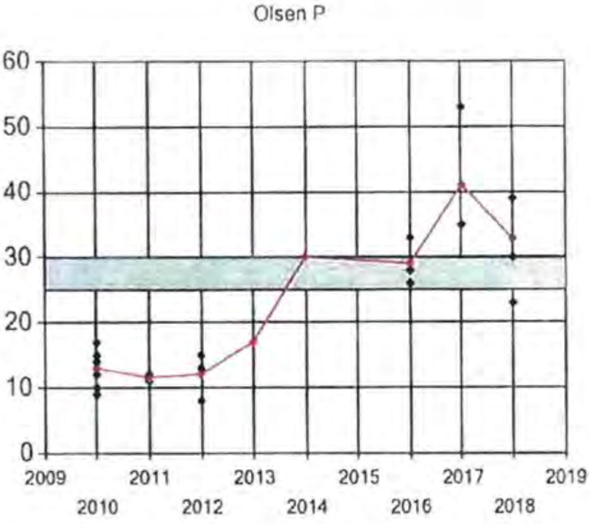
15/07/2018

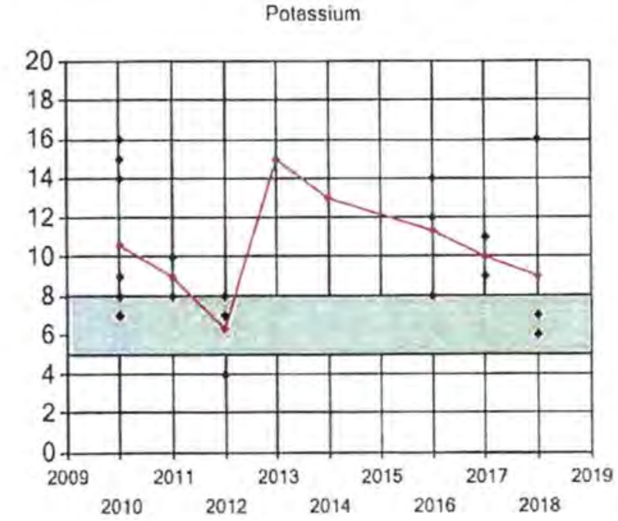
Customer Number: 60842383

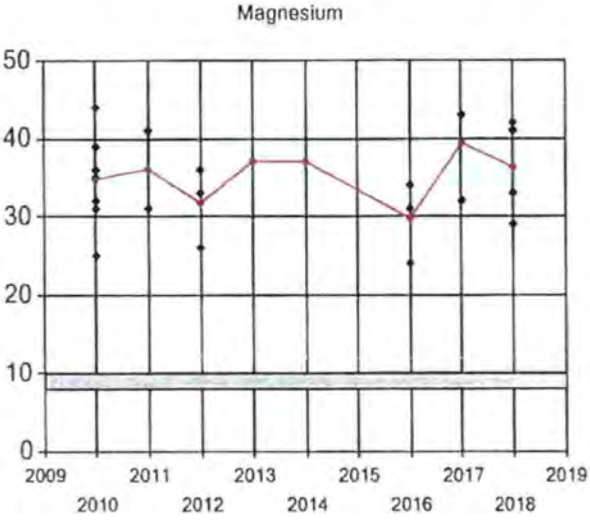
Soil Fertility Trends

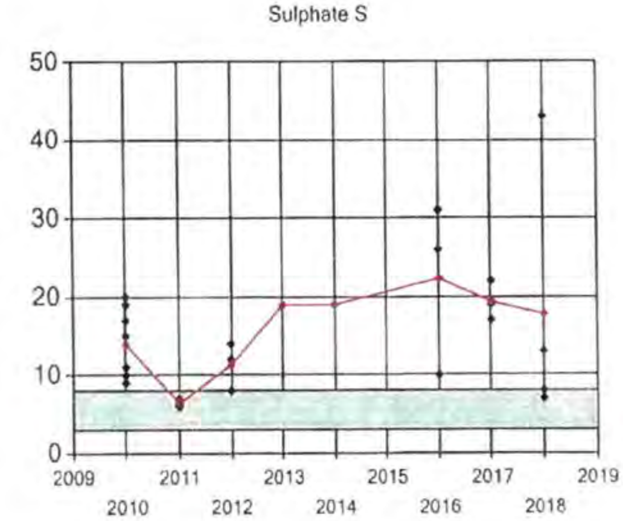
Horner Block

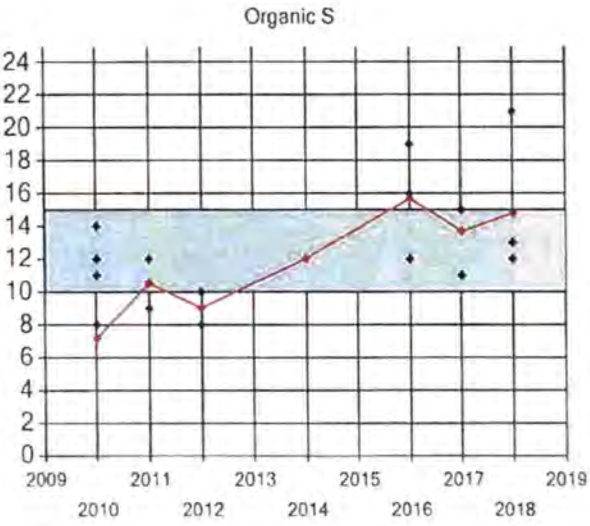












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Note: Areas are in hectares

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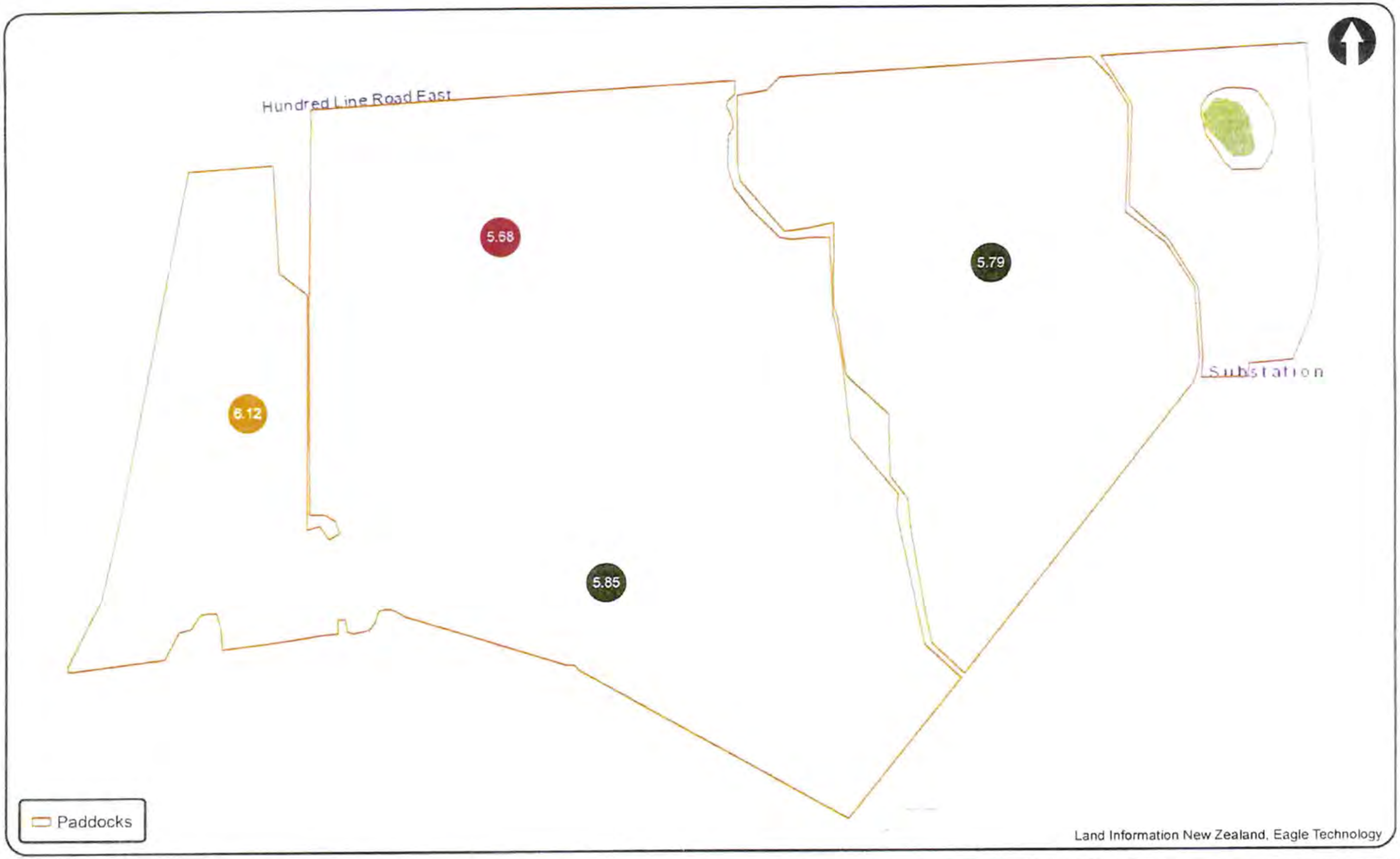
15 July 2018



My Ravensdown Smart Maps
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Note: Areas are in hectares

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ravensdown

15 July 2016

My Ravensdown Smart Maps
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Note: Areas are in hectares

Horner K

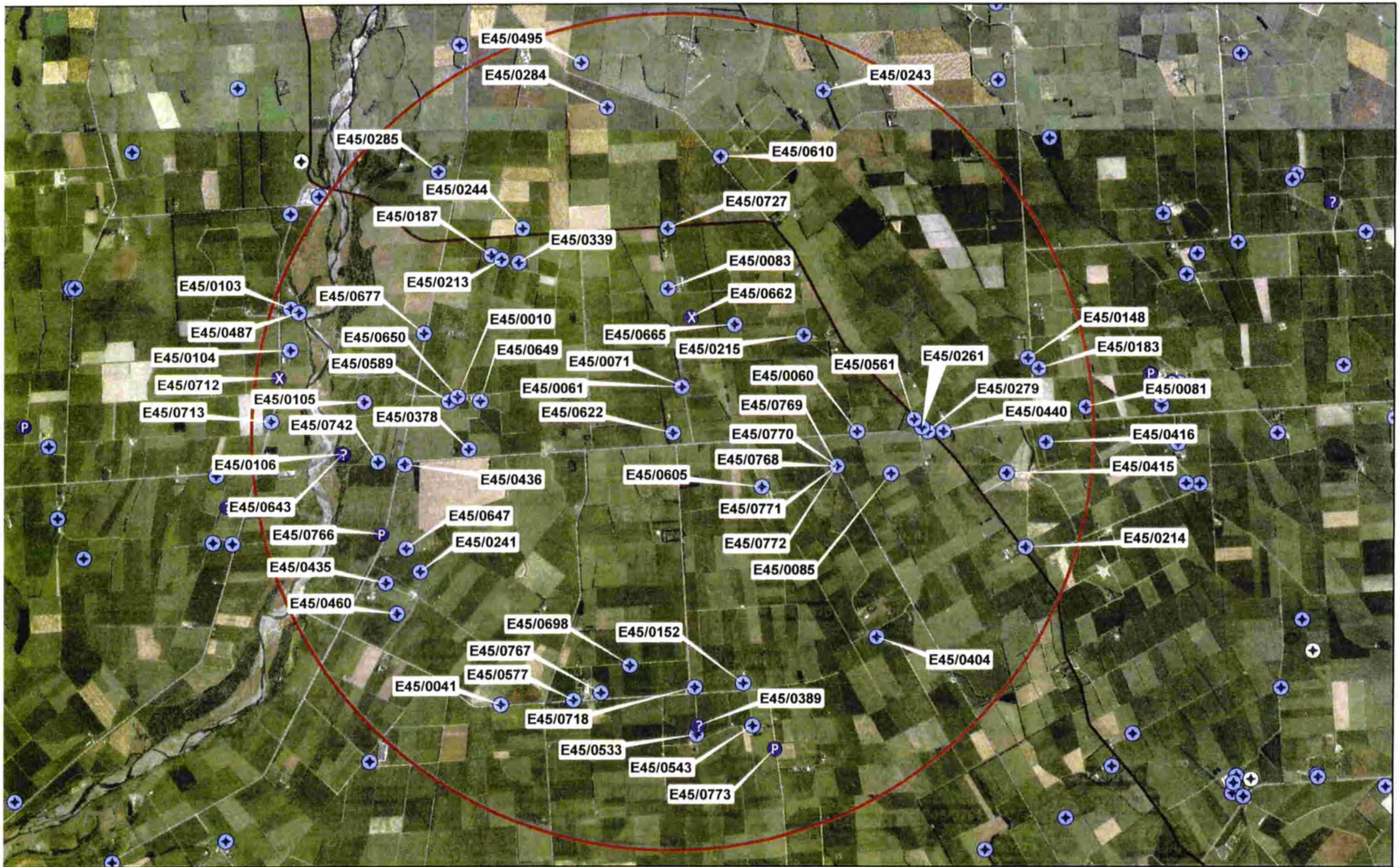
0 50 100 200 300 400 Metres

ravensdown

15 July 2018

WW1&2 consent application

Appendix C



environment SOUTHLAND
REGIONAL COUNCIL
Te Taiao Tonga

Bore Search 4000 m 1225067E 4888309N

Monday, 18 June 2018

Wells

N

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DISCLAIMER
While every effort has been made to ensure the content is correct. Environment Southland cannot guarantee the accuracy of the data. This information should not be reused in any manner without consultation

Aerial Photography dated 5/2/2007 to 24/03/2011.
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ES data for bore testing

E45/0622 (WW1)

E45/0665 (WW2 monitoring bore)

E45/0768 Boyle road monitoring bore (~3m depth)

Site Name	Time	E-Coli <MPN> (mpn/100 ml)	Nitrogen (Nitrate Nitrite) (g/m3)
E45/0768	12-May-2005 09:10:00	1.00	12.00
E45/0768	15-Nov-2005 14:50:00	3.00	6.50
E45/0768	24-Jan-2006 10:00:00	<1.00	6.30
E45/0768	31-Mar-2006 12:30:00	<1.00	7.30
E45/0768	19-May-2006 09:31:00	42.00	8.00
E45/0768	20-Jul-2006 14:50:00	1.00	8.00
E45/0768	29-Aug-2006 12:55:00	<1.00	9.20
E45/0768	02-Mar-2007 11:09:00	<1.00	7.30
E45/0768	22-May-2007 00:00:00	<1.00	10.00
E45/0768	22-May-2007 11:57:00	<1.00	10.00
E45/0768	26-Jul-2007 00:00:00	6.00	16.00
E45/0768	26-Jul-2007 13:10:00	6.00	16.00
E45/0768	11-Oct-2007 08:25:00	<1.00	15.00
E45/0768	13-Nov-2007 08:40:00	2.00	14.00
E45/0768	13-Feb-2008 13:25:00	<1.00	14.00
E45/0768	22-Apr-2008 00:00:00	80.00	13.00
E45/0768	22-Apr-2008 09:49:00	80.00	13.00
E45/0768	24-Jun-2008 00:00:00	4.00	14.00
E45/0768	24-Jun-2008 10:35:00	4.00	14.00
E45/0768	15-Aug-2008 12:13:00	<1.00	15.00
E45/0768	15-Aug-2008 12:30:00	<1.00	15.20
E45/0768	04-Nov-2008 09:16:00	<1.00	13.00
E45/0768	04-Nov-2008 10:16:00	<1.00	13.00
E45/0768	27-Jan-2009 11:26:00	<1.00	13.20
E45/0768	29-Apr-2009 00:00:00		
E45/0768	29-Apr-2009 11:18:00	1.00	13.10
E45/0768	17-Jul-2009 10:30:00	<1.00	10.70
E45/0768	23-Sep-2009 10:50:00	<1.00	11.00
E45/0768	21-Oct-2009 15:30:00		10.70
E45/0768	20-Nov-2009 00:00:00		11.00
E45/0768	16-Dec-2009 08:55:00		12.80
E45/0768	21-Jan-2010 00:00:00		12.70
E45/0768	21-Jan-2010 11:30:00		12.70
E45/0768	15-Feb-2010 13:55:00		10.80
E45/0768	16-Mar-2010 00:00:00		11.00
E45/0768	16-Mar-2010 10:30:00		11.00
E45/0768	20-Apr-2010 00:00:00		11.00
E45/0768	20-Apr-2010 11:36:00		11.00
E45/0768	30-Jun-2010 12:34:00		11.20
E45/0768	27-Jul-2010 12:43:00		10.00
E45/0768	18-Aug-2010 00:00:00		10.00
E45/0768	18-Aug-2010 09:40:00		10.00
E45/0768	15-Sep-2010 00:00:00		10.90
E45/0768	15-Sep-2010 12:55:00		10.90
E45/0768	14-Oct-2010 09:40:00	<1.00	10.70
E45/0768	16-Nov-2010 11:59:00		10.40

E45/0768	16-Dec-2010 08:25:00		11.90
E45/0768	20-Jan-2011 08:40:00		13.90
E45/0768	22-Feb-2011 09:30:00		13.80
E45/0768	23-Mar-2011 09:18:00		13.60
E45/0768	19-Apr-2011 13:21:00		14.40
E45/0768	25-May-2011 10:22:00		13.60
E45/0768	24-Jun-2011 14:35:00		11.60
E45/0768	22-Aug-2011 16:10:00		14.80
E45/0768	20-Sep-2011 09:49:00		13.80
E45/0768	20-Oct-2011 09:18:00		13.00
E45/0768	21-Nov-2011 11:30:00	<1.00	13.80
E45/0768	14-Dec-2011 10:35:00		12.60
E45/0768	26-Jan-2012 08:52:00		12.90
E45/0768	07-Mar-2012 12:10:00		14.30
E45/0768	20-Mar-2012 12:26:00		14.10
E45/0768	16-May-2012 13:38:00		14.30
E45/0768	16-Jul-2012 09:49:00		14.20
E45/0768	18-Mar-2013 09:28:00	<1.00	12.30
E45/0768	26-Jun-2013 12:11:00	<1.00	10.90
E45/0768	12-Sep-2013 10:26:00	<1.00	10.00
E45/0768	16-Dec-2013 10:06:00	<1.00	11.80
E45/0768	18-Mar-2014 08:12:00	2.00	12.30
E45/0768	16-Jun-2014 11:16:00	<1.00	11.50
E45/0768	25-Sep-2014 12:15:00	<1.00	11.50
E45/0768	19-Dec-2014 12:25:00	<1.00	10.00
E45/0768	19-Mar-2015 11:08:00	<1.00	11.40
E45/0768	09-Jun-2015 11:37:00	<1.00	11.10
E45/0768	16-Sep-2015 11:07:00	<1.00	8.90
E45/0768	18-Dec-2015 10:17:00	<1.00	8.00
E45/0768	18-Mar-2016 10:40:00	<1.00	9.10
E45/0768	17-Jun-2016 11:33:00	<1.00	8.90
E45/0768	21-Sep-2016 11:27:00	<1.00	9.00
E45/0768	21-Dec-2016 11:15:00	<1.00	9.50
E45/0768	21-Mar-2017 10:09:00	<1.00	10.60
E45/0768	20-Jun-2017 11:04:00	<1.00	9.40
E45/0768	27-Sep-2017 11:14:00	<1.00	12.20
E45/0768	15-Dec-2017 11:52:00	5.00	9.90
E45/0768	21-Mar-2018 09:52:00	<1.00	10.30
E45/0622	01-May-2013 09:08:00	3.00	1.53
E45/0622	29-Nov-2013 12:00:00	25.00	4.30
E45/0622	09-Apr-2014 12:20:00	137.00	2.00
E45/0622	05-Nov-2014 08:20:00	2.00	6.20
E45/0622	08-Apr-2015 13:59:00	<1.00	1.59
E45/0622	11-Nov-2015 12:57:00	2.00	0.00
E45/0622	14-Apr-2016 11:55:00	<1.00	2.20
E45/0622	01-Nov-2016 13:50:00	397.00	15.40
E45/0622	07-Apr-2017 12:17:00	3.00	1.22
E45/0622	09-Nov-2017 12:52:00	3.00	2.10
E45/0622	26-Apr-2018 13:34:00	3.00	2.00
E45/0665	30-Apr-2015 12:25:00	<1.00	9.10

E45/0665	11-Nov-2015 11:59:00	<1.00	8.60
E45/0665	14-Apr-2016 11:05:00	<1.00	7.60
E45/0665	01-Nov-2016 12:50:00	38.00	7.70
E45/0665	07-Apr-2017 11:06:00	1.00	7.20
E45/0665	09-Nov-2017 12:00:00	548.00	8.80
E45/0665	26-Apr-2018 12:01:00	<1.00	8.10

Invercargill

WATER TESTING LABORATORY

Lake Street Invercargill
ph(03) 216 2189 fax (03) 216 2789

19-Feb-18 **Lab Reference Number:** **B 21264**

Water Test Report:

Name:	Heddon Bush School	
Address:	233 Hall Road RD3 Winton 9783	
Order No:		
Date Received:	15/02/2018	4.00 p.m.
Date Sampled:	15/02/2018	12:35 p.m.
Sample Description:	Bore Water	

BACTERIOLOGICAL

Total Coliform:	*(Method: APHA 9223B 23rd Ed.)	**less than 1**	MPN per 100ml
Escherichia coli:	*(Method: APHA 9223B 23rd Ed.)	**less than 1**	MPN per 100ml

A. Cocker
Lab Manager

Ministry of Health Approved Laboratory Registration No. 1023

** Tests reported herein have been performed in accordance with the laboratory's scope of certification.*
Results relate to samples as received.

Invercargill

WATER TESTING LABORATORY

Lake Street Invercargill
ph(03) 216 2189 fax (03) 216 2789

08-Nov-17 **Lab Reference Number: B 21024**

Water Test Report:

Name:	Cleanflo Filtration
Address:	PO Box 5118 Invercargill
Order No:	PO 3831
Date Received:	2/11/2017 14:50
Date Sampled:	2/11/2017
Sample Description:	Heddon Bush School - Bore

Bacteriological Analysis

Test	*Result*	*Units*	*Method*
Total Coliform:	less than 1	Colony Forming Units per 100ml	*(APHA 23ed 9222 B)*
Faecal Coliform:	less than 1	Colony Forming Units per 100ml	*(APHA 23ed 9222 D)*
Enterococci:	less than 1	Colony Forming Units per 100ml	*(APHA 23ed 9230 C)*
Escherichia coli:	less than 1	Colony Forming Units per 100ml	*(APHA 23ed 9222 G)*

A. Cocker
Lab Manager

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PO Box 2614
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clientsupport@water.co.nz

Certificate of Analysis
Laboratory Reference:171218-143

Attention	John Scandrett	*Final Report*	**255884-0**
Client	**JOHN.SCANDRETT**	*Report Issue Date*	**17-Jan-2018**
Address	**PO Box 5003, Invercargill, 9840**	*Received Date*	**18-Dec-2017**
Client Reference	**Potable Water**	*Sampled By*	**JS**
Purchase Order	**Not Supplied**	*Quote Reference*	**4446**

Sample Details		WATERS	WATERS	WATERS
Lab Sample ID:		**171218-143-1**		
Client Sample ID:				
Sample Date/Time:		18/12/2017 14:00		
Description:		H B School		
Chemistry Detailed				
Anions by Ion Chromatography (0.45 µm Filtered)				
Nitrate (as N)	mg/L	2.0		
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli	MPN/100 mL	<1.0 *		

*Results marked with * are not accredited to International Accreditation New Zealand*

Where samples have been supplied by the client they are tested as received. A dash indicates no test performed.

Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
Chemistry Detailed				
Anions by Ion Chromatography (0.45 µm Filtered)				
Nitrate (as N)	In House based on APHA (online edition) 4110 B and EPA 300.0	0.002 mg/L	All	Auckland
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100 mL	All	Invercargill

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher

For more information please contact the Operations Manager

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

Watercare Laboratory Services is a division of Watercare Services Limited.

ilac-MRA IANZ ACCREDITED LABORATORY

Report Signatory 17/01/2018
Zum Nguyen KTP Signatory

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Wakatipu,
(03) 409 0559

www.watercarelabs.co.nz
clientsupport@water.co.nz

Certificate of Analysis
Laboratory Reference:180112-124

Attention:	John Scandrett	*Final Report*	**255886-0**
Client	**JOHN.SCANDRETT**	*Report Issue Date:*	**18-Jan-2018**
Address	**PO Box 5003, Invercargill, 9840**	*Received Date*	**12-Jan-2018**
Client Reference	**Nitrate/Ecoli Samples**	*Sampled By*	**JS**
Purchase Order	**Not Available**	*Quote Reference*	**4446**

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**180112-124-1**			
Client Sample ID:		1			
Sample Date/Time:		12/01/2018			
Description:		HB School			
Chemistry Detailed					
Anions by Ion Chromatography (0.45 µm Filtered)					
Nitrate (as N)	mg/L	1.8			
Microbiology					
Escherichia coli by MPN(Colilert-18)					
Escherichia coli (Colilert-18)	MPN/100 mL	<1.0			

Sample Details		WATERS
Lab Sample ID:		
Client Sample ID:		
Sample Date/Time:		
Description:		
Chemistry Detailed		
Anions by Ion Chromatography (0.45 µm Filtered)		
Nitrate (as N)	mg/L	
Microbiology		
Escherichia coli by MPN(Colilert-18)		
Escherichia coli (Colilert-18)	MPN/100 mL	

*Results marked with * are not accredited to International Accreditation New Zealand*

Where samples have been supplied by the client they are tested as received. A dash indicates no test performed.

Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
Chemistry Detailed				
Anions by Ion Chromatography (0.45 µm Filtered)				
Nitrate (as N)	In House based on APHA (online edition) 4110 B and EPA 300.0	0.002 mg/L	All	Auckland
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli (Colilert-18)	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100 mL	All	Invercargill
Preparations				
Membrane Filtration (0.45 µm)	APHA (online edition) 4500-P B (preliminary filtration)		All	Auckland

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher

For more information please contact the Operations Manager

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

Watercare Laboratory Services is a division of Watercare Services Limited.

ilac-MRA IANZ ACCREDITED LABORATORY

Report Signatory 18/01/2018
Zum Nguyen KTP Signatory

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Certificate of Analysis
Laboratory Reference: 180314-158

Attention:	John Scandrett	*Final Report:*	**263054-0**
Client:	**JOHN.SCANDRETT**	*Report Issue Date:*	**15-Mar-2018**
Address:	**PO Box 5003, Invercargill, 9840**	*Received Date:*	**14-Mar-2018**
Client Reference:	**Bore Waters**	*Sampled By:*	**JS**
Purchase Order:	**Not Available**	*Quote Reference:*	**4446**

Sample Details		**WATERS**	**WATERS**	**WATERS**	**WATERS**
Lab Sample ID:		**180314-158-1**			
Client Sample ID:		HB School			
Sample Date/Time:		14/03/2018 12:10			
Description:		Ground water			
General Testing					
Nitrate Nitrogen (as N)	mg/L	1.8			
Microbiology					
Escherichia coli by MPN(Colilert-18)					
Escherichia coli (Colilert-18)	MPN/100 mL	<1.0			

Sample Details		**WATERS**
Lab Sample ID:		
Client Sample ID:		
Sample Date/Time:		
Description:		
General Testing		
Nitrate Nitrogen (as N)	mg/L	
Microbiology		
Escherichia coli by MPN(Colilert-18)		
Escherichia coli (Colilert-18)	MPN/100 mL	

*Results marked with * are not accredited to International Accreditation New Zealand*

Where samples have been supplied by the client they are tested as received. A dash indicates no test performed.

Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Nitrate Nitrogen (as N) by Colorimetry/Discrete Analyser	Nitrate-N Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N	0.010 mg/L	All	Invercargill
Microbiology				
Escherichia coli by MPN(Colilert-18)				
Escherichia coli (Colilert-18)	APHA (online edition) 9223 B Colilert Quantitray	1 MPN/100 mL	All	Invercargill

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher

For more information please contact the Operations Manager

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

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Report Signatory 15/03/2018
Tonia Bulling KTP Signatory

WW1&2 consent application

Appendix D

MEMORANDUM

Date:	13 July 2018
To:	**Michael Durand**
From:	**Philip Maw / Kate Woods**

WOLDWIDE FARMS - INTERPRETATION OF "LANDHOLDING" UNDER THE PSWLP

1. You have asked for our advice on how the word "landholding" should be interpreted in the context of applications for resource consent from Woldwide 4 Ltd and Woldwide 5 Ltd (**Woldwide 4 & 5**) and Woldwide 1 Ltd and Woldwide 2 Ltd (**Woldwide 1 & 2**), pursuant to Rule 20 of the proposed Southland Water and Land Plan (**pSWLP**).

2. In particular, you have asked us to consider whether:

   a. the support blocks to be utilised by Woldwide 4 & 5 (namely the Gladfield Block and the Horner Block); and

   b. the support block to be utilised by Woldwide 1 & 2 (the Horner Block),

   should be considered as part of their "landholding" for the purposes of their respective applications under Rule 20 of pSWLP.

Executive summary

3. In our opinion, the support blocks utilised by Woldwide 4 & 5 and Woldwide 1 & 2 in their applications for resource consent, whether it be the Horner Block and/or the Gladfield Block, should be considered as part of its "landholding" for the purposes of assessing their applications for resource consent under Rule 20 of the pSWLP.

4. This interpretation is consistent with the policy framework implemented by Rule 20, and the interpretation will not result in an absurd result whereby adverse effects resulting from a farming activity can be "exported" to another property owned or controlled by the same group of people, without those effects being appropriately considered.

Background

5. We understand Woldwide Farms Ltd owns several individual farms (Woldwide 1 Ltd, Woldwide 2 Ltd, Woldwide 3 Ltd, Woldwide 4 Ltd, Woldwide 5 Ltd). Woldwide Farms Ltd also owns two support blocks, the Gladfield Block and the Horner Block, which are outside of the farm boundary of Woldwide 1, 2, 3, 4 and 5, but in close proximity to those farms. The land ownership, company shareholdings and directorships are common across the Horner Block, Gladfield Block and Woldwide Farms 1-5 Limited (A & J de Wolde).

6. Woldwide 4 & 5 have lodged a resource consent application to expand land area and utilise the Gladfield Block and the Horner Block as support blocks. Woldwide 4 & 5 will predominantly utilise the Gladfield Block and have modelled this block for the

application. Some sludge from Woldwide 4 & 5 will also be spread on the Horner Block, however this has not been modelled in the application.

7. Woldwide 1 & 2 intend to lodge a resource consent application to expand land area and also increase dairy cow numbers. Woldwide 1 & 2's proposal requires certain farming activities to be undertaken on the Horner Block. For example, the Horner Block will receive some of the farm dairy effluent from Woldwide 1 & 2, provide grazing for young stock, and provide intensive winter grazing. With the exception of the farm dairy effluent discharge, all the activities on the Horner Block are permitted under the pSWLP. Woldwide 1 & 2 do not intend to model the Horner block for the future expansion application.

8. In short, changes to farming practices will be made to ensure the nutrient budget for the Woldwide 4 & 5 and Woldwide 1 & 2 properties remain neutral when cow numbers and/or land area increases. We understand the Council is concerned this may mean that Woldwide 4 & 5 and Woldwide 1 & 2 will be able to "export" the additional effects caused by increased stock numbers and/or land area, to somewhere else in the Region where they are largely permitted under the pSWLP.

Meaning of "landholding"

9. Landholding is defined in the pSWLP as follows:

> **Landholding**
>
> (a) Any area of land, including land separated by a road or river or modified watercourse, held in one or more than one ownership, that is utilised as a single operating unit, and may include one or more certificates of title; except
>
> (b) For land with a residential, commercial, industrial, infrastructural or recreational zoning or designation in the relevant district plan means any area of land comprised wholly of one Certificate of Title or any Allotment as defined by Section 218 of the RMA.
>
> ***Note**: for the purposes of this definition, a "single operating unit" may include, but is not limited by, the following features:*
>
> *(a) It has effective control by any structure of ownership of the same group of people (for example, land that is controlled by a family trust, or beneficiaries of that family trust or a related group of companies, or an estate, or partner, or individual/s or a combination of); and*
>
> *(b) It is operated as a single business entity.*

10. Therefore, whether the support blocks (Gladfield Block and/or Horner Block) are part of Woldwide 4 & 5's or Woldwide 1 & 2's "landholding" turns on whether the two farms utilise their land, and their support block's land, as a "single operating unit." Some guidance as to whether the land is being utilised as a "single operating unit" can be gleaned from the list of features in the explanatory note below the definition, however, that list is non-exhaustive.

11. Generally, words in an enactment or a plan will be given their plain and ordinary meaning unless there is some ambiguity, uncertainty or it may result in absurdity. Therefore, the starting point is examining the plain and ordinary meaning of the words that make up the phrase "single operating unit."

12. The Oxford English Dictionary contains the following relevant definitions:

Single - Only one; not one of several. Regarded as distinct from each other or others in a group.

Operate – (With reference to a machine, process etc.) function or control the function of. (With reference to organisation) manage or be managed and run.

Unit – An individual thing or person regarded as single or complete but also able to form an individual component of a larger whole

13. Combining and applying those definitions to the present context means that Woldwide 4 & 5 and Woldwide 1 & 2's land, and their respective support block's land, would need to be managed or controlled as a single thing or entity, noting that it is also able to form an individual component of a larger whole.

14. Taking the example of Woldwide 1 & 2's application, the farm and the Horner Block are controlled and owned by the same group of people. It is possible that by moving several aspects of Woldwide 1 & 2's farming activity to the Horner Block, the two farms are being operated as a single entity. The two farms are clearly being managed to the overall benefit of the single owner.

15. We understand that Mr de Wolde considers that as the Horner Block trades with the Woldwide farms group, Woldwide 1 & 2 and the Horner Block are not operated as a single business entity. It is unclear whether the Horner Block trades exclusively with the Woldwide farms group or to other farms as well. Although if this is the case, this may distinguish the Horner Block from other 'support' blocks that may be necessary for farming but are provided by professional winter graziers without common control and ownership. However, in light of the meaning of "unit", whereby a unit can form an individual component of a larger whole, we do not consider it matters if the Horner Block is being used to support other farms.

16. Based on the plain and ordinary meaning of the words comprising the phrase "single operative unit", we are of the opinion that Woldwide 1 & 2 and the Horner Block are being operated as a single operating unit. We consider that this reasoning can be extended to the application by Woldwide 4 & 5. Woldwide 4 & 5 and the support blocks it will utilise (i.e. both the Gladfield Block and Horner Block) are being operated as a single operating unit. However, in order to ensure that that interpretation is correct, it is necessary to consider the purpose of the definition.

Principles of statutory interpretation

17. Plans have the effect of regulations made under the Resource Management Act 1991, and so the principles of statutory interpretation apply. Section 5 of the Interpretation Act 1999 also provides that the meaning of an enactment must be ascertained from its text and in the light of its purpose.

Case law

18. It is accepted that in cases involving a "long and complicated town planning scheme ... A purposive interpretation is particularly called for..."[1] Indeed, in circumstances

---

[1] *Powell v Dunedin City Council* [2004] NZRMA 49 at [29], citing *Sandstad v Cheyne Developments Ltd* (1986) 11 NZTPA 250, 256.

where the social policy behind a plan may be compromised, the plain and ordinary meaning of a word may be departed from.

19. In *Powell v Dunedin City Council* the High Court helpfully summarised the various approaches to interpretation of planning documents adopted by the courts in different cases, and concluded:[2]

> The cases reveal differing approaches to the interpretation of planning documents. To an extent that reflects the clarity or otherwise of the planning document being considered by the Court and the very circumstances of the different cases. On those authorities I consider it is necessary to take into account the following:
>
> a) The words are to be given their plain ordinary meaning unless this is clearly contrary to statutory purpose or the social policy behind the plan and rules, or otherwise produces some injustice, absurdity, anomaly or contradiction.
>
> b) The planning document should only affect common law rights where there is an express provision to this end or it follows as a matter of necessary implication.
>
> c) There is a need for certainty in the description of permitted activities and the operative parts of the plan, But the language used in the plan is to be given its "plain ordinary meaning", the test being "what would an ordinary reasonable member of the public examining the plan, have taken from" the planning document.
>
> d) The interpretation should not prevent the plan from achieving its purpose.
>
> e) If there is an element of doubt the matter is to be looked at in context and it is appropriate to examine the composite planning document.

20. On appeal, the Court of Appeal endorsed this approach:[3]

> While we accept it is appropriate to seek the plain meaning of a rule from the words themselves, it is not appropriate to undertake that exercise in a vacuum. As this Court made clear in *Rattray*, regard must be had to the immediate context (which in this case would include the objectives and policies and methods set out in section 20) and, where any obscurity or ambiguity arises, it may be necessary to refer to the other sections of the plan and the objectives and policies of the plan itself. Interpreting a rule by a rigid adherence to the wording of the particular rule itself would not, in our view, be consistent with a judgment of this Court in *Rattray* or with the requirements of the Interpretation Act.

Application to this context

21. The overall purpose of the pSWLP is to provide direction and guidance regarding the sustainable use, development and protection of water and land resources in the Southland region. The pSWLP also commences the process of giving effect to the National Policy Statement for Freshwater Management, as amended in 2017 (**NPSFM**), that requires, among other things, that water quality is maintained and, in circumstances where it is degraded, it is improved.

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[2] *Powell v Dunedin City Council* [2004] NZRMA 49 at [35].

[3] *Powell v Dunedin City Council* (2005) 11 ELRNZ 144, [2004] 3 NZLR 721, [2005] NZRMA 174 at [35].

22. The pSWLP seeks to better manage rural land use activities that are considered to contribute a disproportionate amount of contaminants (nitrogen, phosphorus, sediment, and microbes) to the environment. In particular, the pSWLP introduces additional land use controls in respect of intensive winter grazing, cultivation and further intensification or establishment of new dairy farms.

23. Rule 20 of the pSWLP is one of these controls. One of the key purposes of Rule 20 is to control the intensification of existing dairy farms (i.e., by requiring resource consent) to manage the discharge of contaminants that may affect water quality. The discharge of contaminants is assessed and calculated with reference to the farming activity's landholding. The Rule does not anticipate that certain adverse effects of the farming activity may be able to be transferred somewhere outside of the landholding in order to minimise the farming activity's discharge of contaminants.

24. The High Court's comments in *Powell v Dunedin City Council*, namely that words are to be given their plain ordinary meaning unless this is clearly contrary to statutory purpose or the social policy behind the plan and rules, or otherwise produces some injustice, absurdity, anomaly or contradiction, are particularly relevant here. Adopting an interpretation of landholding that enables a farming operation to "export" the additional effects arising from intensified farming activities to somewhere else in the Region may thwart the underlying purpose of Rule 20 and the pSWLP. It could also lead to absurd results whereby farmers could purchase separate "support blocks" and shift some of their farming activity to the support block and in doing so may be able to artificially reduce nutrient losses on their primary farm.

25. Further, the interpretation of landholding advocated by Woldwide 4 & 5 and Woldwide 1 & 2 would not achieve the relevant objectives and policies in the pSWLP. Of particular relevance are Objective 6 and Policy 16:

> **Objective 6**
>
> There is no reduction in the overall quality of freshwater, and water in estuaries and coastal lagoons, by:
>
> (a) maintaining the quality of water in waterbodies, estuaries and coastal lagoons, where the water quality is not degraded; and
>
> (b) improving the quality of water in waterbodies, estuaries and coastal lagoons, that have been degraded by human activities.
>
> **Policy 16 – Farming activities that affect water quality**
>
> 1. Minimising the adverse environmental effects (including on the quality of water in lakes, rivers, artificial watercourses, modified watercourses, wetlands, tidal estuaries and salt marshes, and groundwater) from farming activities by:
>
>   (a) discouraging the establishment of new dairy farming of cows or new intensive winter grazing activities in close proximity to Regionally Significant Wetlands and Sensitive Waterbodies identified in Appendix A; and
>
>   (b) ensuring that, in the interim period prior to the development of freshwater objectives under Freshwater Management Unit processes, applications to establish new, or <u>further intensify existing,</u>

> dairy farming of cows or intensive winter grazing activities will generally not be granted where:
>
> (i) the adverse effects, including cumulatively, on the quality of groundwater, or water in lakes, rivers, artificial watercourses, modified watercourses, wetlands, tidal estuaries and salt marshes cannot be avoided or mitigated; or
>
> (ii) existing water quality is already degraded to the point of being overallocated; or
>
> (iii) water quality does not meet the Appendix E Water Quality Standards or bed sediments do not meet the Appendix C ANZECC sediment guidelines; and
>
> ....
>
> **(emphasis added)**

26. An interpretation of "landholding" in this context that seeks to exclude from consideration, the effects of the discharge of additional nutrients into the environment, would not be consistent with Objective 6 and Policy 16. That is because the cumulative effects on the quality of groundwater may not be avoided or mitigated.

27. For these reasons, a purposive approach to interpretation leads to the same outcome as giving the words within the definition their plain and ordinary meaning. As such, we consider that:

    a. both the Gladfield Block and the Horner Block should be considered as part of Woldwide 4 & 5's landholding; and

    b. the Horner Block should be considered as part of Woldwide 1 & 2 's landholding.

28. For completeness, even if it can be successfully argued that the Gladfield and Horner Blocks are not part of Woldwide 4 & 5's and Woldwide 1 & 2's "landholding", we consider Environment Southland would still need to consider all effects of the farming activity, including the effects of any farming activity undertaken on the Gladfield and Horner Blocks, when assessing the respective applications for consent.

29. The Environment Court has previously held that when assessing an application for resource consent, it may be appropriate to take into account consequential effects on the environment that might flow from allowing the activity for which consent is sought, if not too uncertain or remote.[4] In this case, the effects of the farming activities are clearly going to extend to the Gladfield and Horner Blocks (as stated in the applications) and therefore it is appropriate to take those effects into account when assessing the respective applications for consent

[4] *Beadle v Minister of Corrections* Decision No. A 74/2002 Sheppard PEJ presiding (EC); *P & E Ltd v Canterbury Regional Council* [2015] NZEnvC 106.

ADDENDUM

UPDATE TO OPINION FOLLOWING CLARIFICATION OF UNDERLYING FACTUAL SITUATION

8 October 2018

1. Following the provision of our legal opinion on 13 July 2018, Woldwide Farms has clarified some of the underlying facts relating to the applications for resource consent from Woldwide 4 & 5 and Woldwide 1 & 2. Woldwide Farms' advisor provided some written comments and clarifications on our opinion on 19 July 2018.

2. Accordingly, you have asked us to review those comments and advise whether Woldwide Farms' clarifications change our opinion recorded above at paragraph 27 that:

   a. both the Gladfield Block and the Horner Block should be considered as part of Woldwide 4 & 5's landholding; and

   b. the Horner Block should be considered as part of Woldwide 1 & 2's landholding,

   for the purposes of assessing their respective applications for resource consent under Rule 20 of the pSWLP.

3. We set out the amended factual situation and our revised analysis below.

Woldwide 4 & 5's application

4. Initially you asked whether the support blocks to be utilised by Woldwide 4 & 5 (namely the Gladfield Block and the Horner Block) should be considered as part of Woldwide 4 & 5's "landholding" for the purposes of their respective applications under Rule 20 of pSWLP. Woldwide 4 & 5 have lodged a resource consent application to expand its land area.

5. We had understood that Woldwide 4 & 5's application included the use of the Gladfield Block and the Horner Block as support blocks, specifically:

   a. Woldwide 4 & 5 would predominantly utilise the Gladfield Block and this had been included in the modelling for the application.

   b. Some sludge from Woldwide 4 & 5 will also be spread on the Horner Block, although this had not been modelled in the application.

6. However, Woldwide Farms denies that some sludge from Woldwide 4 & 5 will also be spread on the Horner Block, meaning the Gladfield Block will be the only support block use by Woldwide 4 & 5. Woldwide Farms has also confirmed that the Gladfield Block is owned and operated under direct control of Woldwide 4.

7. Accordingly, we consider the Gladfield Block only should be considered as part of "landholding" for the purposes of assessing Woldwide 4 & 5's applications for resource consent under Rule 20 of the pSWLP. The Horner Block should not be considered in the context of Woldwide 4 & 5's application.

Woldwide 1 & 2's application

8. Initially you asked whether the support block to be utilised by Woldwide 1 & 2 (the Horner Block) should be considered as part of Woldwide 1 & 2's "landholding" for the purposes of its application under Rule 20 of pSWLP.

9. We had understood Woldwide 1 & 2 intended to lodge a resource consent application to expand its land area and increase dairy cow numbers. Also, we had understood that Woldwide 1 & 2's proposal required certain farming activities to be undertaken on the Horner Block, including that the Horner Block would receive some of the farm dairy effluent from Woldwide 1 & 2, provide grazing for young stock, and provide intensive winter grazing for Woldwide 1 & 2 stock. Woldwide 1 & 2 did not intend to model the Homer Block as part of its future expansion.

10. However, Woldwide Farms has informed Environment Southland that Woldwide 1 & 2's proposal only requires farm dairy effluent discharge to be spread on the Horner Block and this will be covered by a separate discharge permit. Woldwide 1 & 2 will not use the Horner Block for grazing of young stock or for intensive winter grazing.

11. Woldwide Farms has also advised that the Horner Block is owned and operated as part of Woldwide Farm Ltd operations. Woldwide Farms Ltd is a trading/commercial entity completely separately run from Woldwide 1 & 2, undertaking feed trading, contracting, logistics, supply management, machine hire, office support and knowledge support.

12. We consider that these changes affect our opinion that the Horner Block is part of Woldwide 1 & 2's "landholding." It is unlikely that by only exporting one aspect of its farming operations to the Horner Block (i.e. the discharge of sludge), Woldwide 1 & 2 is utilising the Horner Block as part of a "single operating unit." This is different than if Woldwide 1 & 2 was intending to utilise the Homer Block for multiple aspects of its farming operations and if its use of the Horner Block was central to its overall farming operation.

13. Accordingly, we consider that the Horner Block is not part of Woldwide 1 & 2's "landholding" for the purposes of their respective applications under Rule 20 of pSWLP.

14. We consider that this situation is more analogous to the scenario that was assessed in our advice dated 27 July 2018. In that advice, you asked us to consider whether Environment Southland could consider, as part of a resource consent application to increase cow numbers, part of the farming activity, e.g. intensive winter grazing, where it was proposed to be carried out off-farm (under the control of a third party).

15. In that case, where the intensive winter grazing activity is to be operated and managed separately from the rest of the farming activity, we consider the activities do not constitute a "single operating unit" and therefore do not meet the definition of "landholding" for the purposes of assessing an application for resource consent under Rule 20 of the pSWLP.

16. However, we consider that Environment Southland can still consider all effects of the farming activity, including the effects of any part of that farming activity that is undertaken on a different landholding (i.e. the off-site intensive winter grazing), when assessing the respective applications for consent under section 104 of the RMA.

17. As noted in our opinion dated 27 July 2018, the effects of the farming activity that is undertaken on a different landholding can be considered where these activities may also require other resource consents under the pSWLP.

18. The Courts have held that under section 104, the scope of the effects to be considered is not restricted and the effects from allowing an activity may include those effects which inevitably follow, including where these activities / effects may be the subject of another resource consent application.[5]

19. Applying our reasoning to this situation, we consider that Environment Southland can consider all effects of the Woldwide 1 & 2 farming activity, including the effects of the spread of sludge on the Horner Block, when assessing the applications for consent.

20. For completeness, we note that Rule 20(d) of the pSWLP provides that the use of land for a farming activity, including an increase in cow numbers (in certain circumstances) is a restricted discretionary activity provided certain conditions are met. The assessment of the relevant contaminants and the Farm Environment Management Plan required under Rule 20(d) are both restricted to the relevant "landholding" itself, and not the off-site land.

21. However, where an application to increase cow numbers is made under Rule 20(d), we consider that the effects of any off-site discharge of sludge can be considered under matter of discretion (5) which restricts the Council's discretion to:

> (5) the potential effects of the farming activity on surface and groundwater quality and the sources of drinking water...

22. Other applications to increase cow numbers will be a discretionary activity under Rule 20(e), and all relevant effects will be able to be considered under section 104 of the RMA.

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[5] *Auckland City Council v Auckland Regional Council* EnvC Auckland A101/97, 25 August 1997 at 7, *Pukenamu Estates Ltd v Kapiti Environmental Action* Inc HC Wellington AP106/02, 1 July 2003

WW1&2 consent application

Appendix E

Overseer data

Average N loss/ha/year: Farms within a 20 km radius of WWIx2.

1	Cows	Nitrogen Loss
2	750	51
3		31
4	500	36
5	580	43
6	900	39
7	500	64
8	415	61
9	570	61
10		52
11		52
12	600	37
13	560	53
14	480	45
15	270	31
16	600	38
17	650	43
18	320	33
19	420	52
20	420	51
21	900	51
22	630	72
23	490	26
24	425	45
25	425	36
26	440	41
27	715	55
28	500	39
29	400	45
30	330	40
31	1100	30
32	700	43
33	220	36
34	475	59
35	750	39
36	400	44
37	400	47
38	780	34
39	155	43
40	620	25
41	800	37
42	375	38
43	600	26
44	730	50
45	700	30
46	520	34
47	420	41
48	800	29
49	680	68
50	445	32
51	515	40
52	800	36
53	650	66
54	480	39
55	650	36
56	280	55
57	730	38
58	450	37
59	470	23
60	550	36
61	650	38
62	370	41
63	670	40
64	580	47
65	800	58
66	800	49
67	500	41
68	780	37
69	370	50
70	850	27
71	350	54
72	285	44
73	490	33
74	190	30
75	800	40
76	450	41
77	475	50
78	500	42
79	660	27
80	540	21
81	300	23
82	425	42
83	1000	58
84	510	49
85	585	46
86	900	42
87	500	44
88	475	44
89	480	50
90	530	54
91	520	46
92	850	64
93	550	39
94	800	46
95	540	55
96	580	38
97	590	54
98	180	41
99	940	45
100	950	43

101	300	42
102	850	25
103	550	26
104	800	54
105	450	34
106	450	47
107	510	53
108	490	52
109	500	39
110	500	25
111		59
112	600	47
113	300	38
114	900	33
115	540	36
116	1000	29
117	480	41
118	600	72
119	585	42
120	550	56
121	700	66
122	785	55
123	700	50
124	1000	51
125	700	71
126	650	54
127	730	34
128	470	23
129	500	40
130	440	39
131	680	55
132	700	62
133	320	44
134	460	42
135		43
136	860	26
137	620	55
138	500	34
139	200	54
140	520	44
141	580	67
142	580	47
143	350	39
144	560	34
145	780	24
146		68
147	930	47
148	660	48
149	590	41
150	520	68
151		48
152	600	40
153	450	55
154	540	51
155	450	38
156	575	57
157	575	60
158	500	42
159	430	53
160	410	51
161	600	48
162	525	51
163	760	58
164	880	46
165	265	69
166	700	54
167	340	43
168	700	52
169	300	30
170	430	23
171	320	48
172	750	67
173	410	67
174	300	43
175	650	47
176	680	65
177	500	48
178	970	78
179	551	54
180	670	40
181	550	46
182	600	39
183	850	48
184	200	53
185	280	56
186	580	27
187	310	67
188	250	58
189	500	38
190	640	40
191	525	29
192	900	81
193	550	54
194	400	53
195	250	42
196	460	36
197	420	35
198	565	35
199	325	32
200	210	57

201	340	52
202	800	26
203	950	51
204	560	30
205	700	29
206		59
207	240	60
208	1400	63
209	500	52
210	420	20
211	200	45
212	1000	197
213	580	46
214	630	34
215		38
216	600	50
217	450	49
218	550	78
219	680	87
220	700	47
221	800	76
222	1100	86
223	650	27
224	640	29
225	700	37
226	550	20
227	980	19
228	860	24
229	725	20
230	500	33
231	810	43
232	390	54
233	300	31
234	250	73
235	440	44
236	600	55
237	124	63
238	600	58
239	430	41
240	340	31
241	590	100
242	320	41
243	330	48
244	660	30
245	590	48
246	335	91
247	420	41
248	690	77
249	1030	74
250		51
251	660	61
252	500	73
253	530	89
254	430	54
255	450	52
256	990	47
257	1100	44
258	450	44
259	200	55
260	900	28
261	400	34
262	530	43
263	550	40
264	360	36
265		48
266	850	65
267	600	39
268		57
269	660	50
270	580	79
271	780	75
272	850	61
273	600	50
274	900	41
275		29
276	470	45
277		37
278	490	30
279	670	38
280	680	40
281	850	34
282	600	39
283	850	40
284	680	48
285	500	38
286	300	33
287	800	44
288	400	43
289	470	41
290	950	57
291	420	33
292	800	71
293		52
294	230	40
295	620	39
296	420	22
297	320	37
298	800	30
299	400	33
300	400	33

301	240	21
302	580	74
303	485	37
304	540	34
305	580	35
306	270	31
307	800	36
308	1000	49
309		38
310	550	41
311	520	38
313		49
314	255	26
315	421	23
316	620	41
317	420	66
318	1600	40
319	625	60
320	1500	73
321	580	62
322	1500	68
323		63
324		51
325	1100	55
326		54
327	600	55
328	300	44
329	330	41
330	380	82
331	545	48
332	690	42
333	340	36
334	250	54
335	320	74
336	450	42
337	455	40
338	900	63
339		65
340	550	35
341	410	67
342	820	64
343	510	25
344	200	35
345	1050	42
346		34
347	350	35
348	480	34
349	1000	50
350	820	42
351	800	38
352	800	52

Ontario data.

Max cow no.s / month : Farms within a 20km radius of WWTx2

	January	February	March	April	May	June	July	August	September	October	November	December
5	216	216	216	161	130	0	0	230	230	230	230	230
12	280	280	280	200	200	0	0	50	150	280	280	280
15	225	212	212	212	180	0	0	180	225	225	225	225
18	275	275	275	226	226	0	0	293	293	293	293	293
25	290	270	250	240	169	0	14	301	300	300	300	300
32	320	320	320	258	258	0	0	340	340	340	340	340
33	329	329	329	262	262	0	0	350	350	350	350	350
35	330	320	310	280	240	0	0	180	260	345	345	345
36	329	329	329	280	263	0	0	350	350	350	350	350
38	300	282	282	282	240	0	0	240	300	300	300	300
43	400	400	400	298	298	0	0	425	425	425	425	425
44	367	367	367	300	270	0	0	390	390	390	390	390
45	400	380	350	300	250	0	300	415	420	420	420	402
52	330	330	320	310	300	0	0	50	150	300	360	360
54	339	339	336	312	284	0	0	270	353	352	349	349
72	350	350	340	340	350	0	10	250	350	350	350	350
77	450	450	450	350	350	0	0	100	200	450	450	450
78	450	450	450	350	350	0	0	200	450	450	450	450
80	404	404	404	353	342	0	0	305	430	430	430	430
85	425	420	400	370	320	0	150	400	437	432	430	430
88	451	451	451	374	288	0	49	480	480	480	480	480
89	470	470	470	375	375	0	0	350	400	500	500	500
90	470	470	470	375	375	0	0	500	500	500	500	500
100	470	470	470	390	390	0	0	500	500	500	500	500
112	494	494	494	404	380	0	0	525	525	525	525	525
115	508	508	508	405	405	0	81	540	540	540	540	540
118	471	441	441	408	200	0	0	508	498	492	481	481
122	410	410	410	410	360	0	0	450	445	440	440	440
130	531	531	531	424	356	0	13	565	565	565	565	565
137	545	545	545	435	283	0	0	580	580	580	580	580
141	588	588	588	438	438	0	0	625	625	625	625	625
142	555	555	555	442	442	0	0	590	590	590	590	590
147	500	490	480	450	390	0	0	545	545	545	520	510
148	564	564	564	450	450	0	0	600	600	600	600	600
169	559	559	559	476	476	0	0	595	595	595	595	595
174	525	510	500	485	453	0	0	560	555	545	545	535
175	611	611	611	488	439	0	112	650	650	650	650	650
176	630	630	630	489	469	0	0	529	670	670	670	670
181	590	580	540	500	482	0	0	300	601	600	595	590
182	540	540	540	500	450	0	0	350	500	550	550	550
186	639	639	639	510	332	0	0	483	680	680	680	680
188	550	530	530	510	490	0	50	520	560	550	550	550
189	598	565	533	514	507	0	129	633	623	617	610	604
192	649	649	649	518	518	0	0	690	690	690	690	690

200	658	658	658	525	525	0	0	700	700	700	700	700
208	634	634	634	533	432	0	32	675	675	675	675	675
214	549	549	549	549	549	0	0	260	495	550	554	554
217	570	570	560	555	480	0	150	400	550	615	580	580
221	658	658	658	560	543	0	17	700	700	700	700	700
227	595	595	570	570	560	0	25	550	610	610	600	598
228	600	600	600	580	500	0	0	600	600	600	600	600
229	600	580	580	580	580	0	0	606	606	606	606	606
238	658	658	658	595	482	0	113	700	700	700	700	700
240	600	600	600	600	600	0	0	650	650	650	650	650
252	620	620	620	605	540	0	50	250	610	675	675	650
258	785	785	785	626	626	0	0	835	835	835	835	835
264	766	766	766	636	636	0	0	815	815	815	815	815
265	766	766	766	636	636	0	83	815	815	815	815	815
266	799	799	799	638	638	0	19	850	850	850	850	850
270	650	640	640	640	530	0	0	685	685	685	675	685
276	690	649	649	649	483	0	100	338	690	690	690	690
290	874	874	874	688	654	0	0	930	930	930	930	930
297	879	879	879	701	701	0	0	935	935	935	935	935
306	875	875	800	750	700	0	0	300	960	960	900	900
314	810	761	761	761	608	0	0	608	810	810	810	810
320	1034	1034	1034	825	776	0	0	1100	1100	1100	1100	1100
327	1128	1128	1128	900	756	0	0	1200	1200	1200	1200	1200
328	1128	1128	1128	900	846	0	207	1200	1200	1200	1200	1200
332	950	950	950	950	750	0	0	700	950	950	950	950
333	970	970	950	950	850	0	0	1000	990	980	980	980
336	1030	1020	1000	970	890	0	0	1120	1095	1075	1065	1030
338	1241	1241	1241	990	990	0	0	515	1320	1320	1320	1320
340	1100	1020	1000	1000	900	0	0	800	1100	1250	1200	1100
341	1050	1050	1000	1000	800	0	0	1000	1200	1200	1150	1100
254	761	761	761	608	590	6	6	810	810	810	810	810
194	520	520	520	520	520	10	10	520	520	520	520	520
260	846	846	846	630	630	19	0	846	900	900	900	900
91	470	470	470	375	375	11	0	500	500	500	500	500
187	639	639	639	510	510	15	0	680	680	680	680	680
284	850	850	850	678	678	20	20	904	904	904	904	904
300	882	882	882	704	704	21	0	938	938	938	938	938
261	790	790	790	630	630	19	0	840	840	840	840	840
347	1532	1532	1532	1222	1222	37	477	1630	1630	1630	1630	1630
277	702	702	676	652	530	17	0	679	718	702	702	702
213	658	658	658	546	546	16	0	700	700	700	700	700
216	696	696	696	555	555	17	0	644	740	740	740	740
157	573	573	573	458	458	14	0	494	610	610	610	610
99	489	489	489	390	390	12	0	520	520	520	520	520
248	724	724	724	601	601	18	78	770	770	770	770	770

155	550	550	550	456	456	14	46	585	585	585	585	585
161	550	550	550	468	468	14	0	585	585	585	585	585
108	470	470	470	400	400	12	0	405	500	500	500	500
172	555	555	555	484	484	15	0	478	590	590	590	590
149	510	500	470	450	425	15	15	525	522	520	515	510
127	470	450	430	420	420	15	15	120	300	518	520	490
105	479	479	479	393	393	16	16	510	510	510	510	510
344	1150	1150	1100	1100	900	50	50	1150	1150	1150	1150	1150
278	680	660	660	660	660	30	30	730	700	680	680	680
267	799	799	799	638	638	38	38	850	850	850	850	850
58	385	385	385	316	316	25	0	381	410	410	410	410
93	470	470	470	375	375	34	90	500	500	500	500	500
224	600	564	564	564	480	48	230	480	600	600	600	600
210	630	630	630	536	520	54	166	670	670	670	670	670
133	540	540	540	430	430	50	50	560	560	550	550	550
281	790	790	790	672	558	81	81	840	840	840	840	840
185	597	597	597	508	508	76	91	635	635	635	635	635
268	799	799	799	638	638	115	115	850	850	850	850	850
95	415	415	400	380	370	60	60	438	438	435	430	425
60	340	320	320	320	255	48	41	207	340	340	340	340
293	761	750	721	694	642	113	113	798	791	788	771	762
68	423	423	423	338	304	64	64	450	450	450	450	450
296	790	780	750	700	650	120	120	812	800	800	800	800
123	575	575	575	410	398	90	90	612	612	612	612	612
294	752	752	752	696	619	118	139	800	800	800	800	800
34	329	329	329	262	241	52	52	350	350	350	350	350
190	620	620	620	515	515	98	252	660	660	660	660	660
282	846	846	846	675	675	135	128	900	900	900	900	900
308	940	940	940	750	615	150	382	1000	1000	1000	1000	1000
203	658	658	658	525	525	110	525	700	700	700	700	700
14	263	263	263	210	193	44	44	280	280	280	280	280
201	705	705	705	525	525	121	105	578	750	750	750	750
202	705	705	705	525	514	121	121	750	750	750	750	750
199	630	630	630	523	445	110	136	670	670	670	670	670
222	752	752	752	560	549	134	437	800	800	800	800	800
274	804	804	804	641	641	147	147	855	855	855	855	855
92	470	470	470	375	322	86	86	500	500	500	500	500
242	752	752	752	600	600	138	228	800	800	800	800	800
259	790	790	790	630	630	145	0	0	0	840	840	840
307	979	979	979	750	750	180	165	938	1042	1042	1042	1042
102	489	489	489	390	390	90	148	520	520	520	520	520
76	432	432	432	345	345	80	80	460	460	460	460	460
280	727	702	682	668	658	130	130	771	761	751	750	750
31	301	301	301	256	256	56	95	320	320	320	320	320
263	776	776	776	635	572	146	210	825	825	825	825	825

119	479	479	479	408	408	94	86	484	510	510	510	510
4	192	192	192	153	153	38	50	204	204	204	204	204
243	752	752	752	600	600	150	222	800	800	800	800	800
83	456	456	456	364	364	91	91	461	485	485	485	485
106	479	479	479	398	398	96	96	510	510	510	510	510
346	1230	1230	1200	1200	1050	250	250	1250	1250	1250	1250	1230
215	589	554	554	554	438	113	113	471	589	589	589	589
256	724	724	724	616	585	148	148	770	770	770	770	770
305	874	874	874	725	674	181	181	930	930	930	930	930
140	549	549	549	438	438	114	101	310	584	584	584	584
241	705	705	705	600	600	150	150	750	750	750	750	750
177	500	500	500	490	450	107	263	530	530	530	530	530
64	409	409	409	326	326	88	78	426	435	435	435	435
269	799	799	799	638	549	172	172	850	850	850	850	850
275	771	771	771	648	648	168	149	697	820	820	820	820
53	330	310	310	310	231	69	69	159	330	330	330	330
82	453	453	453	362	362	101	83	448	482	482	482	482
178	620	620	620	495	376	139	139	627	660	660	660	660
55	392	392	392	313	275	88	88	417	417	417	417	417
23	291	291	291	232	153	67	67	310	310	310	310	310
110	470	470	470	400	368	112	400	500	500	500	500	500
135	540	540	540	431	129	129	129	575	575	575	575	575
109	410	410	400	400	350	100	100	420	420	420	420	410
61	365	358	337	321	303	90	90	386	382	378	372	367
249	733	733	601	601	601	186	218	725	780	780	780	733
69	423	423	338	338	338	108	140	450	450	450	450	423
124	517	517	517	412	412	132	214	550	550	550	550	550
271	660	660	640	640	580	170	170	340	680	680	680	680
318	880	850	830	800	780	220	250	650	850	900	900	890
62	404	404	404	322	322	106	113	430	430	430	430	430
219	700	700	700	559	559	184	0	507	745	745	745	745
143	555	555	555	442	442	146	0	590	590	590	590	590
195	611	611	611	520	520	161	161	650	650	650	650	650
164	583	583	583	471	471	155	165	620	620	620	620	620
165	583	583	583	471	471	155	184	620	620	620	620	620
173	583	583	583	484	484	155	276	620	620	620	620	620
6	221	221	221	176	176	60	72	235	235	235	235	235
19	268	268	268	228	228	73	68	285	285	285	285	285
26	301	301	301	240	240	84	96	320	320	320	320	320
29	254	254	272	253	240	71	67	199	259	288	286	271
316	987	987	987	788	788	276	788	1050	1050	1050	1050	1050
107	500	500	500	399	399	144	92	452	532	532	532	532
104	526	526	526	392	392	157	110	560	560	560	560	560
272	660	660	660	640	580	200	180	500	685	680	675	665
74	461	461	461	343	343	141	134	480	490	490	490	490

101	470	470	470	390	390	148	140	405	500	500	500	500
253	760	760	760	606	606	242	218	808	808	808	808	808
150	564	564	564	450	450	180	0	600	600	600	600	600
145	597	597	597	444	426	191	195	616	635	635	635	635
48	385	385	385	308	308	126	71	410	410	410	410	410
183	611	611	611	500	500	200	205	572	650	650	650	650
30	320	320	320	255	255	105	105	340	340	340	340	340
42	314	297	297	297	275	100	100	325	319	321	317	317
20	271	271	271	230	230	94	32	288	288	288	288	288
291	951	951	951	688	688	337	282	759	1012	1012	1012	1012
81	423	423	423	360	360	151	151	450	450	450	450	450
2	140	138	138	130	125	50	50	75	116	141	140	140
325	924	923	894	892	886	341	341	948	940	935	932	927
196	540	540	540	520	460	200	200	580	575	569	565	565
28	338	338	338	252	252	126	0	360	360	360	360	360
179	596	596	596	495	485	223	223	634	634	634	634	634
9	229	221	213	193	163	88	157	248	237	233	231	229
159	564	564	564	462	416	231	240	600	600	600	600	600
167	594	594	594	474	474	251	251	632	632	632	632	632
126	505	505	505	419	419	222	222	537	537	537	537	537
335	1128	1128	1128	960	960	499	480	1020	1200	1200	1200	1200
191	550	517	517	517	412	231	227	358	550	550	550	550
22	265	265	265	231	231	120	139	282	282	282	282	282
158	488	459	459	459	342	209	195	277	488	488	488	488
70	398	398	398	338	338	183	169	423	423	423	423	423
230	644	644	644	580	529	300	300	680	661	661	659	659
193	547	532	520	520	516	250	0	400	500	580	550	547
79	414	414	414	352	352	197	194	383	440	440	440	440
250	808	808	808	602	602	391	397	765	860	860	860	860
67	414	414	414	330	330	201	248	440	440	440	440	440
348	1438	1375	1372	1290	1265	684	684	1549	1540	1523	1486	1444
324	1081	1081	1081	886	886	540	540	874	1150	1150	1150	1150
239	630	626	626	595	500	315	315	663	652	640	635	630
212	649	649	649	545	545	332	191	690	690	690	690	690
334	950	950	950	950	830	510	465	520	750	1030	1020	1015
17	282	282	282	225	225	153	151	270	300	300	300	300
1	89	89	89	70	70	50	48	82	95	95	95	95
166	555	555	555	472	472	316	312	531	590	590	590	590
96	430	420	400	380	360	240	240	450	440	440	440	430
279	700	700	680	660	540	400	400	500	600	700	700	700
315	959	959	959	785	785	557	550	1020	1020	1020	1020	1020
46	320	301	301	301	256	182	187	256	320	320	320	320
146	520	485	485	445	420	300	300	570	550	544	540	540
37	305	305	300	280	260	200	75	175	280	320	320	320
113	430	404	404	404	322	267	93	213	430	430	430	430

286	750	750	680	680	680	500	500	600	600	700	760	750
163	483	470	470	470	450	320	320	510	500	490	483	483
303	740	730	720	720	720	500	500	500	700	760	760	750
339	1060	996	996	996	954	687	687	954	1060	1060	1060	1060
220	595	559	559	559	452	393	108	294	595	595	595	595
231	595	595	580	580	576	420	420	620	620	610	610	610
154	611	611	611	455	455	432	96	481	650	650	650	650
3	140	132	132	132	98	98	98	98	140	140	140	140
128	564	564	564	420	420	420	420	600	600	600	600	600
206	639	639	639	530	530	477	488	680	680	680	680	680
40	357	357	357	293	270	270	293	380	380	380	380	380
71	442	442	442	338	338	338	338	470	470	470	470	470
162	611	611	611	468	468	468	468	650	650	650	650	650
205	620	620	620	528	475	475	0	660	660	660	660	660
345	1532	1532	1532	1174	1174	1174	1174	1630	1630	1630	1630	1630
129	490	480	450	420	580	374	560	520	500	500	470	460
326	950	950	893	893	893	741	741	741	741	950	950	950
134	450	445	430	430	425	350	350	485	475	470	470	450
59	404	404	404	318	318	318	318	430	430	430	430	430
111	495	495	495	401	401	393	393	527	527	527	527	527
144	470	442	442	442	352	352	352	352	470	470	470	470
84	462	462	462	368	368	368	368	363	491	491	491	491
132	455	428	428	428	341	341	341	341	455	455	455	455
184	630	630	630	502	502	502	502	670	670	670	670	670
114	430	404	404	404	322	322	322	322	430	430	430	430
73	429	429	429	342	342	342	342	456	456	456	456	456
116	508	508	508	405	405	405	405	540	540	540	540	540
117	508	508	508	405	405	405	405	540	540	540	540	540
27	306	306	306	244	244	244	244	325	325	325	325	325
323	1081	1081	1081	862	862	862	862	1150	1150	1150	1150	1150
218	696	696	696	555	555	555	555	740	740	740	740	740
57	395	395	395	315	315	315	315	420	420	420	420	420
103	489	489	489	390	390	390	390	520	520	520	520	520
41	371	371	371	296	296	296	296	395	395	395	395	395
39	300	282	282	282	225	225	225	225	300	300	300	300
94	470	470	470	375	375	375	375	500	500	500	500	500
151	564	564	564	450	450	450	450	600	600	600	600	600
152	564	564	564	450	450	450	450	600	600	600	600	600
204	658	658	658	525	525	525	525	700	700	700	700	700
283	846	846	846	675	675	675	675	900	900	900	900	900
309	940	940	940	750	750	750	750	1000	1000	1000	1000	1000
310	940	940	940	750	750	750	750	1000	1000	1000	1000	1000
329	1128	1128	1128	900	900	900	900	1200	1200	1200	1200	1200
337	1222	1222	1222	975	975	975	975	1300	1300	1300	1300	1300
235	733	733	733	585	585	585	585	780	780	780	780	780

138	545	545	545	435	435	435	435	580	580	580	580	580
139	545	545	545	435	435	435	435	580	580	580	580	580
255	763	763	763	609	609	609	609	812	812	812	812	812
331	1175	1175	1175	938	938	938	938	1250	1250	1250	1250	1250
180	620	620	620	495	495	495	495	660	660	660	660	660
49	385	385	385	308	308	308	308	410	410	410	410	410
50	385	385	385	308	308	308	308	410	410	410	410	390
136	536	536	536	433	433	429	429	570	570	570	570	570
16	273	273	273	220	220	220	220	290	290	290	290	290
322	871	962	878	849	855	776	773	746	887	872	889	873
295	865	865	865	699	699	699	699	920	920	920	920	920
156	564	564	564	456	456	456	456	600	600	600	600	600
207	658	658	658	532	532	532	532	700	700	700	700	700
289	846	846	846	684	684	684	684	900	900	900	900	900
288	680	680	680	680	600	550	550	720	720	720	720	720
292	855	855	855	692	692	692	692	910	910	910	910	910
65	404	404	404	327	327	327	327	430	430	430	430	430
56	338	337	332	315	300	273	108	108	360	352	350	344
63	395	395	395	323	323	323	323	420	420	420	420	420
317	975	975	975	798	798	798	798	1037	1037	1037	1037	1037
131	519	519	519	425	425	425	425	552	552	552	552	552
13	254	254	254	208	208	208	208	270	270	270	270	270
251	640	602	602	602	493	493	493	493	640	640	640	640
98	470	470	470	385	385	385	385	500	500	500	500	500
160	564	564	564	462	462	462	462	600	600	600	600	600
225	600	564	564	564	462	462	462	462	600	600	600	600
287	830	830	830	680	680	680	680	883	883	883	883	883
343	1269	1269	1269	1040	1040	1040	1040	1350	1350	1350	1350	1350
285	827	827	827	678	678	678	678	880	880	880	880	880
236	716	716	716	587	587	587	587	762	762	762	762	762
168	578	578	578	474	474	474	474	615	615	615	615	615
24	291	291	291	239	239	239	239	310	310	310	310	310
153	545	545	545	452	452	452	452	580	580	580	580	580
226	686	686	686	569	569	569	569	730	730	730	730	730
301	750	705	705	705	585	585	500	750	750	750	750	750
298	846	846	846	702	702	702	702	900	900	900	900	900
299	846	846	846	702	702	702	720	900	900	900	900	900
237	600	600	590	590	590	500	500	500	620	600	600	600
311	893	893	893	750	750	750	750	950	950	950	950	950
11	235	235	235	198	198	198	198	250	250	250	250	250
7	212	212	212	180	180	180	180	225	225	225	225	225
171	567	567	567	482	482	482	482	603	603	603	603	603
232	682	682	682	580	580	580	580	725	725	725	725	725
223	662	662	662	563	563	563	563	704	704	704	704	704
170	564	564	564	480	480	480	480	600	600	600	600	600

197	611	611	611	520	520	520	520	650	650	650	650	650
245	705	705	705	600	600	600	600	750	750	750	750	750
211	639	639	639	544	544	544	544	680	680	680	680	680
209	626	626	626	533	533	533	533	666	666	666	666	666
97	451	451	384	384	384	384	480	480	480	480	480	451
75	404	404	404	344	344	344	344	430	430	430	430	430
47	357	357	357	304	304	304	304	380	380	380	380	380
120	479	479	479	408	408	408	408	510	510	510	510	510
121	479	479	479	408	408	408	408	510	510	510	510	510
8	216	216	216	184	184	184	184	230	230	230	230	230
66	385	385	385	328	328	328	328	410	410	410	410	410
312	700	700	750	750	750	600	600	800	750	700	700	700
302	808	808	808	705	705	705	705	860	860	860	860	860
342	1156	1156	1156	1009	1009	1009	1009	1230	1230	1230	1230	1230
51	329	329	329	308	308	308	308	350	350	350	350	350
125	442	442	442	414	414	414	414	470	470	470	470	470
313	794	794	794	752	752	752	452	525	525	525	525	525
21	230	230	230	230	230	230	230	230	230	230	230	230
244	600	600	600	600	600	600	350	400	620	620	620	620
247	650	650	650	600	600	650	650	650	650	650	650	650
10	193	193	193	195	185	197	197	185	185	193	193	193
87	388	388	380	370	360	398	398	395	395	390	388	388
319	570	670	790	800	660	690	660	560	790	820	770	670
262	660	660	660	630	630	680	680	675	670	665	665	665
234	580	580	580	580	560	600	600	600	600	600	580	580
321	825	825	825	825	700	855	855	825	825	825	825	825
233	640	640	600	580	520	670	670	670	670	650	650	650
273	710	710	710	640	566	755	755	755	755	755	755	755
304	800	760	750	720	600	810	810	810	810	810	810	810
257	591	583	619	618	659	622	0	824	682	663	603	592
330	949	948	948	931	931	1020	1010	1005	992	983	979	952
86	390	390	390	370	370	420	420	420	420	390	390	390
246	600	550	600	600	600	650	650	640	630	625	625	625
198	0	0	560	520	510	625	625	620	610	599	595	0

Drummond Swamp vegetation report

Introduction

Drummond Swamp is classified as a Wildlife Management Reserve and is located c. 4km south-east of Drummond. Drummond Swamp is one of the larger reserves on the Southland Plains (256.42ha). It is one of only two peatland reserves on the Southland Plains. Despite its ecological importance it has received relatively little botanical attention and remains relatively poorly known. The current survey was undertaken to improve botanical knowledge of the wetland also to assess weed control requirements. The survey was undertaken by myself, Lynne Huggins, Graeme Miller and Jolie Hazley, on 26 February 2008.

Ecological Setting

Drummond Swamp is a large peat bog is the eastern portion of the Southland Plains (Southland Plains Ecological District). Peat bogs are a distinctive feature of the Southland Plains ED. The Southland Plains Ecological District – Survey report for the Protected Natural Areas Programme (Walls and Rance, 2003) considered the 1840 extent of peat bogs to be 3% (7,520ha) of the Southland Plains ED. The two major protected areas are Drummond Swamp (256 ha) and Bayswater Scientific Reserve (528 ha = 210 + c.318 ha addition)

Vegetation

Wirerushland: This is the most extensive community with wirerush (*Empodisma minus*) dominant throughout. However there is some variation, probably dependent upon the fire history.

Generally the community is dominated by wirerush (*Empodisma minus*, 50-90% cover, average 80%, including c. 5% dieback), with much tangle fern (*Gleichenia dicarpa*, 2-50%, average 20%), sphagnum moss (Sphagnum cristatum, up to 15%) and swamp inaka (*Dracophyllum oliverii*, up to 10%). Other minor species include manuka (*Leptospermum scoparium*), *Celmisia gracilenta, Cyathodes empetrifolia, Nertera scapaniodes, Baumea rubiginosa* and *B. tenax.*

Areas that have not been burnt for longer have a greater cover of wood species with manuka (5%) and swamp inaka (2%), also tangle fern tends to be more common in these areas.

Lowland flax is locally common in areas on the north side of the wetland.

There are some localised and small scale mossy hollows containing *Baumea rubiginosa* and *B. tenax.*

Disturbed areas: Within the wetland was a large disturbed area, which was thought to be an old gull colony. This area was dominated by exotic grasses (65%, mainly sweet vernal and Yorkshire fog), soft rush (*Juncus effusus*, 20%), catsear (*Hypochaeris radicata*, 5%), manuka, bulbous rush (*Juncus bulbosus*), giant rush (*Juncus procerus*), wirerush, pedicelled sedge (*Carex secta*), blackberry (*Rubus fruticosa*) the liverwort *Marchantia beteroana* and locally cutty grass (*Carex coriacea*).

Ponds: Near the northern boundary of the wetland are a couple of ponds. These ponds have a margin containing much pedicelled sedge and lowland flax. Adjacent to the ponds is a wet channel dominated by pedicelled sedge and lowland flax.

Treeland: In the north-western boundary (adjacent to McLeish's ponds) is a treeland. This community is dominated by wirerush (35-50%), bracken (*Pteridium esculentus*, 25-45%), a gum tree (*Eucalyptus* sp. 25%), manuka (8%), *Amalancher* sp. (5%), tangle fern (<5%), water fern (*Histeopteris incisa*), lowland flax and swamp inaka.

Flora

A flora of 44 indigenous plant species has been recorded from Drummond Swamp. This flora is typical of peat bogs on the Southland Plains. The woody flora is limited with bog pine, celery pine and pygmy pine all absent.

The most notable plant recorded was Olearia laxiflora, with a single plant recorded from the southern boundary. It is uncommon on the Southland Plains.

Weeds

A total of 36 exotic species were recorded. Of these 11 are considered of conservation concern. These include:

Gorse (*Ulex europaeus*): Gorse is the most widespread weed species, however is largely confined to the modified margins of the wetland. Without control it will expand around the margin of the wetland and slowly invade into the wetland.

Blackberry (*Rubus fruticosus*): Blackberry was scattered through disturbed internal areas which were thought to be old gull colony site. It will expand in these areas and potentially invade into more intact areas. It is of particular concern because of its ability to grow on peat soils and it ability to spread widely through bird dispersal.

Cut-leaved blackberry (*Rubus laciniatum*): This blackberry was localized, however poses a similar threat the common blackberry.

Grey willow (*Salix cinerea*): Grey willow was scattered through disturbed internal areas which were thought to be old gull colony site. It will expand in these areas and potentially invade into more intact areas. It is of particular concern because of its ability to grow on peat soils and it ability to spread widely through wind dispersal.

Silver birch (*Betula pendula*): Silver birch was scattered through disturbed internal areas which were thought to be old gull colony site. It will expand in these areas and potentially invade into more intact areas. It is of particular concern because of its ability to grow on peat soils and it ability to spread widely through wind dispersal.

Service berry (*Amelancher* sp): Service berry was confined to the treeland area adjacent to the north-western boundary. This small tree is a relatively recent discovery as a weed on peat bogs in Southland. It currently has a restricted distribution within the wetland, however is spreading. It is a priority to control while it remains localized.

Rowan (Sorbus aucuparia): Rowan was also localized and uncommon within the wetland. It is a known weed of peat bogs and so is a priority for control.

Gum trees (Eucalyptus sp.): The gum trees have slowly invaded the peat bog and now form a treeland community adjacent to the north-western boundary. While their spread is slow the existing trees demonstrate the ability to invade the peat bog. They are a lower priority for control than other more aggressive weeds, but their removal needs to be planned.

Crack willow (*Salix fragilis*): Crack willow was confined to some ponds near the northern edge of the wetland. It is localized and probably not spreading, however should be removed.

Broom (*Cytasus scoparius*): Broom was uncommon in the wetland.

Pine tree (Pinus sp.): A few pine trees were present within the wetland (mainly treeland area adjacent to the north-western boundary.

Rhododendron (*Rhododendon* sp.): A single rhododendron plant was observed. The plant was relatively large and is thought to have been present for many years. This plant is thought to have self seeded and is therefore of concern as it presents a seed source for further establishment.

Summary

Drummond Swamp is a large peat bog reserve, being one of the largest and most intact peat bogs on the Southland Plains. It has previously received limited management input. The wetland is generally intact though has suffered from historic fires. A modified area in the central portion is thought to have resulted from a gull colony. This area should be monitored to check that recovery is occurring.

Weed control is the major management requirement for the wetland. There are a number of weeds present. Those that have an ability to invade intact peat bogs are the priority for control. These include grey willow, silver birch, service berry, rowan, blackberry and cut-leaved blackberry.

Brian Rance
4 June 2008

From:	Nessa Legg <nessa.dgl@xtra.co.nz>
Sent:	Monday, 2 September 2019 10:06 a.m.
To:	Aurora Grant
Cc:	abe@woldwide.nz; 'Anita de Wolde'; 'Mike Freeman'; 'Matilda Ballinger'; 'Cain Duncan'; 'Hans van der Wal'
Subject:	Woldwide Runoff - AEE update; WW1&2 FEMP

Hi Aurora,

WRO - AEE

An amended copy of the original proposal/AEE document for WRO has been uploaded to Sharepoint (*Woldwide Runoff – proposal and AEE – 31-8-19.docx*):

- Our agreement was to provide updated AEE information only. Content on pages 1-15 is not part of the AEE so has not been altered at this time.
- Pages 16-28 of the original doc are the AEE section.
- Parts of the AEE that are either no longer relevant OR that have been superseded, have been deleted using the Track Changes function. When the document is viewed with No Markup, the AEE is pages 16-22.
- The WRO section of the Water Quality report you received on 23/8/19 supersedes deleted parts of the AEE section in their entirety.

WW1&2 FEMP

- An updated FEMP for WW1&2 was provided to you on 23/8/19 (version 1.4)
- This replaces two individual FEMPs for WW1 (version 1.3) and WW2 (version 1.3) combining information into a single FEMP
- I did not use the track changes function at the time
- Property detail table, maps, nutrient management, GMPs reflect WW1&2, including mitigation measures
- Tiaki Phosphorous Mitigation Plan was added
- Minor changes were made to provide ES with certainty regarding farm management – e.g. phrases like "where possible" "where practical" have been removed. "Should" has been replaced with "will."
- The detailed effluent management plan has been removed as it is not required by Appendix N (and will be provided separately as per discharge consent conditions)

Regards,
Nessa

Nessa Legg
Dairy Green Ltd
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Woldwide One limited and Woldwide Two Limited

Amendments

Amendments to application for resource consent – WW1&2

Table 1.1: Remove *Lot 3 5610*

Table 1.2: Replace location GPS coordinates with:

Merrivale: 1202164E, 4885024N

Merriburn: 1199656E, 4885435N

Amendments to application for resource consent – Woldwide Runoff Proposal and AEE

Table in section 3: Replace location GPS coordinates with

Merrivale: 1202164E, 4885024N

Merriburn: 1199656E, 4885435N

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

15 August 2019

Environment Southland
Private Bag 90116
Invercargill 9348

Our ref:
ES ref: APP- 20191052

Attn: Aurora Grant

Dear Aurora,

RE: Request for Further Information under Section 92(1) of the Resource Management Act 1991 – APP 20191052.

Please find below our response to your request for further information dated 15 July 2019.

Please let me know if you have any further questions or require any further explanations.

Yours sincerely,
Nessa Legg
Consultant for *Woldwide 1 Limited and Woldwide 2 Limited*

Assessment of effects on the freshwater resources associated with the proposed abstraction of groundwater.

Please see responses to questions 2 – 5, noting that technical analyses have been provided by Aqualinc Research Limited.

Response to Question 2:

As clarified via email on 15/7/19, the proposed abstraction is 180 m^3/day, which is aligns with the Environment Southland Guideline of 120 l/cow/day. This is the figure stated in the proposal and AEE. There is an error on page 21 of the application, where 180 m^3/day is correctly stated but erroneously 91,000 litres is stated for WW1. This should be 84,000 litres as is stated in the proposal (pages 105/106) and AEE. A maximum daily take of 84,000 litres represents an increase of 24,000 litres relative to the current consented maximum daily take.

Responses to questions 3 – 5

No change in maximum daily abstraction (96 m^3/day) is proposed for bores E45/0083 and E45/0727 combined and the maximum rate will not exceed 2 l/s. The maximum daily take from bore E45/0071 is proposed to increase by 24 m^3 to 84 m^3/day although the maximum rate will not exceed 2 l/s.

Environmental Setting

To accurately assess the stream depletion effects it is important to look at the environmental setting of the aquifer and provide a conceptual model as per the requirements of Appendix L.2.

The subsurface geology of the wider Central Plains area consists of a variable thickness of alluvial gravels (between 20 and 100+ metres thick) which overlie Tertiary mudstone and limestone of the East Southland Group (i.e. the limestone deposits of the Winton Hill and Forest Hill Formations and the mudstone and lignite deposits of the Gore Lignite Measures). Outcrops of the Forest Hill Formation form a prominent limestone ridge running from Otautau to Isla Bank that hosts an extensive unconfined aquifer system with significant secondary permeability developed through jointing. The limestone sediments of the Winton Hill formation are much thinner and are interspersed with sand, lignite and mudstone sediments.

The alluvial deposits of the Upper and Lower Aparima groundwater management zones comprise remnant mid-Quaternary alluvial terraces bisected by recent (Q1) gravel deposits of the Aparima River floodplain. The late Quaternary (Q2) alluvial deposits are moderately weathered and form an extensive low yield unconfined aquifer which is typically less than 20 metres thick.

Bore yields increase with proximity to the Aparima River reflecting the reworking of the gravel deposits during river entrenchment. Recent drilling investigations near Drummond and Gladvale also indicated the presence of semi-confined water-bearing layers in the older (Q6-Q8+) alluvial deposits that overlie the Tertiary sediments.

Figure 1 below shows a simple conceptual model of the hydrogeological setting in the vicinity of the proposed take. The figure shows a narrow band of reworked Q1 alluvium along the margins of the Aparima River. While these recent alluvial deposits are hydraulically connected to the Aparima River, the river itself appears to have limited interaction with the groundwater system in the adjacent Waimatuku groundwater zone which is primarily recharged by local rainfall.

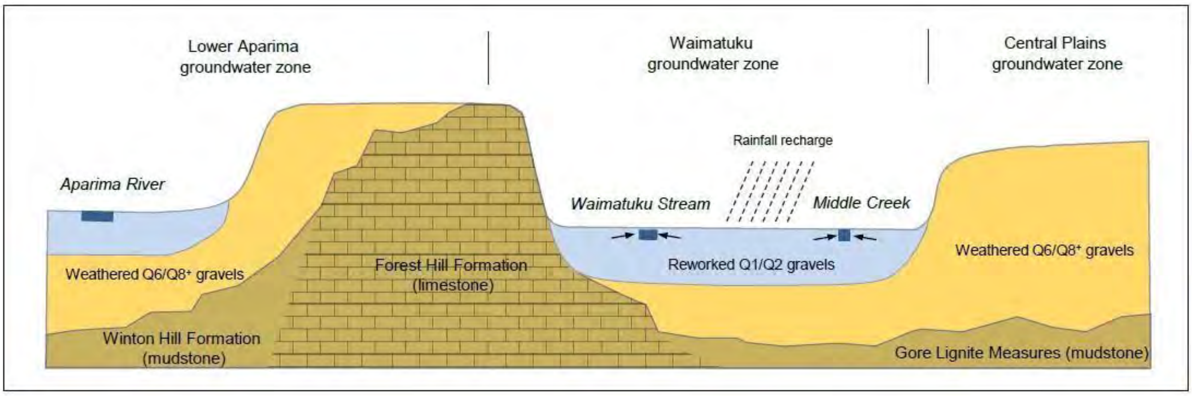

Figure 1: *Waimatuku groundwater zone schematic.*

Stream depletion

Pumping water from a well has the potential to reduce the flow of nearby streams which are connected to groundwater. We have undertaken a preliminary stream depletion assessment using the Hunt (1999) equation.

Please note that the methodology and parameters used in this assessment is based on the recent RFI response for the application APP-20191140. This methodology has been reviewed and approved by Environment Southland.

As such, this assessment assumes a 100% irrigation efficiency (to take account of the water not being used for irrigation). We have used a range of transmissivity and specific yield values. A stream bed conductance of 2 m/day and specific yields between 0.001 and 0.0001 have been used as the typical/default specific yield value for unconfined clay-bound gravel aquifers.

The nearest possible waterway is a stream that discharges into Middle Creek and then into the Waimatuku Stream. This stream, at its closest point, is 130 m from bore E45/0071 (see Figure 2). All of the assessment parameters have been chosen based on advice provided by Brydon Hughes (Liquid Earth) for this specific waterway. Mr Hughes advised that a transmissivity value of 200 m2/dy and a storativity value of 0.01 would be appropriate for the assessments. To be conservative we have also assessed the effects using parameters higher and lower than those which were recommended.

Figure 2: Closest waterway to bore E45/0071.

***Table 1:** Stream depletion effects on the tributary of the Waimatuku Stream from pumping bore E45/0071 for 7 days.*

Stream depletion effect (% and rate) on the stream at a distance of **130 m** after **7** continuous days pumping of **86 m^3/day (1.0 L/s).**		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Specific yield	**0.01**	85%; 0.8 L/s	85%; 0.8 L/s	83%; 0.8 L/s
	0.001	85%; 0.8 L/s	85%; 0.8 L/s	83%; 0.8 L/s
	0.0001	95%; 1.0 L/s	95%; 1.0 L/s	95%; 1.0 L/s

***Table 2:** Stream depletion effects on the tributary of the Waimatuku Stream from pumping bore E45/0071 for 300 days.*

Stream depletion effect (% and rate) on the stream at a distance of **130 m** after **300** continuous days pumping of **86 m^3/day (1.0 L/s).**		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Specific yield	**0.01**	98%; 1.0 L/s	98%; 1.0 L/s	98%; 1.0 L/s
	0.001	98%; 1.0 L/s	98%; 1.0 L/s	98%; 1.0 L/s
	0.0001	99%; 1.0 L/s	99%; 1.0 L/s	99%; 1.0 L/s

Table 3: *Stream depletion effects on the tributary of the Waimatuku Stream from pumping bores E45/0083 and E45/0727 for 7 days.*

Stream depletion effect (% and rate) on the stream at a distance of **210 m** after **7** continuous days pumping of **96 m^3/day (1.1 L/s)** (assumes all water is being taken from the closest bore (E45/0083))		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Specific yield	**0.01**	42%; 0.5 L/s	47%; 0.5 L/s	48%; 0.5L/s
	0.001	79%; 0.8 L/s	80%; 0.8 L/s	81%; 0.9L/s
	0.0001	93%; 0.9 L/s	94%; 0.9 L/s	95%; 1.0 L/s

Table 4: *Stream depletion effects on the tributary of the Waimatuku Stream from pumping bores E45/0083 and E45/0727 for 300 days.*

Stream depletion effect (% and rate) on the stream at a distance of **210 m** after **300** continuous days pumping of **96 m^3/day (1.1 L/s)** (assumes all water is being taken from the closest bore (E45/0083))		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Specific yield	**0.01**	91%; 1.0 L/s	93%; 1.0 L/s	93%; 1.0 L/s
	0.001	97%; 1.1 L/s	97%; 1.0 L/s	97%; 1.0 L/s
	0.0001	99%; 1.1 L/s	99%; 1.1 L/s	99%; 1.1 L/s

In accordance with Appendix L.2 it appears that the take can be classified as Direct or Low Hydraulic Connection depending on how Table L.2 is interpreted. Therefore, the groundwater take could be considered an equivalent surface water take for flow and allocation purposes and therefore subject to any relevant minimum flow regime (Waimatuku Stream). However, it is very unlikely that the combined absolute effect from all three bores exceeds 2 L/s. Given that the effects of such a take are likely to be less than minor, we conclude that consideration of PSWLP policies 20 and 23 should result in a take of this scale **not** being subject to minimum flow provisions.

Interference Assessment and Effects on Neighbouring Bores

For the neighbouring bore interference assessment we have used the same conservative T and S values for drawdown calculations. The closest neighbouring bore is E45/0605, located 1,220 m to the SE of bore E45/0071. This bore is used for stock supply. The other two bores (E45/0083 and E45/0727) are more than 2 km away from E45/0605, and hence are unlikely to be affecting it.

Table 5: *Drawdown effects on bore E45/0605 from pumping bore E45/0071 for 7 days.*

Drawdown at **1,220m** distance under a range of T & S values after **7** days of continuous pumping at **1.0 L/s**.		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Storativity	**0.01**	0.00 m	0.00 m	0.00 m
	0.001	0.04 m	0.03 m	0.03 m
	0.0001	0.16 m	0.10 m	0.06 m

Table 6: *Drawdown effects on bore E45/0605 from pumping bore E45/0071 for 300 days*.

Drawdown at **1,220m** distance under a range of T & S values after **300** days of continuous pumping at **1.0 L/s**.		**Transmissivity (m^2/day)**		
		100	**200**	**400**
Storativity	**0.01**	0.11 m	0.08 m	0.05 m
	0.001	0.26 m	0.15 m	0.09 m
	0.0001	0.41 m	0.23 m	0.13 m

Based on an aquifer thickness of 10 m the drawdown in bore E45/0605 for 7-days pumping is approximately 1.6%, and 300-days pumping is 4.1% of the aquifer thickness, which is within the 20% percent available drawdown recommended by Policy 31 of the RWP, and Policy 22, Rule 54 and Appendix L.3 in the pSWLP (Decisions Version).

As such, the assessment demonstrates that even with a worst-case combination of T and S values and continuous pumping at the maximum daily rate of take the estimated drawdown at bore E45/0605 would be considered ‘acceptable’ under Appendix L.3 of the pSWLP.

Please note that this neighbouring bore interference assessment assumes no connection to surface water. However, as demonstrated in the stream depletion assessment, the take is considered to be strongly connected to a nearby waterway, which is much closer to the applicant’s bore than any neighbouring bores, and therefore it is very unlikely that drawdown effects would propagate beyond the distance to the stream.

Question 4 states that an aquifer test "may" be required. However, given the scale of the proposed take, the stream depletion and interference assessments provided above, in addition to significant cost, it is considered unnecessary to carry out an aquifer test at this time.

Effects of increased abstraction from the aquifer considered in context of effects on other users and effects on the groundwater system.

Given the very small proposed increase in the rate of abstraction compared to the scale of the existing inputs and outputs to the groundwater system, the effects of this proposal will be so minor that they would not be able to be measured or even estimated.

Effects of abstraction on surface water quality and quantity of the Waimatuku Stream

The effects of the proposed take on the Waimatuku Stream have been assessed above (stream depletion). We conclude that given the scale of the abstraction and minimal effects on water resources, no adverse effects on water quality or quantity of the Waimatuku Stream are expected.

From: Lacey Bragg
Sent: Friday, 23 August 2019 11:52 a.m.
To: Mike Doesburg; 'Abigail Lovett'; 'Belinda Meares'; Nicole Phillips
Subject: WW applications - reporting officer discussion on landholding for circulation
Attachments: Draft Landholding discussion for applicant.pdf

Good morning,

Please find information attached and below.

Regards

From: Aurora Grant
Sent: Friday, 23 August 2019 9:49 AM
To: Lacey Bragg <Lacey.Bragg@es.govt.nz>
Subject: WW applications - reporting officer discussion on landholding for circulation

Mōrena Lacey,

Attached is my draft discussion on where I have arrived at for the landholding for the WW applications, for circulation to the applicant and all other parties please.
I would like to draw the various parties attention to the following points along with the release of this information:

- The release of this discussion excerpt from my S42A report has arisen from the meeting held on 9 August between the Applicant and Council, where I offered to release this early as I considered it would be beneficial for the applicant to receive and consider prior to my evidence circulation date;
- The attached discussion is in draft form based on my current knowledge of the operation and applications. This view is subject to change as further evidence is provided and my draft report in its entirety is reviewed;
- I recognise that I have since received a comprehensive letter (dated 22 August) from the Applicant's legal counsel, Mr van der Wal, regarding landholding definitions. I thank Mr van der Wal for his feedback and trust that the attached discussion will clarify his concerns and show that the landholding matter is not linked to identified non-compliances with the operation which are being addressed by the councils compliance team and are separate to this process with the exception of permitted baseline considerations;
- I note that the applicants legal counsel letter appears to infer that council is attempting to delay the hearing in light of where I have arrived at for my consideration on landholding. I would like to clarify this is not the case, and in actual fact, the proffering of this information early was to because I considered it would be helpful to the applicant, to avoid any delays to the process and to allow the applicant more time to respond than is statutorily required normally. This is clearly transcribed in the recorded notes from the meeting;
- I have not made any changes to my view on landholding for the release of the draft excerpt in light of Mr van der Wal's letter, however I will address this in my final report if necessary.

Ngā mihi,

Aurora

What makes up the proposal's "landholding"

Summary

In order to determine what effects from the proposed activity will be controlled by the land use consent for farming (if granted), the commissioners will need to make a determination regarding what constitutes the operation's "landholding".

In this section I have detailed the various companies that are in play for this operation, what their roles are and what effects are transferred as I understand it. I have then drawn a conclusion for what I believe to be the applicants' landholding from a planning perspective under the pSWLP.

When assessing this proposal, I have determined that the following constitutes the applicants' landholding:

- dairy platforms at WW1, WW2, WW3, WW4 and WW5;
- the Gladfield block;
- the Horner block;
- WRO – Merrivale and Merriburn.

These are shown on Figures 4.5.3 and 4.5.4 below.

What has been applied for in this application, and related application APP-20191052, differs from the conclusion I have reached for the entirety of the landholding. This is because, despite the fragmented approach that the both applications take to the operations, I have found that when assessed through a planning lens using the definition of landholding in the pSWLP that the entire of the WW operation goes beyond the fragments that have been applied for in this application and are all inextricably linked. Breaking the platforms into separate landholdings as has been applied for, in my opinion does not meet the intention of the pSWLP when accounting for landholdings.

It is important to note that all effects from the proposed operation are required to be considered, regardless of what is determined to be within the landholding. Despite where I have arrived with my view of the landholding from a planning perspective, I acknowledge the applicants' right to apply for aspects of their farming activity separately, and as such I have assessed the applications and their associated effects as presented to me in the respective applications.

I consider that most of the activities applied for under the application operation could conceivably be consented as outlined in the consent applications for the respective dairy platforms, such as land use for wintering barns and effluent storage.

The issue arises when considering how the conditions of consent (if granted) will ensure that the activities of land use for "farming" are appropriately controlled, especially in the absence of an application for the farming activity for WW3. I consider that if resource consent for land use for farming is granted, the commissioners have the following options available to them:

- consider the applications as presented by the applicants, with three fragmented land use consents "farming activities" on three separate "landholdings". This approach would exclude the WRO block from being part of the landholding and may limit the ability to impose conditions relating to effects on the environment from the WRO block. In my opinion this option would not achieve the intention of the pSWLP when considering the definition of "landholding";

- consider the applications as presented, but determine that the landholding is the entirety of the WW operation including the farms that I have outlined above. In essence, this would require the two current applications to be considered together. If they are minded to grant consent, the commissioners could grant the separate consents sought for the "farming activities" described in the applications, but impose consent conditions relating to the entire "landholding".

The second of these options, in my opinion, is the most appropriate for these applications. However, in the absence of the inclusion of WW3 into this proposal, it would require the construction of conditions that allow for the inclusion of those activities at such a time as a proposal is made.

I consider that in this instance, not considering the two applications together would be inappropriate, as the effects of exercising the two land use for farming consents (should they be granted) would overlap and would have consequential or flow-on effects that are not distinct from each other.

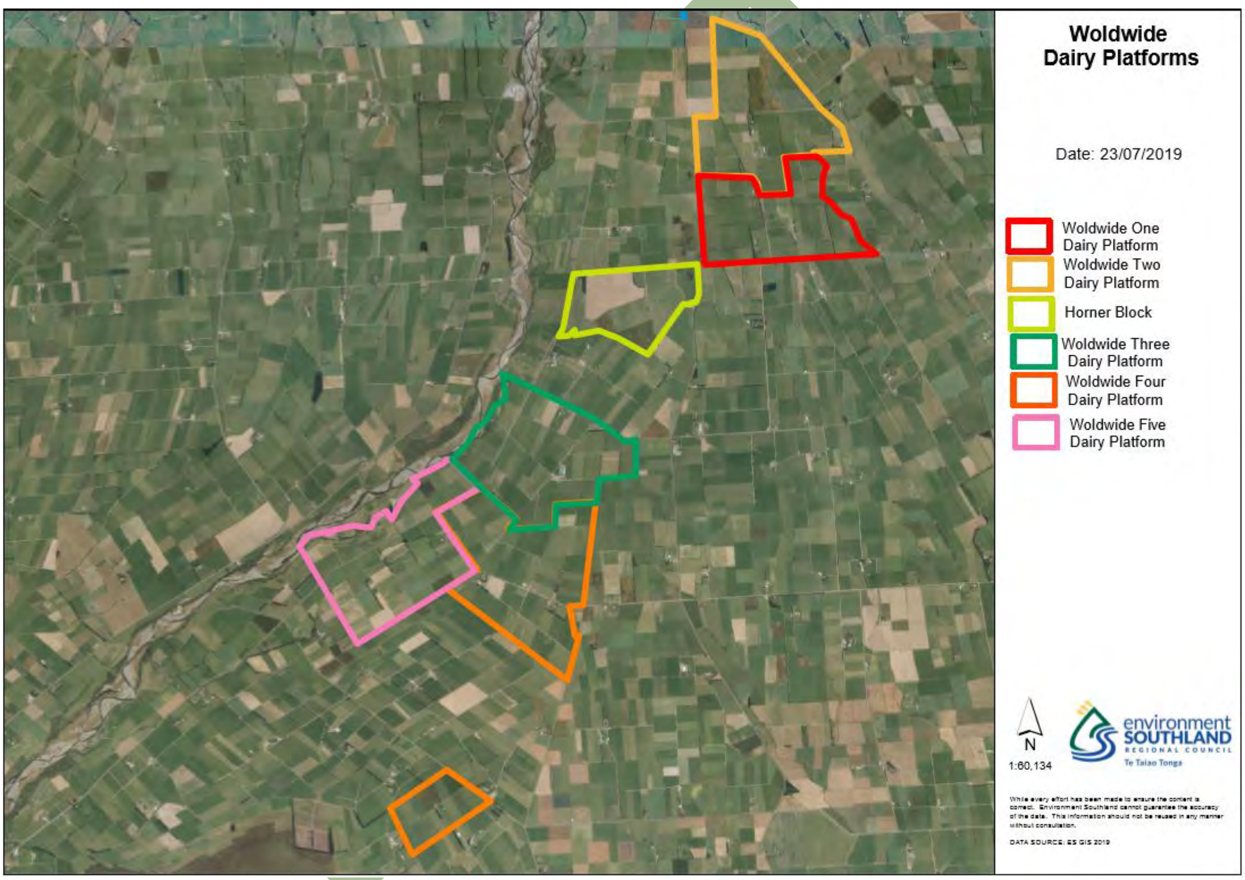

Figure 4.5.3: Location of WW3, WW4, WW5 and Gladfield block property boundaries and surface water catchments. I consider that these three blocks that are pictured, together with WRO blocks make up the landholding for this proposal

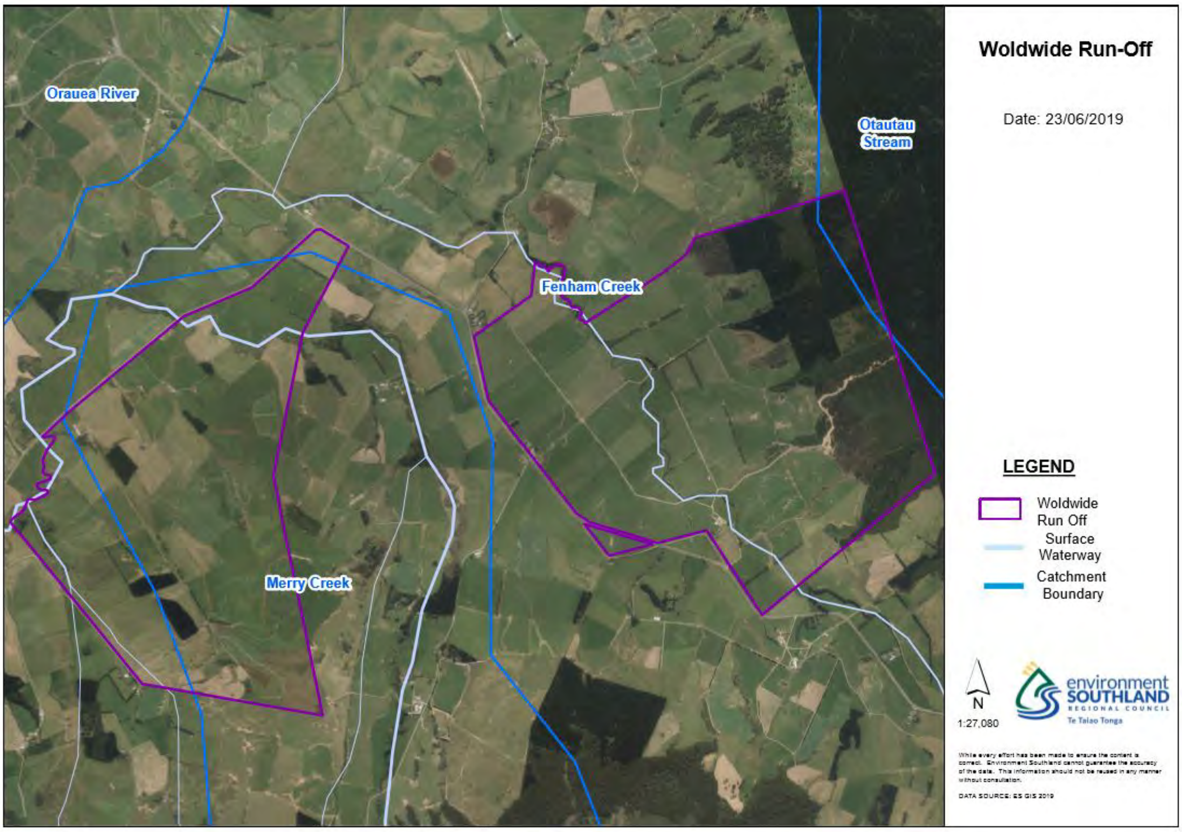

Figure 4.5.4: Location of the WRO block

Analysis

My reasoning for my conclusions on the landholding is as follows:

Landholding is defined by the proposed Southland Water and Land Plan as (my emphasis added in underlined areas):

(a) <u>any area of land</u>, including land separated by a road or river or modified watercourse, <u>held in one or more than one ownership</u>, that is <u>utilised as a single operating unit</u>, and may include one or more certificates of title; except

(b) for land with a residential, commercial, industrial, infrastructural or recreational zoning or designation in the relevant district plan means any area of land comprised wholly of one Certificate of Title or any Allotment as defined by Section 218 of the RMA.

The definition is accompanied with a note which states (my emphasis added in underlined areas):

Note: *For the purposes of this definition, a "<u>single operating unit</u>" may include, but <u>is not limited by</u>, the following features:*

(a) it has <u>effective control by any structure of ownership</u> of the same group of people (for example, land that is controlled by a family trust, or beneficiaries of that family trust or <u>a related group of companies</u>, or an estate, or partner, or individual/s or a combination of); and

(b) it is operated as a <u>single business entity</u>.

The key issue is whether each application relates to a "single operating unit" or whether the whole operation is a single operating unit. As the note above indicates, two considerations for determining if an area of land is a single operating unit are shared ownership or control and whether the land is operated as a single business entity. In my opinion, other helpful considerations include whether operating units can function separately without a material change to the farming system and whether the effects generated by operating units are transferred between different areas. I address these considerations below.

Company structure and roles

Below I have attempted to break down the ownership structure of the related groups of companies, and the roles that all of the related companies offer to the proposal:

Table 4.5.5: Company structure

Company	Directors	Role of company to the proposal
Woldwide One Limited	Albert De Wolde Janita De Wolde	Provides dairy platform, effluent to platform and Horner block, young stock to WRO and owns WW3.
Woldwide Two Limited	Albert De Wolde Janita De Wolde	Provides dairy platform, effluent to platform and Horner block, young stock to WRO.
Woldwide Three Limited	Albert De Wolde Janita De Wolde	Not applied for, but transfers effects between all other related properties.
Woldwide Four Limited	Albert De Wolde Janita De Wolde	Covered by related application APP-20191140.
Woldwide Five Limited	Albert De Wolde Janita De Wolde	Covered by related application APP-20191140.
Woldwide Farm Limited (Horner block)	Albert De Wolde Janita De Wolde	Provides wintering of stock from WW1, WW2, WW3, WW4, WW5. Provides additional area to discharge agricultural effluent produced on the dairy platforms from WW1, WW2 and WW3. Provides fresh grass and silage to feed WW1, WW2 and WW3 stock.
Woldwide Run-off Limited (Owned by Woldwide Farm Limited)	Albert De Wolde Janita De Wolde	Provides IWG of stock from WW1, WW2, WW3, WW4, WW5. Provides grazing of young stock, dry stock and supplementary stock from WW1, WW2, WW3, WW4, WW5.

Company	Directors	Role of company to the proposal
		Provides cut and carry of feed to support collective stock on the platform.

As detailed in the application, the argument to exclude certain blocks from the landholding is that the blocks are under different ownership by different companies. These companies then buy, sell and offer goods and services to the other companies for their farming operations on those blocks. The view is that this model does not operate as a “single operating unit”.

While I respect the applicants’ view on this matter, all of the companies have the same ownership and control structure (i.e. all have the same directors and shareholders). While the companies are all strictly separate legal entities, Mr and Mrs De Wolde control and benefit from all of the related companies.

In terms of whether each company operates as a single business entity, I acknowledge that there is some differentiation between the companies as to the activities each undertakes, however, from the information provided to me I do not consider that they are independent businesses. From the evidence that has been presented, the various companies work together to undertake the overall farming enterprise for Mr and Mrs De Wolde, rather than providing grazing, feed etc to the open market individual of each other.

Below I have only detailed the components that each company offers to the operation, based on what currently occurs within the farm system, and what is proposed moving forward. I have not detailed other services provided by the companies as I do not consider them relevant to this proposal.

As can be seen from the tables above and below, the related companies all add an essential component to the current and proposed operation. Without all of these components, the application would be materially different.

The table below also shows that environmental effects of each of the related companies and land areas are shared – supplement feed, effluent and stock grazing is transferred between all of the various farm components. This is important given the focus of the pSWLP’s objectives and policies on “holding the line” on water quality. To achieve the objectives and policies, all actual and potential adverse effects on water quality must be considered and (if consent is granted) be appropriately managed by conditions. Such an approach is not possible if resource consents are considered in a fragmented way.

Breakdown of land ownership and use for this application

Table 4.5.6: Breakdown of land use for this application

Land and ownership	Use	Link to other parts of operation/effect transferred?	Essential to proposed farm system?	Part of proposed landholding?	Justification for inclusion to landholding
Horner block – owned by WWFL	Cut and carry operation of fresh grass and silage. Used as a discharge area for	Nutrients are transferred between Horner block and the dairy platforms, through feed fed to cows, and back in the	Yes	Yes	Without the Horner block the entire operation would not be able to operate as stated in the application.

Land and ownership	Use	Link to other parts of operation/effect transferred?	Essential to proposed farm system?	Part of proposed landholding?	Justification for inclusion to landholding
	agricultural effluent from WW1, WW2, WW3	form of effluent spread on the block.			The application relies on nutrients to be spread on this block, without it, the losses would increase on the dairy platforms. The operation also relies on the feed generated on the block to sustain cows on the dairy platforms. WWFL is under the same ownership structure and control as WW1, WW2, WW3 with the same directors and shareholders. The Horner block is already consented as part of WW2 land use consent for dairy farming and has conditions restricting activities here.
Merrivale and Merriburn blocks – Owned by Woldwide Run-off Limited	Grazing and IWG of stock from WW1 WW2 WW3 WW4 WW5	Young stock are raised on WRO blocks up to the age of rising two years olds. This includes IWG. Dry stock are also grazed on the blocks.	Yes	Yes	Without the WRO the operation would not be able to operate as stated in the application. The application relies on stock being grazed on the block to keep losses lower on the dairy platform. WRO is under the same ownership structure and control as WW1 and WW2, with the same directors and shareholders.
WW1	Dairy platform	*Effect transferred out:* Winter barn effluent – to Horner block *Effect transferred in:* Supplement – from Horner block	Yes	Yes	The proposal will see additional milking cows added to the dairy platform, which subsequently triggers Rule 20 in the proposed SWALP.

Land and ownership	Use	Link to other parts of operation/effect transferred?	Essential to proposed farm system?	Part of proposed landholding?	Justification for inclusion to landholding
		Effects transferred in and out: Young and dry stock – to/from WRO			
WW2	Dairy platform	*Effect transferred out:* Winter barn effluent – to Horner block *Effect transferred in:* Supplement – from Horner block *Effects transferred in and out:* Young and dry stock – to/from WRO.	Yes	Yes	The proposal relies on combining the two dairy platforms into one landholding. No additional cows will be milked through WW2's milking platform.
Cochranes Block – Owned by Woldwide Farm Limited	IWG of stock from WW1 and WW2	Milking aged cows from WW1 and WW2 (and other platforms) that do not currently fit in the wintering barns are grazed on this block. Young stock and support stock are also IWG on this block.	Yes	Yes	To be converted to dairy platform.
WW3	Dairy platform	*Effect transferred out:* Effluent – to Horner and WW5 (area overlaps with effluent from WW5) *Effect transferred in:* Supplement – from Horner Young stock and dry stock *Effects transferred in and out:* Young stock – to/from WRO, and displaced from Cochranes to elsewhere? Dry stock – to/from WRO, and displaced from Cochranes to elsewhere? Cows IWG (some) – to WRO, displaced from Cochranes to elsewhere?	Yes	Yes	See discussion further down this report.

Breakdown of land use for related application APP-20191140

Table 4.5.7: Breakdown of land use for APP-20191140

Land and ownership	Use	Link to other parts of operation/ Effect transferred?	Essential to proposed farm system?	Part of landholding?	Justification for inclusion to landholding
WW3	Dairy platform	*Effect transferred out:* Effluent – to Horner and WW5 (area overlaps with effluent from WW5) *Effect transferred in:* Supplement – from Horner Young stock and dry stock *Effects transferred in and out* Young stock – to/from WRO, and displaced from Cochranes to elsewhere? Dry stock – to/from WRO, and displaced from Cochranes to elsewhere? Cows IWG (some) – to WRO, displaced from Cochranes to elsewhere?	Yes	Yes	See discussion below this table.
WW4 (including Gladfield)	Dairy platform	*Effect transferred out:* Winter barn effluent – to Gladfield *Effect transferred in:* Supplement – from Gladfield (part of WW4 platform under proposal) *Effects transferred in and out:* Young and dry stock – to/from WRO Phase 1, Cows IWG (some) – to/from WRO	Yes	Yes	The proposal will see additional milking cows and land added to the dairy platform, which subsequently triggers Rule 20 in the proposed SWALP.
WW5	Dairy platform	*Effect transferred in:* Effluent – from WW3 Supplement – from Gladfield *Effects transferred in and out* Young stock – to/from WRO Dry stock – to/from WRO Young stock – to/from WRO Dry stock – to/from WRO Phase 1, Cows IWG (some) – to WRO and Gladfield (modelled)	Yes	Yes	The proposal will see additional milking cows and land added to the dairy platform, which subsequently triggers Rule 20 in the proposed SWALP.

Land and ownership	Use	Link to other parts of operation/ Effect transferred?	Essential to proposed farm system?	Part of landholding?	Justification for inclusion to landholding
Merrivale and Merriburn blocks – Owned by Woldwide Run-off Limited	Grazing and IWG of stock from all dairy platforms	Young stock are raised on WRO blocks up to the age of rising two years olds. This includes IWG. Dry stock are also grazed on the blocks.	Yes	Yes	Without the WRO the operation would not be able to operate as stated in the application. The application relies on stock being grazed on the block to keep losses lower on the dairy platform.
Cochranes Block – Owned by Woldwide Farm Limited	IWG of stock from WW1, WW2, WW3, WW4, WW5	Milking aged cows from all WW platforms are IWG here currently. Young stock and support stock are also IWG on this block.	Yes	Yes	To be converted into dairy pasture and split between WW4 and WW5 dairy platforms

Given the above, in my opinion, the landholding in terms of Rule 20 of the pSWLP is the entire Woldwide farming operation. It has common ownership, works together for a single business purpose, its individual farms cannot function without the others as currently operated and there is a transfer of environmental effects between the various farms. Simply put, stepping back and looking at the operation as a whole, it is not realistic to separate out the individual farms. As such, I consider that excluding the other blocks from the landholding for this application would not be consistent with the objectives and policies of the pSWLP, the intent of Rule 20, nor the definition of "landholding".

WW3 does not form part of this proposal, however the farming operations occurring under the "WW3" umbrella appear to be inherently linked with the farming activities which are subject to this proposal. Due to these factors, I have found it impossible to consider WW3 as separate from the other WW operations and therefore conclude it is part of the landholding for this proposal. My reasons for this determination are as follows:

- there is a clear transfer of effects between the landholding subject to this application and the operations occurring on WW3, with three key practices that make it difficult to argue that WW3, WW4 and WW5 are not operating as a "single operating unit" as defined in the pSWLP;

- WW3 holds discharge permit AUTH-301665-V2, which permits the discharge of dairy shed effluent to land from 1,000 cows. The discharge area for this platform is extensive and spans several properties including the WW3 dairy platform (owned by WW1), the WW5 dairy platform (owned and/or leased by WW5) and the Horner block (owned by WWFL and subject to a separate application);

- the discharge area authorised by AUTH-301665-V2 (held by WW3) overlaps with the discharge area for WW5 on the WW5 dairy platform. The activity requires the transfer of effluent, and by virtue nutrients from the WW3 to the WW5 platform, and consequently a transfer of effects from WW3 to WW5. WW5 can then utilise the additional nutrients to support pasture growth and supplement fertiliser requirements;

- the discharge of effluent on WW5 will also attribute to the contaminant loss from the property and hence the farming activity for WW5 also. A clear distinction cannot be made that would provide a valid reason for WW3 to be excluded from the same landholding as WW5 (and as a consequence WW4 and WRO) and the application is completely silent on this matter and does not attempt to provide any form of evidence;

- WW3 also utilises WRO for the grazing, including intensive winter grazing of young stock and dry stock and has utilised Cochrane's block (although unlawfully) for the same. The stock from WW3 are not kept separate from those from any of the other WW farms when located at WRO. WW3 relies on WRO to provide grazing largely for their young stock and without this land would either have to employ a third party grazier or purchase replacement stock. As such, this practice inherently forms part of their farming activity. As the stock from the various Woldwide properties at WRO are not kept separate there is no separation of goods and services offered by WRO to all the properties, nor is there a separation of effects from each "individual" farming activity. Consequently, this practice forms a single activity, and as such WRO is not utilised as a "single operating unit".

- It is also prudent to note that WW3 has the same ownership structure as WW4 and WW5, specifically at the director level and as such is under the same effective control by a structure of ownership such as a related group of companies, as the rest of the landholding subject to this application.

- finally, in relation to WW3, Rule 20(a)(2)and(3) of the pSWLP only permits farming if:
  - the dairy platform had a dairy effluent discharge permit on 3 June 2016 that specified a maximum number of cows; and
  - cow numbers have not increased beyond the maximum number specified in the dairy effluent discharge permit that existed on 3 June 2016;

- due to WW3 utilising WW5's platform, and the cows proposed to increase on WW5, WW3 inadvertently trips this part of the rule;

- in addition to rule 20, cows from WW3 are currently illegally IWG on Cochrane's block without the required GMPs, so in turn triggers consent under Rule 20.

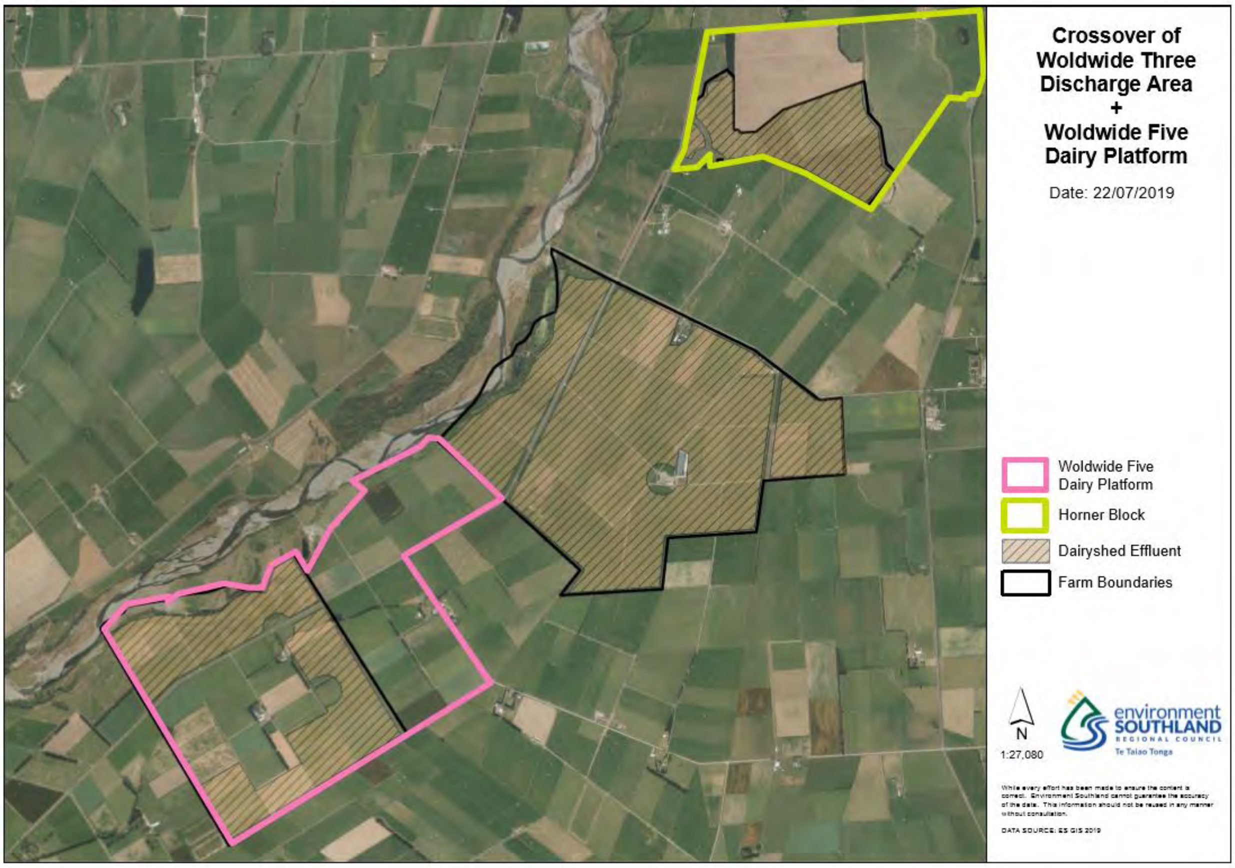

Figure 4.5.8: Woldwide Three Discharge Area

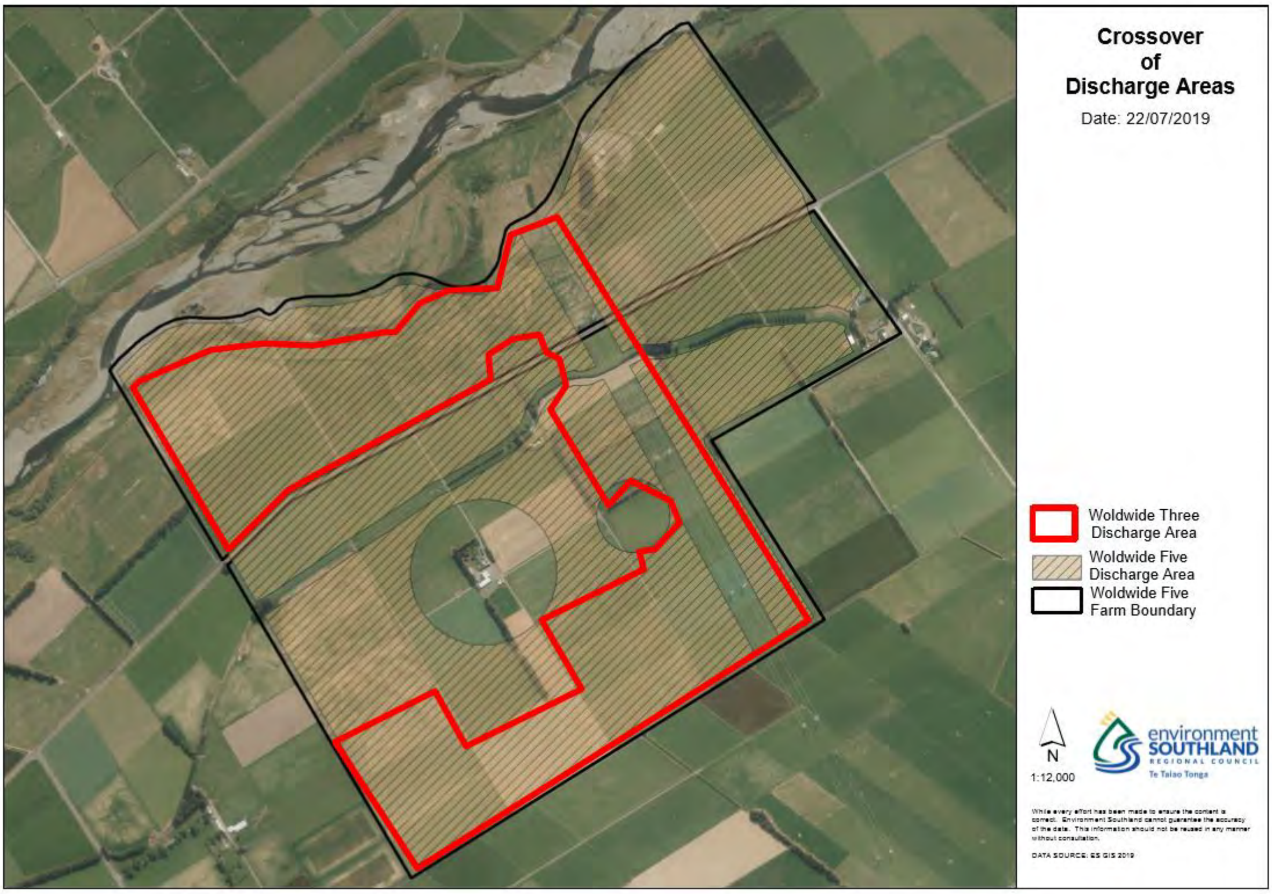

Figure 4.5.9: Overlap of WW3 and WW5 discharge areas

Aside from the other activities that are offered by WFL, there is no difference in links between all of the WW companies – for example, the links between WW1, WW2 and Horner block (subject to a separate but related application) and WW3, WW4, WW5 and WFL.

The application uses the same argument <u>for</u> joining WW1 and WW2 dairy platforms together into one landholding (despite the additional cow numbers only being added to WW1's side of the proposed operation), as it does to dismiss the other related blocks from the landholding. The proposed joining of WW1 and 2 platforms allows the applicants to "even out" and distribute losses over the two platforms (when the increased losses will only occur on one platform from the increase in cows) so the nutrient budgets show neutral or a decrease in losses, however, the application details that the two platforms that will be joined will still remain in separate ownership and at an operation level, will run completely independent of each other, with <u>no transfer of effects</u> between the two.

I also note that despite the majority of the application details that it is considered that WRO and Horner block are not in the landholding, the Horner block is considered part of WW2's farming platform under the current land use consent for "dairy farming" and the nutrient budget report for this application also considers the Horner block as part of the landholding.

In my view, it is not appropriate to effectively "pick and choose" when and how the "landholding" definition is able to be applied in this manner and when it is not, especially with such a high level of inconsistency within a single application. Aside from the other activities that are offered by WWFL, there is no difference in links between all of the companies – for example, the links between WW1 and WW2 and WW1 and WWFL. Using the applicants viewpoint on the landholding, if WWFL and WRO do <u>not</u> form part of the landholding for this operation, then WW1 and WW2 could not make up part of the same landholding either and the operations would need to be separated out into different land use applications for each dairy platform.

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22 August 2019

By Email: Aurora.Grant@es.govt.nz

Environment Southland
Attention: Aurora Grant

Dear Aurora

APP-20191140 Clarification of "Landholding" Issue

1 As you are aware, we act for the Applicants in the above applications. You are aware that a hearing date has been provided for these applications. We write to clarify the "landholding" issue discussed the 9 August meeting and to confirm that it does not give rise to any basis for any further delay. We choose to share this with you now, rather than at the hearing, in the hope that it will assist you with the preparation of your report, and to give you fair notice of our clients' approach.

2 We were a bit surprised to learn that at the 9 August meeting you put forward your view that all the various and dispersed land holdings of the various companies that also have Mr and Mrs De Wolde as directors are a single "landholding" for the purposes of Rule 20 of the PSRLWP. We also understand from your comments at the meeting that you will put this contention to the commissioners presumably with the view that further resource consents are required for this wider landholding and that the process should be further delayed, With respect, we consider there is no basis to support any contention other than that the landholdings are as identified in the applications and Assessments of Effects on the Environment. We explain further below.

Factual Basis

3 Fundamental to all issues concerning the processing of the applications before the Council is that the Council is limited to considering and granting what has actually been sought as part of those applications. That consists of the applications, the AEEs, any subsequent written amendments including in responses to Requests for Further Information under s92. If an applicant in practice goes beyond what was sought in the consent and this associated documentation, then that is a matter for the compliance arm of the Council[1] . The Council is not entitled to use the processing of a consent as an enforcement tool[2]. If you consider there are practices occurring that differ from what is identified in the applications and associated documentation, then that cannot, as a matter of law, alter the application. It simply means that if the application is granted, it is incumbent on the Applicant to ensure that the authorised activities occur in general accordance with the application and associated documents. Our view is therefore based exclusively on the application in its full sense as identified by the footnoted authorities (*Clevedon Protection Society* in particular), which should also be the case for the Council's view.

[1] *Clevedon Protection Society Inc v Warren Fowler Ltd* [1997] 3 ELRNZ 169 (EnvC), *Gillies Waiheke Ltd v Auckland CC* [2004] NZRMA 385 (CA)
[2] *Colonial Homes Ltd v Queenstown Lakes DC* W104/95 (PT)

Interpretation

4 We also understand that you place some considerable reliance on an opinion provided by Wynn Williams regarding the interpretation of the term "Landholding" (but then consider some of its conclusions are incorrect), and the decision of the commissioners in the *Adams* application. First, the *Adams* decision is nothing more than a decision by a consent authority on a very specific set of facts. It has no precedent effect and is certainly not binding on the commissioners who are going to determine this application. Second, we are unsure what the status of the Wynn Williams opinion was in that hearing. The Council was not a submitter, so the opinion cannot have been legal submissions for a submitter. We are unaware that it was commissioned as a report in accordance with s42A or met the other requirements of that section. In any event, we are aware that one of the commissioners in the current application is a lawyer with sufficient expertise to determine interpretation issues and would not need to defer to the expertise of the opinion's author. Third, we do have some reservations as to the approach taken by Wynn Williams to the interpretation of the definition, which we consider is wider than properly supported by the text itself, in the light of its purpose and the scheme and arrangement of the Proposed Southland Water and Land Plan (PSWLP) and the Resource Management Act (RMA) itself.

5 For ease of reference we set out the definition of "Landholding" in full:

(a) Any area of land, including land separated by a road or river or modified watercourse, held in one or more than one ownership, that is utilised as a single operating unit, and may include one or more certificates of title; except

(b) For land with a residential, commercial, industrial, infrastructural or recreational zoning or designation in the relevant district plan means any area of land comprised wholly of one Certificate of Title or any Allotment as defined by Section 218 of the RMA.

Note: *for the purposes of this definition, a "single operating unit" may include, but is not limited by, the following features:*

(a) It has effective control by any structure of ownership of the same group of people (for example, land that is controlled by a family trust, or beneficiaries of that family trust or a related group of companies, or an estate, or partner, or individual/s or a combination of); and

(b) It is operated as a single business entity.

6 The approach to interpreting subordinate legislation (which includes a regional plan) under the Resource Management Act 1991 is subject to the principles of the Interpretation Act 1999[3].

The Text Itself

7 The starting point is the plain and ordinary meaning of the text. It is only to be departed from if it would be clearly contrary to the statutory purpose or social policy behind the plan and its rules[4]. It is to be assumed that the choice of the particular words in the definition above was deliberate. They have a specific meaning:

8 A number of things emerge from the text itself:

8.1 The text refers to an area of land, singular. That is reinforced by the express words "single" and "unit";

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[3] *Spackman v Queenstown Lakes DC* [2007] NZRMA 327 (HC)

[4] *Re an Application by Millbrook Country Club Ltd* EnvC C045/97, *Powell v Dunedin CC* [2004] 3 NZLR 721(CA).

8.2 It expressly includes land separated by a road, river or artificial watercourse, but nothing more;

8.3 There is no limitation of the purpose for which it is operated as a unit, such as only for nutrient management purposes.

9 The definition effectively has two parts:

9.1 One single area of land, which can have a road, river or artificial watercourse running through it and can be held in more than one title; **and**

9.2 It must be operated as a "single operating unit".

10 If only the first or only the second requirement is met, but not both, it does not fall within the definition of "landholding". The first requirement strongly suggests a single area of land, separated only by title boundaries, roads, rivers or drains. It in no way contemplates or provides for multiple areas separated by more than simply a road, river or artificial drain to be a single "landholding". The second requirement suggests something that is, when considered overall, in the normal sense of the words, "a single operating unit". It does not restrict it to one aspect, such as nutrient management or definition to suggest that "a single operating unit" is intended to denote something that is used as a unit for a specific purpose, like for instance nutrient management. That is reinforced by clause (b) of the Note, which specifies that it may include something operated as a "single business entity". The words are to be given their plain and ordinary meaning.

11 The "note" relates only to the second requirement. It has no influence over the first. It is distinguished as not being part of the actual definition, but is provided by way of some guidance, which is by no means determinative or exhaustive. Important are the words "may include" and "but is not limited by", as well as the fact that there are two clauses (a) and (b), which are separated by the word "and", not "or", with the latter clause requiring the establishment of a "single business entity". They indicate that the mere fact that certain parcels may be owned by connected companies or be under the effective control of the same people should not of itself be taken as establishing that they form part of a single operating unit, much less that they are one "landholding", because:

11.1 If (a) in the note can be made out on its own, that is not enough, (b) also has to be made out;

11.2 In any event, even if both parts of the note are made out, it then "may" only be a single operating unit;

11.3 Even if both can be made out, they still do not establish that part (a) of the definition is made out, because the note clearly does not relate to that part.

Purpose, Scheme and Arrangement

12 The meaning is also to be derived from the purpose and indicators of meaning include the scheme and arrangement of the enactment[5]. Absurd or unworkable meanings are to be avoided.

13 The purpose of this definition is simply to give certainty to the term "landholding" used in over 20 provisions in this plan, only one of which is Rule 20. **Attached** is a document setting out each such provision. One cannot properly understand that purpose without looking at all of those provisions. With respect to Wynn Williams, our reservations as to its conclusions are based on the fact that it really only focused on Rule 20 and did not consider these other critical uses of the same term.

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[5] Sections 5(2)&(3) Interpretation Act 1999, *Powell v Dunedin CC* [2004] 3 NZLR 721 (CA), *Queenstown River Surfing Ltd v Central Otago DC* [2006] NZRMA 1 (EnvC)

14 We note that none of the objectives relies on the term. There is only one policy that uses it, namely Policy 12A, which uses it interchangeably with "site". There is nothing in that policy that suggests, much less requires, that it refers to a wide range of geographically dispersed titles that happen to have some links between those who control the companies that own them. Rather, it suggests a single area within the same location.

15 There are no objectives or policies that provide any indication that the word "landholding" is intended to be used to control possible connections between activities on one site and effects on a different site in a different area. Indeed, Rule 20 does not necessarily require that and importantly, none of the other contexts in which "landholding" is used suggest or require that.

16 On the contrary, there are a number of provisions that would be undermined or unworkable if it were given a meaning other than the plain meaning we address above. Examples are:

16.1 Rules 26 and 43: Septic tanks and Farm landfills. A group of companies with sufficient connection could create one large farm landfill on a property owned by one of these companies, to take all the rubbish or domestic effluent from all the properties, as being from the "same landholding";

16.2 The definition of Cleanfill site would become rather wider than it appears to have been intended to mean, as would be the case for "on-site wastewater system";

16.3 Rules 49 and 54 would both become completely unworkable, because they would effectively apply the permitted water take volumes as a maximum across all properties that had common directors and/or shareholders, irrespective of their location and whether they actually formed one physical unit.

17 Also significant is that the relevant definition, which is contained in clause (a) of the definition itself (as opposed to clause (a) of the note) is followed by clause (b), which makes it clear that this definition only applies to rural production land, while for all other land, whether it is part of the same "allotment" or "title" is determinative. That suggests again a physical proximity and one actual physical unit.

18 When all of these matters are properly considered, then it becomes clear that the true purpose of the definition was to acknowledge the reality that often a single "farm" can cover more than one title boundary and can even straddle a road, river or drain. That is both:

18.1 Restrictive, for example, to ensure that limits on permitted activities (e.g. Rules 20, 49 and 54) cannot be circumvented by subdividing the same farm into a number of titles to be vested in separate companies;

18.2 Enabling, for example to ensure that a person who runs a single farm on two adjacent lots can use a single rubbish pit for the entire property (e.g. Rule 43), or does not need to adhere to setbacks from title boundaries within the actual farm (e.g. Rule 35A(iii)(4), Rule 41(iii)(2)).

Other Considerations

19 A regional plan is subordinate legislation. It cannot amend an Act of Parliament. Both the Companies Act and s2 of the RMA, in its definition of "person", uphold the separate legal status of companies as "persons" in their own right. One should be very reticent to read into provisions of subordinate legislation meanings that undermine that separate legal personality and ignore the fact that groups of parcels are owned by separate legal persons.

Proper Meaning

20 The proper meaning is really that "landholding" denotes one single physical "farm". Whether it is or is not is primarily a matter of fact. A person alleging that it is a single landholding must establish that:

20.1 There is one single area of land;

20.2 Only separated by a title boundary, river, artificial drain or road;

20.3 That constitutes a single operating unit;

20.4 It is controlled by a structure of ownership of the same group of people;

20.5 It is also operated as a single business entity.

21 Because of the word “may” in the note to the definition, if all of these matters can be made out, then the area of land “may” be a single landholding. If one of them cannot be made out, then it cannot be a single “landholding”.

Application to the Facts

22 As indicated above, the consent authority’s role when determining applications for resource consents is quite distinct from, and occurs on a different basis to, its enforcement role. The consent authority is required to assess an application submitted in paper, with such additional information as is provided in paper by amending the application or answering requests for further information under s92, and evidence in writing or given orally, at a consent hearing. This information addresses something that is intended to occur in future, once the consents are granted and commence.

23 What the Council has before it is:

23.1 Multiple resource consent applications;

23.2 By four separate legal persons;

23.3 To authorise activities required to undertake four distinct dairy platforms, of which only two (WW1 & WW2) are sufficiently connected to be treated as a single landholding;

23.4 Each owned by a separate company;

23.5 Operated as independent business units.

24 There is no application relating to the independent landholding known as “Woldwide 3”.

25 It should be noted that the Applicants have openly sought to have two properties (WW1 & WW2) processed as forming part of one “landholding”. The Applicants have been co-operative and pragmatic in this regard. We are unaware of any information properly before the Consent Authority that would enable you to demonstrate that they have been misleading as to this aspect of any of the other the applications.

26 They have assessed parts of the runoff block some 20 km distant as part of the same “landholding” as the three respective units. However, we are informed that this was done only to provide you with the information you indicated you required in order for the applications to progress. We do note that in the *Adams* decision the Commissioners noted that they could also take into account consequential effects. Either way, the effects that may arise on other landholdings have been properly addressed. The Commissioners have all the information they require in order to assess the effects of the proposals before them. There is no basis for a further delay on this issue.

27 The proper application of the facts as properly before the consent authority for the purposes of these applications is that these applications relate to no less than three distinct “landholdings”, but that the applicants have agreed to have two of them treated as a single landholding at ES’s request. Please also note that it is up to the Applicants to ensure that all the information is correct, as it is they who bear the risk of either enforcement action if they depart from the

application or a review under s128(1)(c) if the information they provided as part of the application was inaccurate.

28 If you wish to contend that all of the individual Woldwide farms (One, Two Three, Four and Five, or any other properties for that matter) form one "landholding", the burden lies on you to establish that, based on the applications properly before the consent authority, which states and establishes that not less than three landholdings form part of these applications. You will have to establish all five of the matters in paragraph 20 from the application information. That information excludes this possibility.

Issues Arising

29 We trust that the above analysis will demonstrate that the matters you raised in your recent meeting with our clients cannot properly establish that all of the separating operating units are one single landholdings. We do not propose to respond to all of them, but we deal with a few of them to illustrate this point:

29.1 We acknowledge that there is a significant overlap between ownership and directorship of the distinct companies that own each separate unit. Only in the case of WW1 and WW2 is there an acceptance that these two should be treated as a single landholding for the purposes of these applications. However, neither these applicants, nor the other applicants have in any way reqeusted or agreed that all independent units with an overlap in directors and shareholdings can or should be treated as a single landholding. The applicants for WW4 and WW5 have indicated that there is a connection, but these applications make it clear that they neither seek nor agree to be assessed as part of the same landholding. Their indication of a connection does not of itself show that the effective control is not at the management level of the two independent operating units that are WW4 and WW5, much less that none of the other Woldwide properties have such autonomous management and control. Even if you could establish that, then you would still need to establish that all the individual farms are one "operating unit", including that the companies are operated as a single business entity. The information properly before the Council does not allow that conclusion. Even if that were established you would then need to establish that this is a single area of land, which is not possible. All these issues become evident from our analysis at and preceding paragraph 20 above.

29.2 There are some minor overlaps between the resource consents of some of the separate units. However, this does not establish that all the separate farms are indeed one landholding. There is nothing to suggest that for example, two separate operating units cannot rely on the same resource consent. The practice of "global consents" for, for example, stormwater discharges, demonstrates this well. It is also fairly common for someone other than the land owner to hold a consent to undertake a particular activity on a part of a property, that is not part of the operations of the owner of that property. In any event, in relation to the ability to dispose of some of the effluent from WW3 on WW5, this has never been given effect, which illustrates clearly that these are separate and autonomous units. This issue cannot establish even one, let alone all of the matters in paragraph 20.

29.3 While there are arrangements between individual companies within the associated group as to grazing, this is far from something that establishes that all units are therefore one single unit. It is very commonplace for the owners of quite distinct units, who have some connection and who are in the same general area, to enter into arrangements with each for wintering or grazing of some stock. This does not make them part of the same operating unit. Taking that approach almost amounts to reading into the definition a requirement that such arrangements can only be entered into between complete strangers who have no connection with each other. It is simply efficient and normal farming practice that the managers of the distinct units, who know each other, enter into such arrangements with each other. That does not render them part of the same operating unit. It certainly does not establish all the matters in paragraph 20.

29.4 While WW3, WW4 and WW5 are neighbouring properties, that again is not proof that all three, or any combination of two of them, are a single area of land operated as a single operating unit. The application information makes it clear that they are actually each independent operating units. Again, the proximity of these properties does not establish all of the matters that must be established in the definition, as set out in paragraph 20.

The Way Forward

30 We trust that the above has made it clear that these applications are not capable of being treated as applications that all relate to a single landholding. Importantly, we consider that this analysis addresses that issue and cannot form any basis for any further delay of the hearing, nor does it provide a proper basis for a recommendation for refusal of the consents. In particular, we address the sections which may arise in relation to possible further delays:

30.1 Section 21, which requires the Council to avoid unreasonable delay;

30.2 Section 91, which makes it clear that a decision not to proceed with the hearing under that section can only occur if there are reasonable grounds to believe that other resource consents will be required for the proposal to which the application relates, and these applications will lead to a better understanding of the proposal. First, the proposal includes nothing for which additional consents would be required.[6] Second, the consent authority now has all the information before it that it would reasonably require to understand the effects of the proposal;

30.3 Section 91A, which, as we have already indicated, can only be exercised at the applicant's request. That request is not made by these applicants;

30.4 Section 92, which commences with the words "at any reasonable time before the hearing". It is particularly surprising that this matter has only been raised at this very late stage, given how long the applications have already been before the Council and the fact that they were receipted and notified without any mention of this issue. This is not a "reasonable time". We also remind you that s92 is not to be used for ulterior purposes[7]. For completeness, we do not consider that it would be necessary to commission a further report on this issue, such as for example a further Wynn Williams opinion. The Panel includes a very experienced and senior specialist Resource Management and Public Law Barrister whom we would not expect to require advice from Wynn Williams on the interpretation issues above.

30.5 Section 88C, which excludes the ability to suspend the processing timeframes at this stage of processing;

30.6 Section 36(5), which makes it clear that any additional charges over and above fixed fees payable for the application, must be "actual and reasonable costs in respect of the matter concerned". We do not consider that any further cost incurred by the consent authority in commissioning a further report or endeavouring to establish the "single landholding" issue as a grounds for refusal or delay, would be actual or reasonable. This is particularly so where the Panel, whose costs the Applicants have to bear, already includes someone who has all the expertise that might be required to make a ruling on this matter, without further advice.

31 We would expect therefore that this letter will satisfy your concerns about the application of the term "landholding" and clarify that there are no grounds for any further delays.

[6] It is acknowledged that the current operation on WW2 does include a monitoring bore (E45/0622) that has been found to require an upgrade to comply with the applicable permitted activity rule. ES has confirmed that this is not an issue that is sufficiently connected with the effects of the proposal to warrant deferral of the hearing.

[7] *Reuters Homes Ltd v Wanganui DC* [2011] NZRMA 357 (HC)

32 We do wish to record that nowhere in the entire policy framework is there a blanket prohibition on or discouragement of increases in cow numbers per se. It was open to the Council to insert provisions with that express approach, if that had been the most appropriate means of giving effect to the superior planning framework as per the tests in s32. What has instead been chosen quite deliberately is a strong direction not to authorise increases in cow numbers only in certain circumstances. If consents are granted for a proposal that results in an increase in cow numbers because (amongst other reasons) this is shown not to give rise to the circumstances in which such an increase is to be avoided, then the policy direction of both the PSLWP and the superior documents and legislative provisions to which it must give effect will have been achieved. Our clients simply seek a fair opportunity to demonstrate through evidence before the hearing commissioners that these proposal does not result in the circumstances in which increases in cow numbers are discouraged, but achieves outcomes that are in line with the policy framework and overarching legislative requirements.

33 We trust this will assist you with the preparation of your s42A report.

Yours sincerely

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Cc: The Hearings Commissioners (APP-20191052 & 20191140)

2. having particular regard to adverse effects on water quality from contaminants transported via deep drainage, and overland flow where relevant when assessing resource consent applications and preparing or considering Farm Environmental Management Plans; and

3. decision makers generally not granting resource consents for additional dairy farming of cows or additional intensive winter grazing where contaminant losses will increase as a result of the proposed activity.

Policy 12A – Improved physiographic zone information

Where site specific information is available that better identifies or delineates the relevant physiographic zones or contaminant loss pathways for a landholding or site, that information must be taken into account when undertaking activities, preparing Farm Environmental Management Plans or when determining resource consent applications for that landholding or site.

Rule 13 – Discharge from subsurface drainage systems

(a) The discharge of land drainage water to water from an on-farm subsurface drainage system is a permitted activity, provided the following conditions are met:
- (i) the discharge does not cause:
  - (1) a conspicuous change to the colour or clarity of the receiving waters beyond 20 metres from the point of discharge; or
  - (2) conspicuous oil or grease films, scrums or foams, or floatable or suspended materials beyond 20 metres from the point of discharge; and
- (ii) the discharge does not render freshwater unsuitable for consumption by farm animals; and
- (iii) the discharge does not cause the flooding of any other landholding; and
- (iv) the discharge does not cause any scouring or erosion of any land or bed of a water body beyond the point of discharge; and
- (vi) the discharge does not cause any significant adverse effects on aquatic life; and
- (vii) the subsurface drainage system does not drain a natural wetland; and
- (viii) for any known existing drains and for any new drains, the locations of the drain outlets are mapped and provided to the Southland Regional Council on request.

(b) The discharge of land drainage water to water from an on-farm subsurface drainage system that does not comply with Rule 13(a) is a discretionary activity.

Rule 14 – Discharge of fertiliser

(a) The discharge of fertiliser onto or into land in circumstances where contaminants may enter water is a permitted activity provided the following conditions are met:
- (i) other than for incidental discharges of windblown fertiliser dust, there is no direct discharge of fertiliser into a lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, or natural wetland or into groundwater; and
- (ii) there is no fertiliser discharged when the soil moisture exceeds field capacity; and
- (iii) there is no fertiliser discharged directly into or within 3 metres of the boundary of any significant indigenous biodiversity site identified in a district plan that includes surface water; and
- (iv) where a lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse or wetland:
  - (1) has riparian planting from which stock is excluded, fertiliser may be discharged up to the paddock-side edge of the riparian planting but not onto the riparian planting, except for fertiliser required to establish the planting; or
  - (2) does not have riparian planting from which stock is excluded, fertiliser is not discharged directly into or within 3 metres of the bed or within 3 metres of a wetland.

(b) The discharge of fertiliser onto or into land in circumstances where the fertiliser may enter water that does not meet the conditions of Rule 14(a) is a non-complying activity.

Rule 15 – Discharge of stormwater

(a) The discharge of stormwater onto or into land in circumstances where contaminants may enter water, or into a lake, river, artificial watercourse, modified watercourse or wetland, is a permitted activity provided the following conditions are met:
- (i) the discharge is not from a reticulated system; and
- (ii) the discharge does not originate from industrial or trade premises where hazardous substances are stored or used unless:

watercourse, modified watercourse or wetland, as a result of aquifer testing, is a permitted activity provided the following conditions are met:

(i) the discharge does not cause flooding of any other person's property, erosion of the bed or banks of the receiving waterbody or land instability; and

(ii) where the discharge is to water, there is no conspicuous change to colour and clarity of the receiving waters at a distance of 20 metres from the point of discharge.

Rule 17 – Dust Suppressants

(a) The discharge of a dust suppressant onto or into land in circumstances where a contaminant may enter water is a permitted activity, provided one of the following conditions are met:

(i) the dust suppressant is not a hazardous substance; or

(ii) the dust suppressant is approved under the Hazardous Substances and New Organisms Act 1996 and the use and discharge of the dust suppressant is undertaken in accordance with all conditions of the approval.

(b) The discharge of a dust suppressant onto or into land in circumstances where a contaminant may enter water that does not meet the conditions in Rule 17(a) is a discretionary activity.

Rule 18 – Discharge of water from purging of instruments at a water treatment plant and portable potable water treatment units

(a) The discharge of water containing contaminants from the purging of instruments at a water treatment plant and from the use of portable potable water treatment units onto or into land in circumstances where contaminants may enter water is a permitted activity, provided the following conditions are met:

(i) the volume of water discharged does not exceed 3 cubic metres per day; and

(ii) the concentration of chlorine does not exceed 2 milligrams per litre; and

(iii) the pH of the discharge is between 6 and 8; and

(iv) the discharge does not result in overland flow to surface water or beyond the landholding boundary, or ponding.

Rule 18A – Discharges from emergency fire-fighting

(a) The discharge of water or contaminants associated with emergency fire-fighting activities into a lake, river, artificial watercourse, modified watercourse or wetland, or onto or into land in circumstances where the water or contaminants may enter water is a permitted activity.

Rule 18B – Discharges from emergency response training activities

(a) The discharge of water or contaminants associated with emergency response training activities undertaken by Fire and Emergency New Zealand, the Department of Conservation, New Zealand Defence Force or a local authority into a lake, river, artificial watercourse, modified watercourse or wetland, or onto or into land in circumstances where the water or contaminant may enter water, is a permitted activity provided the following conditions are met:

(i) the discharge does not give rise to any of the following effects in a lake, river, artificial watercourse, modified watercourse or wetland:

(1) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; or

(2) any conspicuous change in visual clarity; or

(3) the rendering of freshwater unsuitable for consumption by farm animals; or
(4) any significant adverse effects on aquatic life; and

(ii) the discharge does not occur to a lake, river, artificial watercourse, modified watercourse or wetland for more than two continuous hours within a 24-hour period; and

(iii) the discharge of fire-fighting foam or powder (whether mixed with water or not) does not occur directly to a lake, river, artificial watercourse, modified watercourse or natural wetland.

Rule 19 – Discharge of water associated with water treatment processes

(a) The discharge of water containing contaminants associated with water treatment processes from a water treatment plant onto or into land in circumstances where water containing contaminants may enter water is a controlled activity, provided the following conditions are met:

(i) the associated water take does not exceed 7,500 cubic metres per day; and

(ii) the discharged volume of water containing contaminants does not exceed 8% of the daily water take; and

(iii) at the boundary of the reasonable mixing zone the discharge does not give rise to any or all of the following effects in the receiving water:
(1) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; or
(2) any conspicuous change in visual clarity; or
(3) the rendering of freshwater unsuitable for consumption by farm animals; or
(4) any significant adverse effects on aquatic life; and

(iv) at the boundary of the reasonable mixing zone the discharge does not reduce the water quality below any standards set for the relevant receiving water body in Appendix E "Water Quality Standards".

The Southland Regional Council will reserve the exercise of its control to the following matters:

1. the assimilative capacity and drainage characteristics of the soil;
1a. adverse effects on the soil;
2. compliance with the ANZECC Guidelines for Fresh and Marine Water Quality (2000);
3. the separation distance of the discharge from surface water bodies, artificial watercourses, subsurface drains, the coastal marine area, residential dwellings, landholding boundaries and drinking water sources;
4. management of the discharge, including discharge methods.

Land Use Rules

Rule 20 – Farming

(aa) Unless stated otherwise by Rules 20, 25, 70 or any other rule in this Plan:

(i) intensive winter grazing; or

(ii) cultivation; or

(iii) the disturbance by livestock including cattle, deer, pigs or sheep;

in, on or over the bed of an ephemeral river is a permitted activity.

(a) The use of land for a farming activity is a permitted activity provided the following conditions are met:

(i) the landholding is less than 20 hectares in area; or

(ii) where the farming activity includes a dairy platform on the landholding, the following conditions are met:

(1) the dairy platform has a maximum of 20 cows; or

(2) the dairy platform had a dairy effluent discharge permit on 3 June 2016 that specified a maximum number of cows; and

(3) cow numbers have not increased beyond the maximum number specified in the dairy effluent discharge permit that existed on 3 June 2016; and

(4) from 1 May 2019, a Farm Environmental Management Plan for the landholding is prepared and implemented in accordance with Appendix N; and

(5) the landowner provides to the Southland Regional Council on request:

(A) a written record of the good management practices, including any newly instigated good management practices in the preceding 12 months, occurring on the landholding; and

(B) the Farm Environmental Management Plan prepared in accordance with Appendix N; and

(6) the land area of the dairy platform is no greater than at 3 June 2016; and

(7) no part of the dairy platform is at an altitude greater than 800 metres above mean sea level; and

(iii) where the farming activity includes intensive winter grazing on the landholding, the following conditions are met:

(1) from 1 May 2019, intensive winter grazing does not occur on more than 15% of the area of the landholding or 100 hectares, whichever is the lesser; and

(2) from 1 May 2019, a Farm Environmental Management Plan for the landholding is prepared and implemented in accordance with Appendix N; and

(3) from 1 May 2019, all of the following practices are implemented:

(A) if the area to be grazed is located on sloping ground, stock are progressively grazed (break-fed or block-fed) from the top of the slope to the bottom, or a 20 metre 'last-bite' strip is left at the base of the slope; and

(B) when the area is being break-fed or block-fed, the stock (excluding sheep and deer) are back fenced to prevent stock entering previously grazed areas; and

(C) transportable water trough(s) are provided in or near the area being grazed to prevent stock accessing a lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse or natural wetland for drinking water; and

(D) if supplementary feed (including baleage, straw or hay) is used in the area being grazed it is placed in portable feeders; and

(E) if cattle or deer are being grazed the mob size being grazed is no more than 120 cattle or 250 deer; and

(F) critical source areas (including swales) within the area being grazed that accumulate runoff from adjacent flats and slopes are grazed last; and

(4) from 1 May 2019, a vegetated strip is maintained in, and stock excluded from, the area between the outer edge of the bed of any lake, river (excluding ephemeral rivers where intensive winter grazing is permitted under Rule 20(aa)), artificial watercourse, modified watercourse or natural wetland for a distance of at least 5 metres; and

(5) from 1 May 2019, intensive winter grazing does not occur within 20 metres of the outer edge of the bed of any Regionally Significant Wetland or Sensitive Waterbodies listed in Appendix A, estuary or the coastal marine area; and

(6) no intensive winter grazing occurs at an altitude greater than 800 metres above mean sea level; and

(iv) for all other farming activities, from 1 May 2020 a Farm Environmental Management Plan is prepared and implemented in accordance with Appendix N.

(b) The use of land for a farming activity that includes intensive winter grazing on the landholding and which meets all conditions of Rule 20(a) other than condition (iii)(3) is a permitted activity, provided that:

(i) from 1 May 2019, a vegetated strip is maintained in, and stock excluded from, the area between the outer edge of the bed of any lake, river (excluding ephemeral rivers where intensive winter grazing is permitted under Rule 20(aa)), artificial watercourse, modified watercourse or natural wetland for a distance of at least 20 metres.

(c) Despite any other rule in this Plan, the use of land for a dairy platform or intensive winter grazing at an altitude greater than 800 metres above mean sea level is a prohibited activity.

(d) The use of land for a farming activity that meets all conditions of Rule 20(a) other than (ii), (iii)(1),(iii)(4) or (iii)(5) or does not meet condition (i) of Rule 20(b) is a restricted discretionary activity, provided the following conditions are met:

(i) a Farm Environmental Management Plan is prepared and implemented in accordance with Appendix N; and

(ii) the application includes the following material, prepared by a suitably qualified person:

(1) an assessment that shows that the annual amount of nitrogen, phosphorus, sediment and microbiological contaminants discharged from the landholding will be no greater than that which was lawfully discharged annually on average for the five years prior to the application being made; and

(2) for any mitigation proposed, a detailed mitigation plan (taking into account contaminant loss pathways) that identifies the mitigation or actions to be undertaken including any physical works to be completed, their timing, operation and their potential effectiveness.

The Southland Regional Council will restrict the exercise of its discretion to the following matters:

1. the quality of and compliance with the Farm Environmental Management Plan for the landholding;
2. whether the assessment undertaken under Rule20(d)(ii) above takes into account reasonable and appropriate good management practices to minimise the losses of contaminants from the existing farming activity;
3. good management practices to be undertaken, including those to minimise the discharge of nitrogen, phosphorus, sediment and microbiological contaminants to water from the use of land, taking into account contaminant loss pathways;

4. the potential benefits of the activity to the applicant, the community and the environment;
5. the potential effects of the farming activity on surface and groundwater quality and sources of drinking water;
6. monitoring and reporting undertaken to assess the effectiveness of any mitigation implemented.

(e) The use of land for a farming activity that is not specified as a permitted, restricted discretionary or prohibited activity under Rule 20(d) is a discretionary activity.

Rule 24 – Incidental discharges from farming

(a) The discharge of nitrogen, phosphorus, sediment or microbial contaminants onto or into land in circumstances that may result in a contaminant entering water that would otherwise contravene section 15(1) of the RMA is a permitted activity, provided the following conditions are met:
  (i) the land use activity associated with the discharge is authorised under Rules 20, 25 or 70 of this Plan; and
  (ii) any discharge of a contaminant resulting from any activity permitted by Rules 20, 25 or 70 is managed to ensure that after reasonable mixing it does not give rise to any of the following effects on receiving waters:
    (1) any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; or
    (2) any conspicuous change in the colour or visual clarity; or
    (3) the rendering of fresh water unsuitable for consumption by farm animals; or
    (4) any significant adverse effects on aquatic life.

(b) the discharge of nitrogen, phosphorus, sediment and microbial contaminants onto or into land in circumstances that may result in a contaminant entering water that would otherwise contravene section 15(1) of the RMA and that does not meet one or more of the conditions of Rule 24(a) is a non-complying activity.

Rule 25 – Cultivation

(a) The use of land for cultivation is a permitted activity provided the following conditions are met:
  (i) cultivation does not take place within the bed of a lake, river (excluding ephemeral rivers where cultivation is permitted under Rule 20(aa)), artificial watercourse, modified watercourse or natural wetland; and
  (ii) cultivation does not take place within a distance of 5 metres from the outer edge of the bed of a lake, river (excluding ephemeral rivers where cultivation is permitted under Rule 20(aa)) artificial watercourse, modified watercourse or wetland and
  (iii) cultivation does not occur at an altitude greater than 800 metres above mean sea level; and
  (iv) cultivation does not occur on land with a slope greater than 20 degrees.[7]

(b) The use of land for cultivation that does not meet the setback distance of Rule 25(a)(ii) is a permitted activity provided the following conditions are met:
  (i) cultivation does not take place within the bed of a lake, river (excluding ephemeral rivers where cultivation is permitted under Rule 20(aa)), artificial watercourse, modified

[7] Slope in Rule 25(a)(iv) is the average slope over any 20 metre distance.

Wastewater, Effluent and Sludge

Rule 26 – Discharges from on-site wastewater systems

(a) The discharge of treated domestic wastewater from an existing on-site wastewater system onto or into land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
  (i) the on-site wastewater system had been installed and was operational prior to 3 June 2016; and
  (ii) the discharge does not exceed 1,250 litres per day, averaged over a period of 31 days; and
  (iii) the discharge consists only of contaminants normally associated with domestic wastewater; and
  (iv) the on-site wastewater system is not used for the disposal of wastewater from chemical toilets; and
  (v) there is no faecal contamination of any take of water for human consumption as a result of the discharge; and
  (vi) there is no discharge above the soil surface; and
  (vii) there is no direct discharge to groundwater or a lake, river, artificial watercourse, modified watercourse or natural wetland including discharge via subsurface drainage systems, stormwater drains, artificial free draining areas such as soak holes and overland flow; and
  (viii) the inflow or infiltration of stormwater, other surface water and groundwater to the system is minimised; and
  (ix) the discharge does not occur within the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J.

(b) The discharge of treated domestic wastewater from a new on-site wastewater system or a replacement of an existing system onto or into land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
  (ia) the discharge does not exceed 2,000 litres per day, averaged over any consecutive 7-day period; and
  (i) the treatment and disposal system is designed and installed in accordance with Sections 5 and 6 of New Zealand Standard AS/NZS 1547:2012 – On-site Domestic Wastewater Management; and
  (ii) the treatment and disposal system is operated and maintained in accordance with the system's design specification for maintenance or, if there is no design specification for maintenance, Section 6.3 of New Zealand Standard AS/NZS 1547:2012 – On-site Domestic Wastewater Management; and
  (iii) there is no discharge above the soil surface; and
  (iv) the discharge consists only of contaminants normally associated with domestic wastewater; and
  (v) the on-site wastewater system is not used for the disposal of wastewater from chemical toilets; and
  (vi) the discharge is not within:
    (1) 20 metres of a lake, river, artificial watercourse, modified watercourse or natural wetland excluding interception drains constructed to enable the effective operation of the on-site wastewater system; or
    (2) 50 metres of the coastal marine area or any natural state waters; or
    (3) 50 metres of any bore or well; or

(4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or

(5) 20 metres of any subsurface drainage system, excluding subsurface drainage systems constructed to enable the effective operation of the on-site wastewater system.

(vii) for any land application system, the bottom of the soil infiltration surface is no less than 900 millimetres above the mean seasonal high groundwater table and any perched water.

(c) The discharge of treated domestic wastewater from an on-site wastewater system onto or into land in circumstances where a contaminant may enter water that does not meet the conditions of Rule 26(a) or (b) is a discretionary activity.

(d) The discharge of septage onto or into land, in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:

(i) the discharge occurs on the same landholding as the on-site wastewater system is located; and

(ii) the discharge consists only of contaminants normally associated with domestic wastewater; and

(iii) the on-site wastewater system is not used for the disposal of wastewater from chemical toilets; and

(iv) there is no faecal contamination of any take of water for human consumption as a result of the discharge; and

(v) the maximum depth of septage application is 7 mm; and

(vi) no other effluent is discharged to the septage application area for 28 days before and 28 days after the septage application; and

(vii) the discharge onto or into land does not occur at a location where overland flow will result in contaminants reaching lakes, rivers, artificial watercourses, modified watercourses, natural wetlands or the coastal marine area; and

(viii) the discharge is not within:

(1) 20 metres of a lake, river, artificial watercourse, modified watercourse or natural wetland; or

(2) 50 metres of the coastal marine area or any natural state waters; or

(3) 100 metres of any bore or well; or

(4) 100 metres of any landholding boundary; or

(5) 200 metres of any school, marae, or residential dwelling other than residential dwellings on the landholding; or

(6) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; and

(ix) there is no direct discharge to groundwater or a lake, river, artificial watercourse, modified watercourse or natural wetland including discharge via subsurface drainage systems, stormwater drains, artificial free draining areas such as soak holes, or overland flow; and

(xi) the discharge does not occur on a site less than 100 hectares in area.

(e) The discharge of septage into or onto land that does not meet the conditions of Rule 26(d) is a discretionary activity.

(f) Despite Rule 26(a) to (e), the discharge of untreated domestic wastewater or effluent from mobile toilets, into a lake, river, artificial watercourse, modified watercourse or natural wetland or groundwater is a prohibited activity.

Rule 27 – Discharges from pit toilets

(a) Notwithstanding Rule 26, the discharge of contaminants from a pit toilet onto or into land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
   (i) the discharge does not exceed 320 litres per week; and
   (ii) the discharge comprises only contaminants normally associated with human excreta; and
   (iii) the pit toilet is not used for the disposal of wastewater from chemical toilets; and
   (iv) there is no faecal contamination of any take of water for human consumption as a result of the discharge; and
   (v) the discharge is not within:
      (1) 20 metres of a lake, river, artificial watercourse, modified watercourse or natural wetland, excluding interception drains which benefit the pit toilet; or
      (2) 50 metres of the coastal marine area or any natural state waters; or
      (3) 50 metres of any bore or well; or
      (4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or
      (5) a site that is zoned for residential, commercial or industrial purposes in any district plan; and
   (vi) there is no direct discharge above the soil surface, or to groundwater or to a lake, river, artificial watercourse, modified watercourse or natural wetland, including discharge via subsurface drainage systems, stormwater drains, artificial free draining areas such as soak holes or overland flow; and
   (vii) the soil type does not comprise gravels, coarse or medium sands, fissured rock, or other such materials likely to permit the free travel of contaminants away from the pit; and
   (viii) stormwater or other surface water is prevented from entering the pit toilet; and
   (ix) the discharge does not accumulate within 500 millimetres of the land surface; and
   (x) for any new pit toilet that has been installed and was operational on 3 June 2016 or later, the bottom of the pit is not less than 900 millimetres above the mean seasonal high groundwater table.

(b) The discharge of contaminants from a pit toilet onto or into land, in circumstances where a contaminant may enter water does not meet the conditions of Rule 27(a) is a discretionary activity.

Rule 28 – Discharges of liquid from waterless composting toilet systems

(a) Notwithstanding Rule 26, the discharge of liquid from a waterless composting toilet system onto or into land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
   (i) the discharge occurs on the same landholding as the waterless composting toilet is located; and
   (ii) the volume of the discharge does not exceed 105 litres per week; and
   (iii) the discharge comprises only contaminants normally associated with human excreta; and
   (iv) there is no faecal contamination of any take of water for human consumption as a result of the discharge; and
   (v) the discharge is not within:
      (1) 20 metres of any lakes, rivers, artificial watercourses, modified watercourses, or natural wetlands; or
      (2) 50 metres of the coastal marine area or any natural state waters; or

(3) 50 metres of any bore or well; or
(4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; and

(vi) there is no discharge above the soil surface or direct discharge to groundwater or to a lake, river, artificial watercourse, modified watercourse, or natural wetland including discharge via subsurface drainage systems, stormwater drains, artificial free draining areas such as soak holes, or overland flow; and
(vii) no stormwater, other surface water or groundwater infiltrates the wastewater treatment unit; and
(viii) stormwater, other surface water or groundwater is directed away from the land application system area; and
(ix) for any land application system that has been installed and was operational on 3 June 2016 or later the bottom of the soil infiltration surface is no less than 900 millimetres above the mean seasonal high groundwater table and any perched water.

(b) The discharge of liquid from a waterless composting toilet system onto or into land in circumstances where a contaminant may enter water that does meet one or more of the conditions of Rule 28(a) is a discretionary activity.

Rule 29 – Discharges of aerobically composted human excreta

(a) The discharge of aerobically composted human excreta from a waterless composting toilet system onto or into land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
(i) the discharge occurs on the same landholding that the waterless composting toilet system is located on; and
(ii) the discharge comprises only contaminants normally associated with human excreta; and
(iii) the waterless composting toilet system is not used for the disposal of wastewater from chemical toilets; and
(iv) there is no contamination of any take of water for human consumption as a result of the discharge; and
(v) the material has been subject to aerobic composting decomposition for at least 12 months from the last addition of raw human excreta and is worked into the soil immediately following the discharge; and
(vi) the material is not applied to any food crop for animal or human consumption unless the material has been subject to aerobic composting decomposition and storage for at least 24 months from the last addition of raw human excreta and is worked into the soil immediately following the discharge; and
(vii) the discharge onto or into land does not occur at a location where overland flow will result in contaminants reaching a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; and
(viii) the working of the compost into the soil does not encounter any groundwater or perched water; and
(ix) the discharge is not within:
(1) 20 metres of a lake, river, artificial watercourse, modified watercourse or natural wetland; or
(2) 50 metres of the coastal marine area or any natural state waters; or
(3) 50 metres of any bore or well; or
(4) 10 metres of a landholding boundary; or

(5) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J.

(b) The discharge of aerobically composted human excreta onto or into land, in circumstances where a contaminant may enter water that does not meet the one or more of the conditions of Rule 29(a) is a discretionary activity.

Rule 30 – Discharges from mobile toilets

(a) The discharge of effluent from a mobile toilet into or onto land, or into or onto the beds of lakes or rivers, or into water is a prohibited activity.

Rule 31 – Dump stations

(a) The discharge of effluent into or onto land from an on-site wastewater system that receives effluent from a dump station is a non-complying activity.

Rule 32A – Reconstruction of effluent storage facilities

(a) The reconstruction of an agricultural effluent storage facility is to be assessed as if it were the construction of a new agricultural effluent storage facility under Rule 32B, and the reconstruction of a non-agricultural effluent storage facility is to be assessed as if it were the construction of a new non-agricultural effluent storage facility under Rule 32C.

Rule 32B – Construction, maintenance and use of new agricultural effluent storage facilities

(a) The use of land for the construction, maintenance and use of a new agricultural effluent storage facility, and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, is a permitted activity provided the following conditions are met:
   (i) the total capacity of an agricultural effluent storage facility on a landholding, excluding storage authorised by a resource consent, does not exceed 35 cubic metres; and
   (ii) the agricultural effluent storage facility is constructed using an impermeable concrete or synthetic liner; and
   (iii) the agricultural effluent storage facility is not within 50 metres of any lakes, rivers, artificial watercourses, modified watercourses, natural wetlands or the coastal marine area; and
   (iv) the agricultural effluent storage facility is not within 200 metres of any dwelling not on the same landholding, or within 50 metres of the boundary of any other landholding or road; and
   (v) the agricultural effluent storage facility is not within 100 metres of any authorised drinking water abstraction point; and
   (vi) the agricultural effluent storage facility is not located above any known sub-surface drainage systems.

(b) The use of land for the construction, maintenance and use of a new agricultural effluent storage facility, and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system, or the pond drop test criteria set out in Appendix P, which does not meet condition (i) or condition (ii) of Rule 32B(a) is a controlled activity provided the following conditions are met:

(i) the design is certified by a Chartered Professional Engineer as being in accordance with IPENZ Practice Note 21: Farm Dairy Effluent Pond Design and Construction (2013) or IPENZ Practice Note 27: Dairy Farm Infrastructure (2013); and
(ii) the application includes an operational management plan that addresses operational procedures, emergency response, monitoring and reporting requirements, the undertaking of pond drop tests, and installation of monitoring devices; and
(iii) conditions (iii) to (vi) of Rule 32B(a).

The Southland Regional Council will reserve its control over the following matters:

1. the design and construction of the new agricultural effluent storage facility including its storage capacity, the nature of effluent it will store, and the anticipated life of the storage facility;
2. methods to be used to protect the agricultural effluent storage facility's embankments from damage by animals and machinery;
3. the potential adverse effects of the construction, maintenance and use of the agricultural effluent storage facility on: lakes, rivers, artificial watercourses, installed subsurface drains, groundwater, bores, registered drinking water supplies, the coastal marine area, stop banks, residential dwellings, places of assembly and urban areas;
4. distance of the agricultural effluent storage facility from landholding or road boundaries;
5. the height of the agricultural effluent storage facility's embankments and placement and orientation of the agricultural effluent storage facility relative to flood flows and stormwater run-off;
6. the quality of, and compliance with, the operational management plan;
7. adoption and implementation of an Accidental Discovery Protocol.

(c) The use of land for the construction, maintenance and use of a new agricultural effluent storage facility, and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system, or the pond drop test criteria set out in Appendix P, which meets conditions (i) and (ii) of Rule 32B(a), but which does not meet one or more of conditions (iii) to (vi) of Rule 32B(a), is a discretionary activity.

(d) The use of land for the construction, maintenance and use of a new agricultural effluent storage facility, and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system, or the pond drop test criteria set out in Appendix P, which meets condition (i) of Rule 32B(b), but which does not meet one or more of conditions (ii) and (iii) of Rule 32B(b), is a discretionary activity.

(e) The use of land for the construction, maintenance and use of a new agricultural effluent storage facility, and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, which does not meet condition (i) of Rule 32B(b) is a non-complying activity.

Rule 32C – Construction, maintenance and use of new non-agricultural effluent storage facilities

(a) The use of land for the construction, maintenance and use of a new non-agricultural effluent storage facility and ancillary structures (other than an onsite wastewater system, composting toilet system, mobile toilet or agricultural effluent storage facility but including for wastewater, sludge or effluent from industrial or trade processes), and any incidental discharge of effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, is a restricted discretionary activity provided the following conditions are met:
   - (i) the structural design of the effluent storage facility and ancillary structures is certified by a Chartered Professional Engineer; and
   - (ii) the effluent storage facility is not within 50 metres of any lakes, rivers, artificial watercourses, modified watercourses, natural wetlands or the coastal marine area; and
   - (iii) the effluent storage facility is not within 200 metres of any dwelling not on the same landholding, or within 50 metres of the boundary of any other landholding or road; and
   - (iv) the effluent storage facility is not within 100 metres of any authorised water abstraction point; and
   - (v) the application includes an operational management plan that addresses operational procedures, emergency response, monitoring and reporting requirements, the undertaking of pond drop tests, and installation of monitoring devices.

The Southland Regional Council will restrict its discretion to the following matters:

1. the design and construction of the new non-agricultural effluent storage facility and ancillary structures including its storage capacity, the nature of effluent it will store, and the anticipated life of the storage facility;
2. methods to be used to protect the effluent storage facility embankments from damage by animals and machinery;
3. the potential adverse effects of the construction, maintenance and use of the effluent storage facility on: lakes, rivers, artificial watercourses, modified watercourses, natural wetlands, installed subsurface drains, groundwater, bores, registered drinking-water supplies, the coastal marine area, stop banks, residential dwellings, places of assembly and urban areas;
4. distance of the effluent storage facility from landholding or road boundaries;
5. the height of the effluent storage facility's embankments and placement and orientation of the effluent storage facility relative to flood flows and stormwater run-off;
6. the quality of, and compliance with, the operational management plan;
7. adoption and implementation of an Accidental Discovery Protocol.

(b) The use of land for the construction, maintenance and use of any new effluent storage facility and ancillary structures (other than an onsite wastewater system, composting toilet system, mobile toilet, or agricultural effluent storage facility but including for wastewater, sludge or effluent from industrial or trade processes), and any incidental discharge of effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, that does not meet one or more of conditions (ii) to (iv) of Rule 32C(a) is a discretionary activity.

(c) The use of land for the construction, maintenance and use of any new effluent storage facility and ancillary structures (other than an onsite wastewater system, composting toilet system, mobile toilet or agricultural effluent storage facility but including wastewater, sludge or effluent from an industrial or trade processes), and any incidental discharge of agricultural effluent directly onto or into land from that facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, that does not meet condition (i) of Rule 32C(a) is a non-complying activity.

Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

Rule 32D – Existing agricultural effluent storage facilities

(a) The use of land for the maintenance and use of an existing agricultural effluent storage facility that was authorised prior to Rule 32D taking legal effect, and any incidental discharge directly onto or into land from that storage facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, is a permitted activity provided the following conditions are met:
  - (i) the construction of the existing agricultural effluent storage facility:
    - (1) was lawfully carried out without a resource consent; or
    - (2) was authorised by a resource consent; and
  - (ii) where the construction of the existing agricultural effluent storage facility was lawfully carried out without resource consent, the landholding owner or their agent must provide information to the Southland Regional Council upon request, demonstrating that the existing agricultural effluent storage facility is either:
    - (1) fully lined with an impermeable synthetic liner, or is of concrete construction, or is above ground level, and:
      - (a) has a leak detection system that underlies the entire agricultural effluent storage facility which is inspected not less than monthly and there is no evidence of any leakage; and
      - (b) is certified by a Suitably Qualified Person in accordance with Appendix P within the last 10 years as meeting the relevant pond drop test criteria in Appendix P; or
    - (2) certified by a Suitably Qualified Person in accordance with Appendix P within the last three years as:
      - (a) having no visible cracks, holes or defects that would allow effluent to leak from the effluent storage facility; and
      - (b) meeting the relevant pond drop test criteria in Appendix P.

(b) The use of land for the maintenance and use of an existing agricultural effluent storage facility that was authorised prior to Rule 32D taking legal effect, and any incidental discharge directly onto or into land from that storage facility which is within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, that does not meet one or more conditions of Rule 32D(a) is a discretionary activity.

Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

Rule 33 – Community sewerage schemes (discharge to land)

(a) The discharge of effluent or bio-solids onto or into land, in circumstances where contaminants may enter water, from a community sewerage scheme is a discretionary activity, provided the following conditions are met:
   (ii) the discharge is not within 20 metres of a river, lake, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; and
   (iii) the discharge is not within 200 metres of any place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding; and
   (iv) the discharge is not within 100 metres of any authorised water abstraction point.

(b) The discharge of effluent or bio-solids onto or into land, in circumstances where contaminants may enter water, from a community sewerage scheme that does not meet the conditions of Rule 33(a) is a non-complying activity.

Rule 33A – Community sewerage schemes (discharge to water)

(a) The discharge of effluent or bio-solids from a community sewerage scheme into water in a river, lake, artificial watercourse, modified watercourse or natural wetland is a non-complying activity.

Rule 34 – Industrial and trade processes

(a) Other than as provided for by Rule 32C, the discharge of wastewater, sludge or effluent from industrial and trade processes, other than agricultural effluent, onto or into land in circumstances where contaminants may enter water is a discretionary activity provided the following condition is met:
   (i) any pond, tank or structure used to store the wastewater, sludge or effluent prior to discharge is certified by a Chartered Professional Engineer as having no visible cracks or defects that would allow wastewater, sludge or effluent to leak from the storage.

(b) The discharge of wastewater, sludge or effluent from industrial and trade processes, other than agricultural effluent, onto or into land in circumstances where contaminants may enter water that does not meet the condition of Rule 34(a) is a non-complying activity.

Rule 35 – Discharge of agricultural effluent to land

(a) Other than as provided for by Rules 32A, 32B and 32D, the discharge of agricultural effluent or water containing agricultural effluent onto or into land in circumstances where contaminants may enter water is a permitted activity provided the following conditions are met:
   (i) the discharge is:
      (1) from a dairy shed servicing a maximum of 20 cows or 100 of any other animal; or
      (2) from piggeries with a maximum of 70 x 50 kg pig equivalents; or
      (3) directly from feed pads/lots authorised under Rule 35A; or
      (4) from stock underpasses; or
      (5) from holding tanks on stock trucks; and
   (ii) there is no discharge of agricultural effluent or water containing agricultural effluent to a lake, river, artificial watercourse, modified watercourse or natural wetland either directly or by overland flow, run-off, or via a pipe; and
   (iii) there is no overland flow or ponding of effluent, or application to land when the soil moisture exceeds field capacity; and
   (iv) the discharge is not within 20 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; and

(v) the discharge is not within 200 metres of any place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding or public road; and
(vi) the discharge is not within 100 metres of any authorised water abstraction point; and
(vii) the maximum discharge depth of agricultural effluent or water containing agricultural effluent is 10 millimetres for each individual application; and
(viii) the maximum loading rate of nitrogen onto any land area does not exceed 150 kilograms of nitrogen per hectare per year from agricultural effluent or water containing agricultural effluent; and
(x) the minimum return period for discharging collected agricultural effluent or water containing agricultural effluent onto or into the site is 28 days; and
(xi) the discharge does not occur within the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; and
(xii) the location of any known sub-surface drains within the discharge area, and their outlet position and relative depth, is mapped and provided to the Southland Regional Council upon request.

(b) Other than as provided for by Rules 32A, 32B and 32D, the discharge of agricultural effluent or water containing agricultural effluent onto or into land in circumstances where contaminants may enter water that does not meet one or more conditions of Rule 35(a) is a restricted discretionary activity, provided the following conditions are met:
(i) the discharge is the replacement of an existing discharge consent pursuant to sections 124-124C of the RMA, and
(ii) the existing discharge consent for agricultural effluent specifies a maximum number of animals from which the effluent is collected, and that number is not increasing.

The Southland Regional Council will restrict the exercise of its discretion to the following matters:
1. application depth or rate, storage requirements, nutrient loading rates (in particular nitrogen), size of the disposal area, timing of the discharge, and contingency plans;
2. the separation distance of the discharge from a river, lake, artificial watercourse, modified watercourse, natural wetland, subsurface drain, the coastal marine area, infrastructure, residential dwellings, places of assembly, urban areas, landholding boundaries, water abstraction points and registered drinking water supplies;
3. measures to avoid, remedy or mitigate adverse effects (including cumulative effects directly related to the discharge of farm dairy effluent) on water quality, taking into account the nature and sensitivity of the receiving environment;
4. the duration of consent, including in order to implement the outcomes of any Freshwater Management Unit Process to be undertaken in accordance with Policy 47.

(c) Other than as provided for by Rules 32A, 32B and 32D, the discharge of agricultural effluent or water containing agricultural effluent onto or into land in circumstances where contaminants may enter water that does not meet one or more conditions of Rule 35(a) or conditions (i) or (ii) of Rule 35(b) is a discretionary activity, provided the following conditions are met:
(i) the discharge is not within 20 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; and
(ii) the discharge is not within 200 metres of any place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding; and
(iii) the discharge is not within 100 metres of any authorised water abstraction point.

(d) Other than as provided for by Rules 32A, 32B and 32D, the discharge of agricultural effluent or water containing agricultural effluent to land in circumstances where contaminants may enter water that does not comply with Rule 35(c) is a non-complying activity.

(e) Other than as provided for by Rules 32A, 32B and 32D, the discharge of untreated agricultural effluent directly into surface water or groundwater is a prohibited activity.

Rule 35A – Feed pads/lots

(a) The use of land for a feed pad/lot is a permitted activity provided the following conditions are met:
   - (i) if accommodating cattle or deer, each feed pad/lot services no more than 120 adult cattle, or 250 adult deer, or equivalent numbers of young stock at any one time; and
   - (ii) animals do not remain on the feed pad/lot for longer than three continuous months; and
   - (iii) the feed pad/lot is not located:
      - (1) within 50 metres from the nearest sub-surface drain, lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, natural wetland, or another feed pad/lot on the same landholding; or
      - (2) within a microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or
      - (3) within 200 metres of a place of general assembly or dwelling not located on the same landholding, or
      - (4) within 20 metres of the boundary of any other landholding; or
      - (5) within a critical source area; and
   - (iv) the feed pad/lot is constructed with:
      - (1) a sealed and impermeable base and any liquid animal effluent or stormwater containing animal effluent discharging from the feed pad/lot is collected in a sealed animal effluent storage system authorised under Rule 32B or Rule 32D; or
      - (2) a minimum depth of 500 millimetres of wood-based material (bark, sawdust or chip) across the base of the feed pad/lot; and
   - (v) any material scraped from the feed pad/lot, including solid animal effluent, is collected and if applied to land is applied in accordance with Rule 38; and
   - (vi) the overland flow of stormwater or surface runoff from surrounding land is prevented from entering the feed pad/lot.

(b) The use of land for a feed pad/lot that does not meet one or more of the conditions of Rule 35A(a) is a discretionary activity.

Rule 36 – Horticulture wash-water

(a) The discharge of water containing contaminants from vegetable or bulb washing to land where contaminants may enter water is a permitted activity, provided that the following conditions are met:
   - (i) either the discharge complies with Section 2 "Good Practices" of the Horticulture NZ Washwater Discharge Code of Practice 2017; or
   - (ii) the discharge does not exceed 20 cubic metres per day; and
   - (iii) there is no overland flow; or ponding for more than 24 hours of horticultural washwater, or application of the washwater to land when soil moisture exceeds field capacity; and

(iv) the discharge only contains water, soil, or HSNO approved sanitisers that are used in accordance with their label instructions and comply with NZS 8409:2004 Management of Agrichemicals; and
(v) the discharge is not within:
   (1) 20 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; or
   (2) 20 metres of any landholding boundary; or
   (3) 100 metres of any residential dwelling; or
   (4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J.

Rule 37 – Agricultural dips

(a) The discharge of sludge from stationary agricultural dips, mobile sheep dips and spray dips onto or into land in circumstances where contaminants may enter water is a permitted activity, provided that the following conditions are met:
   (i) there is no discharge of agricultural dip effluent directly to water, including groundwater; and
   (ii) there is no overland flow or ponding of agricultural dip effluent, or application onto land when soil moisture exceeds field capacity; and
   (iii) the discharge is not within:
      (1) 20 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; or
      (2) 100 metres from any existing potable water abstraction point; or
      (3) 20 metres of any landholding boundary; or
      (4) 100 metres from any residential dwelling other than residential dwellings on the landholding; and
      (5) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; and
   (iv) the discharge of agricultural effluent from stationary agricultural dips, mobile sheep dips and spray dips occurs on the landholding where the dipping has taken place; and
   (v) the discharge is undertaken in accordance with any Hazardous Substances and New Organisms Act 1996 approval for the substances being discharged; and
   (vi) a written record of the chemicals used and the volume and location of the discharge is kept and provided to the Southland Regional Council on request.

Rule 38 – Animal and vegetative waste

(a) The discharge of solid animal waste (excluding any discharge directly from an animal to land), sludge or vegetative material containing animal excrement or vegetative material, including from a high intensity farming process, feed pad/lot or wintering barn or industrial or trade process, into or onto land, or into or onto land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
   (i) the material does not contain any hazardous substance or hazardous waste; and
   (ii) the material does not include any waste from a human effluent treatment process; and
   (iii) the maximum loading rate of nitrogen onto any land area does not exceed 150 kilograms of nitrogen per hectare per year; and
   (iv) the material is not discharged:
      (1) onto the same area of land more frequently than once every two months; or

(2) onto land where solid animal waste, or vegetative material containing animal excrement or vegetative material from a previous application is still visible on the land surface; or
(3) onto land when the soil moisture exceeds field capacity or when soil temperatures are below 5 degrees in winter and autumn or 7 degrees in spring; or
(4) within 20 metres of the landholding boundary, a bore used for water abstraction, the bed of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; or
(5) with an average depth of material of greater than 10 millimetres on the land surface.

Rule 39 – Other agricultural effluent disposal

(a) The discharge of agricultural effluent, water containing contaminants from vegetable or bulb washing sludge, stationary agricultural dips, mobile sheep dips and spray dips onto or into land in circumstances where contaminants may enter water, other than as provided for in Rules 32A to 38, is discretionary activity.

Rule 40 – Silage storage

(a) The use of land for a silage storage facility is a permitted activity provided the following conditions are met:
(ii) there is no overland flow of stormwater into the silage storage facility; and
(v) no part of the silage storage facility is within:
(1) 50 metres of a lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, natural wetland or any potable water abstraction point; or
(2) 100 metres of any dwelling or place of assembly, on another landholding constructed or in use prior to the silage storage facility being lawfully established; or
(3) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or
(4) a critical source area; and
(vi) no part of the silage storage facility is located within 50 metres of a classified HAIL site under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011; and
(vii) no part of the silage storage facility is located on land that is made permanently or intermittently wet by the presence of springs, seepage, high groundwater, ephemeral rivers or flows of stormwater other than from any cover of the silage; and
(viii) cattle are not able to graze directly from the silage storage facility, unless the area where the cattle access the silage complies with Rule 35A.

(b) The use of land for a silage storage facility that does not meet the conditions in Rule 40(a) is a restricted discretionary activity provided to the following conditions are met:
(i) no part of the silage storage facility is within:
(1) 20 metres of a lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse or natural wetland; or
(2) 50 metres of a dwelling, potable water abstraction point, or place of assembly on another landholding; or
(3) 50 metres of the main stems of the Waiau, Aparima, Ōreti or Mataura rivers, or inside flood banks of the main stems of these rivers (if present); or

(4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J.

The Southland Regional Council will restrict the exercise of its discretion to the following matters:

2. measures necessary to prevent noxious, dangerous, offensive, or objectionable effects beyond the boundary of the landholding on which silage is stored;
3. measures necessary to prevent inflows of stormwater, or infiltration from underlying seeps, springs, or groundwater;
4. the physical dimensions and location of the silage storage facility;
6. methods of containing any silage leachate that may be emitted prior to application to land, including the volume of any silage leachate storage.

An application for resource consent under Rule 40(b) will be processed and considered without public or limited notification unless the applicant requests notification or the Southland Regional Council considers that special circumstances exist that warrant notification of the application.

(c) The use of land for a silage storage facility that does not meet one or more of the conditions in Rule 40(b) is a non-complying activity.

Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

Rule 41 – Silage leachate

(a) The discharge of silage leachate onto or into land in circumstances where contaminants may enter water is a permitted activity provided the following conditions are met:
  (i) the discharge is via an agricultural effluent discharge system authorised under Rule 35; or
  (iia) there is no discharge of leachate directly to groundwater via a pipe, soak pit or other soil bypass mechanism and there is no overland flow or ponding of silage leachate outside of the silage storage facility; and
  (iii) any discharge is not within:
    (1) 20 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; or
    (2) 100 metres of a place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding; or
    (3) 100 metres of any authorised water abstraction point; or
    (4) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; and
  (iv) any discharge does not result in:
    (2) an application depth in excess of 10 millimetres for each individual application; and
    (3) a loading rate of nitrogen from the discharge of silage leachate in excess of 150 kilograms of nitrogen per hectare per year.

Landfills

Rule 42 – Cleanfill sites

(a) The discharge of cleanfill into or onto land at a cleanfill site in circumstances where contaminants may enter water is a permitted activity provided the following conditions are met:

- (i) the total amount of cleanfill discharged at all cleanfill sites on a landholding does not exceed 500 cubic metres per calendar year, except for a formed road reserve or a rail corridor in which case no limit applies; and
- (ii) the discharge does not occur within:
  - (1) the bed of a lake or river; or
  - (2) 50 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland, the coastal marine area or landholding boundary; or
  - (3) 50 metres of the main stems of the Waiau, Aparima, Ōreti or Mataura rivers, or inside flood banks of the main stems of these rivers (if flood banks are present); or
  - (4) 100 metres of any authorised water abstraction point; and
- (iv) stormwater is directed away from the discharge site.

(b) The discharge of cleanfill into or onto land at a cleanfill site in circumstances where contaminants may enter water that does not meet one or more of the conditions of Rule 42(a) is a restricted discretionary activity.

The Southland Regional Council will restrict its discretion to the following matters:

1. prevention of inundation of any other person's landholding, sedimentation in any waterbody, erosion and land instability, and the restriction or diversion of flood flows;
2. effects on sensitive receiving environments;
4. design, construction and management of the cleanfill site;
5. post-closure management practices and procedures;
6. information and monitoring requirements;
7. the quantity of cleanfill to be discharged.

An application for resource consent under Rule 42(b) will be processed and considered without public or limited notification unless the applicant requests notification or the Southland Regional Council considers special circumstances exist that warrant notification of the application.

Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

Rule 43 – Farm landfills

(a) The discharge of a contaminant into or onto land from a farm landfill in circumstances where that contaminant may enter water is a permitted activity provided the following conditions are met:

- (i) carcasses, offal, compost bulking agents or waste is derived from the same landholding on which the farm landfill is situated, or the activity is carried out by a local authority or government agency in the exercise of their statutory powers; and

(ii) the discharge does not include septic tank sludge, dairy farm sludge or a hazardous substance; and
(iii) the discharge does not occur within:
    (1) the bed of a lake, river, or natural wetland; or
    (2) a critical source area; or
    (3) 50 metres of a lake, river, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; or
    (4) 50 metres of the main stems of the Waiau, Aparima, Ōreti or Mataura rivers, or inside flood banks of the main stems of these rivers (if flood banks are present); or
    (5) 100 metres of any authorised water abstraction point, or dwelling, place of assembly, or landholding boundary; or
    (6) the microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or
    (7) 100 metres of a dwelling, place of assembly, or landholding boundary; and
(iv) stormwater is directed away from the discharge site; and
(v) the farm landfill does not intercept an on-farm sub-surface drain, or a spring, and is not excavated below the seasonal mean groundwater level in that location; and
(vi) as each section of the farm landfill becomes full or unused, the deposited carcasses, offal, compost bulking agents and waste material is covered with soil and the resulting soil surface is restored to a similar state as the surrounding land; and
(vii) any carcass or offal must not come into contact with naturally formed limestone rock.

(b) The discharge of a contaminant into or onto land in circumstances where that contaminant may enter water at a farm landfill that does not meet one or more of the conditions of Rule 43(a) is a discretionary activity.

(c) Notwithstanding the provisions of Rules 43(a) and (b), the discharge of the carcass of, or offal from, a single animal into or onto land in circumstances where a contaminant may enter water is a permitted activity provided the following conditions are met:
(i) the carcass or offal cannot be reasonably disposed of in accordance with the conditions of Rule 43(a); and
(ii) the carcass or offal is derived from the same landholding on which the discharge is to occur; and
(iii) the carcass or offal buried does not occur within:
    (1) 20 metres of surface water or an authorised water abstraction point; or
    (2) 20 metres of a dwelling, place of assembly, or landholding boundary.

(d) The discharge of the carcass of, or offal from, a single animal into or onto land in circumstances where that contaminant may enter water that does not meet one or more of the conditions of Rule 43(c) is a discretionary activity.

Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

Rule 45 – Landfills

(a) Except as provided for elsewhere in this Plan, the discharge of contaminants from a landill into or onto land in circumstances where that contaminant may enter water is a discretionary activity.

Land Contamination

Rule 46 – Land contaminated by a hazardous substance

(a) The discharge of contaminants from land contaminated by a hazardous substance onto or into land in circumstances which may result in contaminants entering water is a permitted activity provided:
   (i) the hazardous substance in the discharge results from an activity authorised by a rule in this Plan or a resource consent granted by the Southland Regional Council; or
   (ii) the discharge does not result in a breach of the trigger values for toxicants presented in Table 3.4.1 in the Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) 2000 at the level of protection set in those guidelines for 80% of species, except for benzene where the level of protection is 90% of species (i.e. 1 milligram per litre), at the nearest of:
      (1) 50 metres from the discharge; or
      (2) the landholding boundary; or
      (3) any point immediately adjacent to any lakes, rivers, artificial watercourses, modified watercourses, natural wetlands, the coastal marine area, or water abstraction bores (excluding monitoring bores); and
   (iii) the discharge does not result in a breach of the Drinking Water Standards for New Zealand 2005 (Revised 2008) in any bore utilised for potable supply, except where the ambient water quality naturally breaches those Standards and the discharge does not result in any further degradation of the water quality.

(b) The discharge of soil from land contaminated by a hazardous substance onto or into land in circumstances which may result in those contaminants entering water is a permitted activity provided:
   (i) the hazardous substance in the soil results from the application of a fertiliser or agrichemical to the land authorised by a rule in this Plan or a resource consent granted by the Southland Regional Council; or
   (ii) the soil is being returned to the excavation or site from which it was taken.

(c) The discharge of contaminants or soil from land contaminated by a hazardous substance onto or into land in circumstances which may result in those contaminants entering water that does not meet one or more of the conditions of Rule 46(a) or (b) is a discretionary activity.

Rule 46A – Site investigations

(a) The use of land for a site investigation to assess concentrations of hazardous substances that may be present in the soil, and any incidental discharges as a result of that investigation, is a permitted activity provided the following conditions are met:
   (i) the site investigation is to be undertaken in accordance with Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils (Ministry for the Environment, 2011) and reported on in accordance with the Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Sites in New Zealand, (Ministry for the Environment, 2011); and
   (ii) the person or organisation initiating the site investigation provides a copy of the report of the site investigation to the Southland Regional Council within two months of the completion of the investigation.

Taking and Using Water

Note: *Takes for drinking water supplies will also need to comply with other requirements including The National Environmental Standard for Sources of Human Drinking Water Regulations 2007 and the Health (Drinking Water) Amendment Act 2007.*

Rule 49 – Abstraction, diversion and use of surface water

(a) The take and use of surface water is a permitted activity provided the following conditions are met:
  - (i) the volume of take does not exceed 2,000 litres per day, plus 250 litres per hectare per day, up to a maximum of 40 cubic metres per landholding per day or per facility per day on public conservation land managed as such under the National Parks Act 1980, Conservation Act 1987 or the Reserves Act 1977; and
  - (ii) the maximum volume of take allowed under this rule and Rule 54(a) are not added together. A maximum of 86 cubic metres of groundwater and surface water combined per landholding per day inclusive of any water taken pursuant to s14(3)(b) of the RMA may be taken; and
  - (iii) the rate of take from a river or modified watercourse does not exceed 30 percent of the instantaneous flow at the time of take; and
  - (iv) the rate of take does not exceed 2 litres per second; and
  - (v) fish are prevented from entering the reticulation system in accordance with Appendix R; and
  - (vi) the following details are supplied to the Southland Regional Council upon request (if applicable):
    - (1) farming type; and
    - (2) stocking rate; and
    - (3) point of abstraction; and
    - (4) what the water was used for; and
    - (5) maximum rate of take; and
  - (vii) where the volume of the take exceeds 20,000 litres per day, a water meter capable of recording the rate of take and the daily volume of take is used. Water take data must be recorded daily and provided to the Southland Regional Council on request. The accuracy of the water meter must be verified every 12 months.

(ab) Despite Rule 49(a), the take and use of surface water for infrastructure construction, maintenance and repair is a permitted activity provided the following conditions are met:
  - (i) the rate of take does not exceed 15 litres per second; and
  - (ii) the volume of take does not exceed 100,000 litres per day; and
  - (iii) the bed of the watercourse from where the take occurs is at least 1 metre wide and the depth of flow in the watercourse at that location exceeds 0.5 metres at the time of the take; and
  - (iv) the take does not occur for more than 45 consecutive minutes and multiple takes from the same site on a single day are at least 30 minutes apart; and
  - (v) the point of abstraction is not located within 50 metres of any existing lawfully established surface water take; and
  - (vi) the Southland Regional Council is notified at least three working days prior to the take commencing; and
  - (vii) the take occurs between 1 September and 31 March inclusive; and
  - (viii) fish are prevented from entering the water intake in accordance with Appendix R.

(b) Except as provided for in Rules 49(a), 49(ab), 50(a), 50(b), 51(a) and 51(b), the taking, diversion and use of surface water is a restricted discretionary activity provided the following conditions are met:

(i) for a lake, river, artificial watercourse, modified watercourse or natural wetland the total surface water allocation is within the secondary allocation specified in Policy 21(3); or
(ii) for non-consumptive takes, the total volume of water taken or diverted is returned within 100 metres of the take or diversion point; or
(iii) for any lakes, rivers, artificial watercourses, modified watercourses or natural wetlands the total volume of water taken is greater than 40 cubic metres per landholding per day but is less than 70 cubic metres per landholding per day.

The Southland Regional Council will restrict its discretion to the following matters:

1. the volume, rate, frequency and timing of water to be taken (including any water to be returned to the lake, river, artificial watercourse, modified watercourse or natural wetland and the delay between the taking and returning of this water);
2. any effects on river flows (including effects on minimum flows, flow variability and duration of flows), wetland or lake water levels, aquatic ecosystems, aquifer storage volumes, the availability and reliability of supply for existing users, and water quality;
3. the location of the take or diversion;
4. the efficiency of water use, in accordance with Appendix O;
5. the installation and use of a water meter;
6. information and monitoring requirements;
7. methods to prevent fish from entering the intake in accordance with Appendix R;
8. take cessation in response to minimum flow and level requirements;
9. consistency with any water conservation order;
10. the degree of hydraulic connection to groundwater;
11. any effect on a natural wetland;
12. the proposed method of take and delivery of the water;
13. any water storage available for the water taken and its volume.

(c) Except as provided for in Rules 49(a), 49(ab), 49(b), 50(a), 50(b), 51(a), 51(b) and 51(c), the taking, diversion and use of surface water where the total rate of authorised surface water abstraction does not exceed the primary allocation specified in Appendix K is a discretionary activity.

(d) Except as provided for in Rules 49(a), 49(ab), 49(b), 49(c), 50(a), 50(b), 51(a), 51(b) and 51(c), the taking, diversion and use of water is a non-complying activity.

(e) Despite Rules 49(b), 49(c), and 49(d) the taking, diversion and use of water from the Cromel Stream is a prohibited activity, unless the application is for the replacement of an expiring water permit pursuant to Section 124 of the Act, the rate of take and volume is not increasing and use of the water is not changing.

Rule 50 – Community water supply

(a) **Existing community water supply**
The taking and use of water for a community water supply is a controlled activity provided:
(i) the application is for the replacement of an expiring water permit pursuant to section 124 of the Act and the rate of take and the volume and use of the water is not changing; and
(ii) a water demand management strategy is lodged as a part of the application.

The Southland Regional Council will reserve its control over the following matters:

1. the quality of and implementation of the water demand management strategy;

The Southland Regional Council will reserve the exercise of its control to the following matters:

1. the proximity of the bore or well to surface water bodies (including spring-fed streams), potential sources of groundwater contamination and existing bores and wells;
2. the design and depth of the bore or well;
3. the method of drilling or excavation;
4. the design and management of the bore head;
5. the use, maintenance and decommissioning of the bore or well;
6. information and monitoring requirements;
7. adoption and implementation of an Accidental Discovery Protocol.

An application for resource consent under Rule 53(a) will be processed and considered without public or limited notification unless the applicant requests notification or the Southland Regional Council considers special circumstances exist that warrant notification of the application.

(b) The use of land for the drilling or construction of any bore or well that does not meet the conditions in Rule 53(a) is a discretionary activity.

(c) The use, maintenance or decommissioning of any bore or well is a permitted activity provided the following conditions are met:
  (i) the bore or well design and headworks prevent:
    (1) the infiltration of contaminants; and
    (2) the uncontrolled discharge or leakage of water to the ground surface or between aquifers.

(d) The use, maintenance or decommissioning of any bore or well that does not meet the conditions in Rule 53(c) is a discretionary activity.

Rule 54 – Abstraction and use of groundwater

***Note**: To determine the aquifer type and allocation volume for a proposed groundwater abstraction, Plan users should firstly refer to Map Series 3: Groundwater Management Zones to establish the relevant groundwater zone. Once the relevant groundwater zone has been established, Appendix L can be used to determine the aquifer type.*

(a) The take and use of groundwater is a permitted activity provided the following conditions are met:
  (i) the volume and rate of abstraction does not exceed:
    (1) a maximum of 86 cubic metres per day per landholding; and
    (2) a maximum rate of 5 litres per second; and
    (3) the point of abstraction is not within 50 metres of an existing lawfully established groundwater take; and
  (ii) the maximum volume of take allowed under this rule and Rule 49(a) are not added together. A maximum of 86 cubic metres of groundwater and surface water combined per landholding per day, inclusive of any water taken pursuant to section 14(3)(b) of the RMA, is allowed; and
  (iii) the following details are supplied to the Southland Regional Council upon request (if applicable):
    (1) farming type; and
    (2) stocking rate; and
    (3) point of abstraction; and
    (4) what the water is used for; and

(5) the maximum rate of take.

(iv) where the volume of the take exceeds 20,000 litres per day, a water meter capable of recording the rate of take and the daily volume of take must be used. Water take data must be recorded daily and provided to the Southland Regional Council on request. The accuracy of the water meter must be verified every 12 months.

(b) The non-consumptive take and use of groundwater is a permitted activity provided the following conditions are met:

(i) the rate and volume of take does not exceed:

(1) a maximum rate of 10 litres per second; and

(2) a maximum daily volume of 750 cubic metres; and

(iia) any interference effects are “acceptable” in accordance with Appendix L.3; and

(ii) the same amount of water is returned to the same aquifer within 250 metres of the point at which it was taken; and

(iii) there is no significant delay between the taking and returning of the water.

(c) The take and use of groundwater for hydraulic testing and bore development purposes and any associated discharge of groundwater into water or onto or into land is a permitted activity provided the following conditions are met:

(i) the Southland Regional Council is notified at least three days prior to test commencement; and

(ii) the rate of take does not exceed 75 litres per second; and

(iii) the duration of pumping does not exceed five consecutive days; and

(iv) any discharge of water to water is consistent with the water quality requirements of section 70 of the RMA; and

(v) water discharged onto land must not contribute to flooding on any other landholding; and

(vi) records of all pumping and recovery tests including the rate and duration of pumping, water levels in the pumped well and any water level observation wells and the time measurements are taken and are provided to the Southland Regional Council within one month of the completion of the test.

(ca) The take and use of groundwater for the purpose of dewatering for carrying out excavation, construction or maintenance and the associated use and discharge of that water is a permitted activity provided the following conditions are met:

(i) the Southland Regional Council is notified at least three days prior to dewatering commencing; and

(ii) the take continues only for the time required to carry out the work, and in any event, the take does not exceed a duration of 60 days in any 12-month period; and

(iii) the rate of take does not exceed 40 litres per second; and

(iv) the taking of water does not cause subsidence of any site not owned by the person undertaking the dewatering; and

(v) the water is not taken from the Lumsden, Wendonside or North Range aquifers; and

(vi) the take or discharge is not from, into, or onto contaminated or potentially contaminated land; and

(vii) the take does not have a Riparian, Direct, Moderate or High stream depletion effect on a surface waterbody, determined in accordance with Appendix L.2, unless the abstracted groundwater is being discharged to the surface water body to which it is hydraulically connected; and

(viii) an assessment of interference effects, undertaken in accordance with Appendix L.3, does not show that any community or private drinking water supply bore will be prevented from taking water; and

(ix) at the point and time of any discharge to a river or artificial watercourse, the rate of flow in the water body is at least five times the rate of the discharge; and

(x) the concentration of total suspended solids in any discharge to lakes, rivers, artificial watercourses, modified watercourses or natural wetlands does not exceed:
    (1) 100 g/m^3 where the discharge is to any Lowland softbed, Lowland hard bed or Hill river or to an artificial watercourse; or
    (2) 50 g/m^3 where the discharge is to any other lake, river or natural wetland; and
(xi) the point of discharge is not within a Drinking Water Protection Zone as set out in Appendix J; and
(xii) records of the rate and duration of pumping are taken and are provided to the Southland Regional Council within three months.

(d) Other than as provided by Rules 54(a), 54(b), 54(c) and 54(ca) the take and use of groundwater from groundwater management zones listed in Appendix L.5 is a discretionary activity provided the following conditions are met:
    (i) the total volume of authorised groundwater abstraction is within the primary allocation limits established in Appendix L.5; and
    (ii) if the degree of hydraulic connection, calculated in accordance with Appendix L.2 Table L.2. is Riparian, Direct, High or Moderate the relevant surface water minimum flows and allocation limits specified in Table L.2 are complied with; and
    (iii) any interference effects are ‘acceptable’ in accordance with Appendix L.3; and
    (iv) minimum groundwater level cut-offs and seasonal recovery triggers are established in accordance with criteria outlined in Appendix L.6.

(e) Other than as provided by Rules 54(a), 54(b), 54(c) and 54(ca) the take and use of groundwater from a confined aquifer is a discretionary activity provided the following conditions are met:
    (i) the total volume of authorised groundwater abstraction is within the primary allocation limits (including minimum water level cut-offs and seasonal recovery triggers) established in Appendix L.5 or following the methodology outlined in Appendix L.6; and
    (ii) any interference effects are ‘acceptable’ in accordance with Appendix L.3.

(f) Other than as provided by Rules 54(a), 54(b) and 54(c) and 54(ca) the take and use of groundwater outside the groundwater management zones listed in Appendix L.5 is a discretionary activity provided the following conditions are met;
    (i) the total volume of authorised groundwater abstraction is within the primary allocation limit established following the methodology outlined in Appendix L.7; and
    (ii) any interference effects are ‘acceptable’ in accordance with Appendix L.3.

(g) The take and use of groundwater that does not comply with Rules 54(b) to 54(f) is a non-complying activity.

Rule 59A – On-farm sediment traps

(a) The construction, excavation, modification or maintenance of an on-farm sediment trap in, on, under or over the bed of any intermittent or ephemeral river and any associated bed disturbance, removal of aquatic weeds and plants and associated discharge resulting from carrying out the activity is a permitted activity provided the following conditions are met:
    (i) general conditions (e), (f), (g), (h) and (i) set out in Rule 55A; and
    (ii) the construction, excavation, modification or maintenance of the sediment trap is undertaken solely for sediment control purposes or maintaining the capacity and effective functioning of the sediment trap; and
    (iii) the sediment trap is not within any mātaitai, nohoanga, or taiāpure; and
    (iv) the sediment trap has:
        (1) fencing to prevent stock access; and
        (2) bank batter slope no less than 3 horizontal:1 vertical; and
    (v) the construction, excavation, modification or maintenance of the sediment trap does not result in the destabilisation of any lawfully established structure; and
    (vi) any build-up of sediment within the sediment trap which may adversely affect flood risk, drainage capacity, or bed or bank stability is removed as soon as practicable.

(b) The construction, excavation, modification or maintenance of an on-farm sediment trap in, on, under or over the bed of any intermittent or ephemeral river and any associated bed disturbance, removal of aquatic weeds and plants, and associated discharge resulting from carrying out the activity that is not permitted by Rule 59A(a) is a discretionary activity.

Rule 60 – Dams and weirs

Note 1: *The Building Act 2004 specifies obligations on the owner of a dam as defined in that Act regarding classification, certification and other matters of safety. Plan users should contact the Southland Regional Council to inquire about these requirements in each case.*

Note 2: *This rule manages dam and weir structures. Any associated take, diversion, use or discharge of water is covered by other rules.*

Note 3: *This rule does not apply to weirs constructed for erosion control purposes under Rule 61.*

(a) The placement, erection or reconstruction of any dam or weir in, on or over the bed of a lake, river, modified watercourse and the associated damming of water (either inside or outside the bed), and any associated bed disturbance and discharge resulting from the carrying out of the activity, is a permitted activity provided the following conditions are met:
    (ia) the general conditions set out in Rule 55A; and
    (i) if the maximum height of the dam or weir exceeds 4 metres or the impoundment volume exceeds 20,000 cubic metres of water or other fluid, a building consent is obtained for the dam or weir prior to its construction commencing; and
    (iii) the dam or weir is located below a catchment area of less than 500 hectares; and
    (iv) the dam or weir is not located upstream of any railway, formed public road, or residence where these are likely to be affected by any failure of the structure; and
    (v) the dam or weir has a spillway, or an auxiliary spillway, that is capable of safely conveying flood flows; and
    (vi) the dam or weir does not impound water or adversely affect drainage beyond the landholding on which it is constructed, unless agreed to in writing by the affected landowner; and
    (vii) the discharge from the dam or weir is to the original channel, and does not cause significant erosion of, or deposition on, the downstream bed or banks; and
    (viii) the dam or weir is not in the Mataura, Ōreti or Waikaia River; and

(ix) For the purposes of Rule 60(a) the height of a dam or weir is the vertical distance from the crest of the dam or weir and must be measured:
   (1) in the case of a dam or weir across a river, from the natural bed of the stream at the lowest downstream outside limit of the dam or weir; or
   (2) in the case of a dam or weir not across a river, from the lowest elevation at the outside limit of the dam or weir; or
   (3) in the case of a canal, from the invert of the canal; and
(x) the structure is not within any mātaitai, nohoanga, or taiāpure.[13]

(ab) The use of any dam or weir is a permitted activity provided the following conditions are met:
   (i) general conditions (f), (i), (j) and (k) set out in Rule 55A; and
   (ii) the structure is lawfully established.

   Note: *In addition to the provisions of this Plan and any relevant district plan, any activity which may modify, damage or destroy pre-1900 archaeological sites is subject to the archaeological authority process under the Heritage New Zealand Pouhere Taonga Act 2014. The responsibilities regarding archaeological sites are set out in Appendix S.*

(b) The use, placement, erection or reconstruction of any dam or weir in, on or over the bed of a lake, river, modified watercourse and the associated damming of water (either inside or outside the bed), and any associated bed disturbance and discharge resulting from the carrying out of the activity, that does not meet one or more of the conditions of Rule 60(ab) or Rule 60(a) respectively and is not a non-complying activity under Rule 60(c) or a prohibited activity under Rule 60(d) is a discretionary activity.

(c) The use, placement or erection of any dam or weir on the main stems of the Aparima River, downstream of the Aparima Forks at NZ Topo 50 CE09 051 299[14], and the Ōreti River, downstream of Rocky Point at NZ Topo 50 CE09 274 327[15] is a non-complying activity.

(d) The placement or erection of dams or weirs in the Mataura or Waikaia River and in the Ōreti River main stem from Rocky Point at NZ Topo 50 CE09 274 327[16] upstream to the forks at NZ Topo 50 CC09 245 832[17] is a prohibited activity.

Rule 61 – Erosion control structures

(a) Notwithstanding any other rule in this Plan, the placement or reconstruction of rock rip rap, gabion baskets or anchored or layered trees in, on, under or over the bed of a lake, river or modified watercourse and any associated bed disturbance and discharge resulting from the carrying out of the activity, is a permitted activity provided the following conditions are met:
   (ai) the general conditions set out in Rule 55A; and
   (i) the work is not in a lake bed, national park, reserve or land in respect of which there is a covenant under the Conservation Act 1987, Queen Elizabeth the Second Trust Act 1977 or Reserves Act 1977; and
   (ii) any anchored or layered trees are anchored to the bed or banks so that they will not wash away in a 2% Annual Exceedance Probability flood event; and
   (iii) there is no planting of pest plant species as identified in the Regional Pest Management Strategy for Southland 2013 or any replacement plan prepared under the Biosecurity

[13] Mātaitai and taiāpure defined in the introduction at page 10.
[14] The equivalent NZ260 map reference is D44 151 919 and the equivalent NZTM2000 coordinates are 1205134 mE 4929948 mN
[15] The equivalent NZ260 map reference is E44 373 946 and the equivalent NZTM2000 coordinates are 1227364 mE 4932686 mN
[16] The equivalent NZ260 map reference is E44 373 946 and the equivalent NZTM2000 coordinates are 1227364 mE 4932686 mN
[17] The equivalent NZ260 map reference is E42 345 450 and the equivalent NZTM coordinates are 1224494 mE 4983155 mN

Catchment

The land area that contributes to the river's flow.

Cleanfill

Any material that when discharged into or onto land will have no or minimal adverse environmental effects, and includes virgin natural matter (e.g. clay, soil, sand, gravel or rock) and other inert products from construction or demolition activities (e.g. concrete or brick) that are free of:

(a) combustible, putrescible, degradable, compostable or leachable components (e.g. animal carcasses, green/garden waste, timber, bark, cork, tree roots, new asphalt);
(b) hazardous substances (e.g. coal tar, or asbestos);
(c) products or materials derived from the treatment, stabilisation or disposal of hazardous waste; and
(d) materials of risk to human or animal health (e.g. medical or clinical waste); and
(e) liquid waste (including sludges).

Cleanfill site

Land used for the permanent disposal of cleanfill and no other type of material but excludes earthworks on the same landholding, earthworks associated with any road, driveway or track, and any area within a road reserve containing a formed road that is used for the deposition of roading material.

Closed landfill

A landfill containing 15,000 cubic metres or more of industrial or community waste that ceased to operate between 1970 and 2012 and remains closed but excludes farm landfills.

Community sewerage scheme

A scheme that collects and treats sewage from more than one landholding which is predominantly from residential housing, but may include a component of industrial and trade process effluent.

Community water supply

A permanent reticulated supply of potable water for use by 25 or more people for at least 60 days per annum.

Composting Toilet

A toilet system that uses a predominantly aerobic processing system that treats human excreta, typically with no water, via composting or managed aerobic decomposition which is often assisted by the addition of sawdust and straw or other carbon rich materials. The operation of some composting toilet systems may involve the transfer of the waste to a hot compost heap while other systems include a specially built tank in which waste is decomposed by aerobic bacteria.

Confined aquifer

An aquifer which is overlain by a low permeability or impermeable layer where water in the aquifer is under pressure.

Conspicuous change in clarity

Means more than a 20% reduction in clarity in all lakes, rivers, modified watercourses and wetlands, except for Lowland soft bed rivers where it means more than a 33% reduction in clarity.

Crest

In relation to a dam, means the uppermost surface of a dam, not taking into account any camber allowed for settlement, or any curbs, parapets, guard rails, or other structures that are not part of the water-retaining structure.

Critical infrastructure

Means infrastructure that provides services which, if interrupted, would have a significant effect on the wellbeing and health and safety of people and communities and would require reinstatement, and includes all strategic facilities.

Critical source area

(a) a landscape feature like a gully, swale or a depression that accumulates runoff (sediment and nutrients) from adjacent flats and slopes, and delivers it to surface water bodies (including lakes, rivers, artificial watercourses and modified watercourses) or subsurface drainage systems; and

(b) areas which arise through land use activities and management approaches (including cultivation and winter grazing) which result in contaminants being discharged from the activity and being delivered to surface water bodies.

Cultivation

Preparing land for growing pasture or a crop by mechanical tillage, direct drilling, herbicide spraying, or herbicide spraying followed by over-sowing for pasture or forage crops (colloquially referred to as 'spray and pray'), but excluding any spraying undertaken solely for the control of pest plant species.

Damming

The impounding of all or part of the natural flow of any water that may involve an associated temporary or permanent structure.

Dairy farming of cows

The farming, including grazing, of milking cows on land during the milking season.

Dairy platform

An area of a landholding where dairy cows being milked on a daily basis are kept during the milking season.

Deposition

The laying down of solid material which has been carried by some natural agency (for example, rivers, wind, etc).

Diadromous

Fish that make migrations between the sea and freshwater. These migrations may be in either direction and not necessarily related to spawning.

Diversion

The redirecting of water flow from its existing direction of flow.

Domestic wastewater

For the purposes of this rule, domestic wastewater is limited to effluent derived from dwellings, business buildings, institutions and the like, and consisting of toilet wastes and wash waters from kitchens, bathrooms and laundries.

natural resources. The Crown may create and grant to Te Rūnanga o Ngāi Tahu renewable entitlements over Crown-owned land in the Ngāi Tahu claim area which meets the criteria set out in Section 258 of the Ngai Tahu Claims Settlement Act 1998, other than land in:

(a) a national park;
(b) a marginal strip;
(c) a nature reserve;
(d) an esplanade reserve;
(e) a scientific reserve;
(f) or that part of an unformed legal road (including a road reserve) within 20 metres of a waterway.

Nutrient

An element or compound essential for the growth and development of life forms. The major plant nutrients are nitrogen, phosphorus, potassium, sulphur, magnesium and calcium but there are also a number of minor nutrients which are required in small quantities.

Nutrient budget

A calculation of the total nutrient balance for a farming activity, taking into account as far as is practicable all nutrient inputs to and outputs from the activity.

On-site wastewater system

The collection, treatment and disposal/reuse of wastewater from dwellings or commercial facilities on the same landholding as it is generated.

Organism

Any living animal or plant including any bacterium or virus.

Perched water

Perched water is a subsurface layer of water that is located above true groundwater. It occurs because of confining layers in the soil such as hard gravel pans. Perched water is nearly always periodic or seasonal.

Periphyton

Non-vasular plants forming crusts, films or filamentous mats on plants or beds of watercourses.

Pest species

Pest species as defined in a Regional Pest Management Plan.

pH

Value taken to represent the acidity or alkalinity of water.

Pit toilet

A toilet which discharges to a hole in the ground. Also known as a pit latrine, long-drop or privy.

Physiographic zone

A physiographic zone represents areas of the landscape with common attributes that influence water quality, such as climate, topography, geology and soil type. Zones differ in the way sediment, microbes and nutrients such as nitrogen and phosphorus accumulate and are transferred through the soil, aquifers and into waterbodies.

The zones are individually described in Part A of this Plan.

Reconstruction

The complete rebuilding or complete replacement of a structure to its original dimensions, on the same site.

Regionally significant infrastructure

Means infrastructure in the region which contributes to the wellbeing and health and safety of the people and communities of the region, and includes all critical infrastructure.

Reticulated system

The means by which water is collected and delivered prior to discharge. In relation to stormwater discharge, a piped or channelled network for collecting stormwater from a number of landholdings with a single common discharge point.

Rip rap

Rock protection work along the bank of a lake, river or modified watercourse.

Riparian area/margins

Land situated along the bank of a lake, river, wetland or other waterbody.

RMA

The Resource Management Act 1991 (including any amendments thereto), unless expressly stated.

Sediment trap

A facility designed and constructed for the primary purpose of slowing water flow to allow sediments to drop from the water column.

Septage

The pumpout contents of a septic tank (or primary compartment of an aerated wastewater treatment system) during desludging operations, which includes scum, sludge and septic tank liquid.

Sewage

The contents of sewers carrying the waterborne wastes of a community. This is sometimes called “wastewater” or “foul sewage” to distinguish it from stormwater.

Silage

Silage is any plant material harvested while green for fodder and kept succulent by partial fermentation, but does not include baleage or hay.

Silage leachate

Silage leachate refers to the liquids generated from the biological processes that occur when wilted grass is preserved as silage, or when soluble components are dissolved out of silage by percolating or infiltrating rainwater, surface water or groundwater. Leachate that results from the making of baleage or hay is not considered silage leachate for the purpose of this plan.

Silage storage facility

Silage storage facility refers to land or structures on which silage is stored, processed or directly utilised. Bales of plant material completely encapsulated in plastic are not considered a “silage storage facility”.

Sludge

The solid residues from effluent.

Appendix N – Farm Environmental Management Plan Requirements

Part A – Farm Environmental Management Plans

A Farm Environmental Management Plan (FEMP) can be based on either of:

1. the material set out in Part B below; or
2. industry prepared FEMP templates and guidance material, with Southland-specific supplementary material added where relevant, so that it includes the material set out in Part B below.

Part B – Farm Environmental Management Plan Content

1. A written FEMP that is:
   (a) prepared and retained, identifying the matters set out in clauses 2 to 5 below; and
   (b) reviewed at least once every 12 months by the landholding owner or their agent and the outcome of the review documented; and
   (c) provided to the Southland Regional Council upon request.

2. The FEMP contains the following landholding details:
   (a) physical address; and
   (b) description of the landholding ownership and the owner's contact details; and
   (c) legal description(s) of the landholding; and
   (d) a list of all resource consents held for the landholding and their expiry dates.

3. The FEMP contains a map(s) or aerial photograph(s) of the landholding at a scale that clearly shows the locations of:
   (a) the boundaries; and
   (b) the physiographic zones (and variants where applicable) and soil types (or Topoclimate South soil maps); and
   (c) all lakes, rivers, streams, ponds, artificial watercourses, modified watercourses and natural wetlands; and
   (d) all existing and proposed riparian vegetation and fences (or other stock exclusion methods) adjacent to waterbodies; and
   (e) places where stock access or cross water bodies (including bridges, culverts and fords); and
   (f) all known subsurface drainage system(s) and the locations of the drain outlets; and
   (g) all land that may be cultivated and land to be cultivated over the next 12-month period; and
   (h) all land that may be intensively winter grazed and the land to be planted for winter grazing for the next period 1 May to 30 September; and
   (i) for land to be cultivated or intensively winter grazed:
      (i) critical source areas; and
      (ii) intended setbacks from any lake, river (excluding ephemeral rivers), artificial watercourses, modified watercourse or natural wetland; and
      (iii) land with a slope greater than 20 degrees.

4. Nutrient Budget

   For all landholdings over 20ha, the FEMP contains a nutrient budget (which includes nutrient losses to the environment) calculated using the latest version of the OVERSEER model in accordance with the latest version of the OVERSEER Best Practice Data Input Standards (or an alternative model approved by the Chief Executive of Southland Regional Council), and which is repeated:

(a) where a material change in land use associated with the farming activity occurs (including a change in crop area, crop rotation length, type of crops grown, stocking rate or stock type) at the end of the year in which the change occurs, and also every three years after the change occurs; and

(b) each time the nutrient budget is repeated all the input data used to prepare it shall be reviewed by or on behalf of the landholding owner, for the purposes of ensuring the nutrient budget accurately reflects the farming system. A record of the input data review shall be kept by the landholding owner.

5. Good Management Practices

The FEMP contains a good management practices section which identifies:

(a) the good management practices implemented since 3 June 2016; and

(b) the good management practices which will be undertaken over the coming 12-month period. These must include practices for:

   (i) the reduction of sediment and nutrient losses from critical source areas, particularly those associated with overland flow;

   (ii) cultivation (including practices such as contour ploughing, strip cultivation or direct drilling);

   (iii) the use of land for intensive winter grazing (including those practices specified in Rule 20(a)(iii);

   (iv) riparian areas (including those from which stock are excluded under Rule 70) and the type of riparian vegetation to be planted, how it will be maintained and how weeds will be controlled;

   (v) minimising of the discharge of contaminants to surface water or groundwater, with particular reference to the contaminant pathways identified for the landholding.

Examples of general good management practices are provided on the Southland Regional Council, DairyNZ and Beef and Lamb New Zealand websites and in the document[38] titled "Industry-agreed Good Management Practices relating to water quality, Version 2, 18 September 2015".

[38] Released by FAR, New Zealand Pork, Dairy NZ, beef + lamb New Zealand, Horticulture New Zealand and Deer Industry New Zealand.

From: Lacey Bragg
Sent: Monday, 19 August 2019 3:58 p.m.
To: 'Emma Christmas'; 'Rob Enright'
Cc: 'flettjo@gmail.com'; 'ivan@agribusiness.co.nz'; 'jolene@agribusiness.co.nz'; 'morgan.fallowfield@beca.com'; 'tom.scott@southerndhb.govt.nz'; Stevie Blair; 'office@tami.maori.nz'; 'lindsayyoungman@xtra.co.nz'; Alex Erceg; 'Mike Freeman'; 'Nessa Legg'; 'abe@woldwide.nz'; Aurora Grant
Subject: FW: - APP-20191052 & APP-20191140

Good afternoon,

Please see the below update from Joanne Flett and Sue Flett.

Cheers
Lacey

From: Joanne Flett <flettjo@gmail.com>
Sent: Monday, 19 August 2019 11:07 AM
To: Lacey Bragg <Lacey.Bragg@es.govt.nz>
Cc: sue flett <sueflett@outlook.co.nz>
Subject: RE: - APP-20191052 & APP-20191140

> Hi Lacy,
> In light of the recent amendments to the Woldwide consent applications we would like to change our position to be heard.
> The amendments under the Woldwide Runoff include significant changes from the original proposal for the Merriburn property and as such our position to be heard has changed. We now wish to be heard in support of our submission.
> Can you please forward this to the appropriate people?
>
> We will be available for the hearing dates that have been set although we are not available from the 5th October to the 8th of October.
>
> Thanks
> Joanne Flett and Sue Flett
> Owners of the Merriburn block

Sent from Mail for Windows 10

From: Lacey Bragg
Sent: Monday, 19 August 2019 10:38 AM
To: 'flettjo@gmail.com'; 'ivan@agribusiness.co.nz'; 'jolene@agribusiness.co.nz'; 'morgan.fallowfield@beca.com'; 'tom.scott@southerndhb.govt.nz'; Stevie Blair; 'office@tami.maori.nz'; 'lindsayyoungman@xtra.co.nz'; Alex Erceg; 'Mike Freeman'; 'Nessa Legg'; 'abe@woldwide.nz'; Aurora Grant
Subject: Circulation of Commissioner Minute - APP-20191052 & APP-20191140

Good morning,

Please find attached a Minute from the Commissioners, regarding the Woldwide applications hearing dates.

Kind regards
Lacey

Lacey Bragg
Consents Coordinator
Environment Southland *Te Taiao Tonga*

P 03 211 5115
Cnr Price St & North Rd, Private Bag 90116, Invercargill 9840
Lacey.Bragg@es.govt.nz | www.es.govt.nz | facebook.com/environmentsouthland

IRIS ID: APP-20191052
Enquiries to: aurora.grant@es.govt.nz

environment SOUTHLAND REGIONAL COUNCIL
Te Taiao Tonga

19 July 2019

Nessa Legg
Nessa.dgl@xtra.co.nz

Dear Nessa

Additional application for consent Required

Thank you for lodging an application on behalf of Woldwide One Limited and Woldwide Two Limited.

I have reviewed the application and consider that an application to use and maintain *(or to decommission)* bore E45/0622 is also required. This application is required under the following rules:

- Rule 53(d) of the proposed Southland Water and Land Plan; and
- Rule 22(d) of the Regional Water Plan

This request will not defer the hearing of the applications.

Please contact me if you have any questions regarding this request.

Yours sincerely

Aurora Grant
Team Leader Consents

[1]Under Section 91 of the Resource Management Act.
[2]Under Section 91(3) of the RMA you may apply to the Environment Court for an order directing that any determination under this section be revoked.

CC: Abe and Anita De Wolde – abe@woldwide.nz

For **now**
& **our future**

Our reference: APP-20191052
Enquiries to: Aurora Grant
Email: Aurora.grant@es.govt.nz

environment SOUTHLAND
REGIONAL COUNCIL
Te Taiao Tonga

15 July 2019

Woldwide One Limited and Woldwide Two Limited
C/- Nessa Legg

DairyGreen

By email

Hi Nessa,

Request for Further Information under Section 92(1) of the Resource Management Act 1991 for Woldwide One Limited and Woldwide Two Limited application for a land use consent for farming, water take and discharge permit.

As you are aware, this application is progressing to hearing on the 19th of August 2019. It has come to my attention through the drafting of the S42A report that further information is required to understand the effects of the proposed water take for the proposal.

The application proposes that existing water permits (AUTH-301664 and AUTH-20171278-02) be replaced with a single water permit for groundwater abstraction for WW1/WW2. The application is for a maximum take of 91 m3/day (an increase of 31 m3/day) from bore E45/0071 and a maximum daily abstraction of 96 m3/day (unchanged) from bores E45/0083 and E45/0727, combined. Groundwater abstraction is for use in the dairy shed and for stock drinking water.

Please address and provide[1], in accordance with Section 92(1) of the Resource Management Act, the following information:

1. **Insufficient information has been provided in the consent application regarding the assessment of effects on the freshwater resources associated with the proposed abstraction of groundwater.**
2. The total proposed abstraction of 187 m3/day from bores E45/0071, E45/0083, and E45/0727 is greater than the Environment Southland guidelines (e.g., 120 L/cow/day = 180 m3/day).
3. Importantly, the application states "The rate of take does not exceed 2 L/sec and should not result in more than minimal stream depletion and interference effects" (Pg. 40). Of significance, is that a stream depletion assessment (or demonstration that there are no nearby surface waters) has not been presented in the application, nor has any aquifer test assessment been presented.

For **now**
& **our future**

4. An increase in the abstraction of groundwater is proposed, however there has been no provision of data or assessment of the effects of this abstraction presented in the application. Appendix 1 of the (pWLP, 2016) states that "Minimum aquifer test requirements to support resource consent applications to take groundwater, other than replacement consent applications for abstraction volumes that have been occurring with no adverse effects of a more than minor scale". Therefore, an aquifer test may be required to show the effects of increased abstraction from bore E45/007. The pWLP (2016) Aquifer Test Requirements for < 250 m3/day specify that (at minimum) a standard yield test comprising 2 hours abstraction at the proposed maximum rate with drawdown and recovery of water levels in the pumped bore measured at regular intervals, is required.
5. Furthermore, groundwater level monitoring from bore E46/0110 (Figure 3.5) indicates lower groundwater levels in summer, likely as a result of increased abstraction and decreased rainfall recharge during this period. The effects of increased abstraction from the aquifer should be considered in the context of effects on other users and effects on the groundwater system. Furthermore, since groundwater from the aquifer discharges as baseflow into Waimatuku Stream, the effects of abstraction on surface water quality and quantity of the stream should be considered.

I require this information because I am unable to determine the full effects of the proposal without it.

Under Section 92A of the RMA you have until 15 working days from the date of this request, which we calculate to be 2 August 2019, to either provide the information, tell the Council, in writing, either that you agree to provide the information or that you refuse to provide the information.

This request will not affect the scheduled hearing dates and the hearing will proceed regardless of if the information is provided, however I consider that it would be helpful to have prior to hearing and to avoid delays in the consent

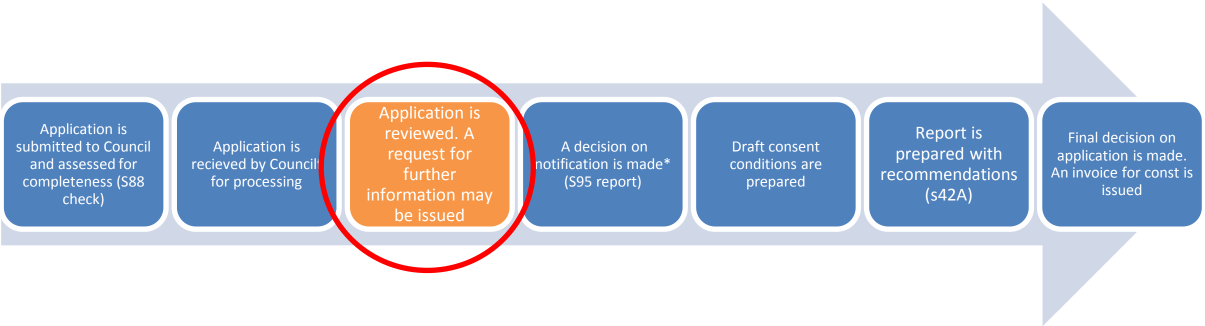
If you refuse to provide the information requested, or if you do not respond to this request, the Council may decline the application on the grounds that it has inadequate information to determine the application.

Please contact me if you have any questions regarding this request.

Yours sincerely

Aurora Grant
Team Leader Consents

Your application is here in the consent process:



*If your application is assessed as needing to be limited or publically notified, you will be contacted regarding the process for these pathways.

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

FORM 13

Submission on a publicly notified application concerning resource consent under section 96, Resource Management Act 1991

To:	Southland Regional Council
Name of submitter:	**Ministry of Education ('the Ministry')**
Address for service:	C/- Beca Ltd PO Box 13960 Armagh Street Christchurch 8141
Attention:	Morgan Fallowfield
Phone:	(03) 367 2494
Email:	Morgan.Fallowfield@beca.com

This is a submission on an application from Woldwide One Limited and Woldwide Two Limited **at** 1200 Hundred Line Road, Bayswater Road, 20 Gill Road and 1711 Otautau Tuatapere Road, Otautau **(legally described as** Part Lot 18 DP 942, Section 420 Taringatura SD, Part Lot 1 DP 4092, Part Lot 18 DP 942, Part Lot 2 DP 4092, Part Lot 1 DP 4092, Part Section 417 Taringatura SD, Section 418 Taringatura SD, Section 419 Taringatura SD, Lot 1 DP 9925, Lot 1 DP 14660, Lot 1 DP 14661, Lot 1 DP 451158, Lot 1 DP 13077, Lot 1 DP 5610 and Lot 1 DP 10885, Lot 4 DP 399915, Part Section 7 Block Xll Waiau SD, Part Section 7 Block Xll Waiau SD, Part Section 7 Block Xll Waiau SD and Lot 1 DP 3537, Lot 1 DP 302409, Sec 26 Merrivale Settlement No. 1 and Sec 27 Merrivale Settlement No. 1**). The application (APP-20191052) is for resource consent for the following;**

<u>Woldwide One Limited and Woldwide Two Limited (located at 1200 Hundred Line Road East Otautau)</u>

- Discharge Permit to discharge dairy shed effluent from up to 1,500 cows and winter barn effluent from up to 1,250 cows, underpass effluent and silage leachate to land via travelling irrigator at 10mm depth, slurry tanker with a trailing shoe at 2.5mm depth, umbilical system at 3mm depth, low rate pods with an instantaneous rate of 10 mm/hr at 10mm depth and a low rate cannon/rain gun with an instantaneous rate of 10 mm/hr at 10 mm depth.
- Land Use Consent to use land for farming including an increase in cow numbers by 160.
- Water Permit to take up to 180,000 litres per day of groundwater from three bores in the Waimatuku Groundwater Zone.
- Land Use Consent to use land to use a winter barn for up to 625 cows at Woldwide One Limited, 1200 Hundred Line Road East, Otautau
- Land Use Consent to use land to use a winter barn for up to 625 cows at Woldwide Two Limited, 1200 Hundred Line Road East, Otautau

<u>Woldwide Farm Limited (known as the Horner Block) located at Bayswater Road, Otautau</u>

- Discharge Permit to discharge winter barn slurry effluent from up to 1,250 cows to land via a slurry tanker at 2.5mm depth and a nitrogen loading that shall not exceed 250 kilograms per hectare per year at Bayswater Road, Otautau.

<u>Woldwide Runoff Limited located at 20 Gill Road Otautau</u>

- Land Use Consent to use land for a farming activity

The specific parts of the application that the Ministry of Education's submission relates to are:

The Ministry's submission relates to the discharge and water permit aspects of the application and how potential discharge of nutrients and take of water may affect the drinking water supply for Heddon Bush School (the School). The School operates a drinking water supply bore on their site, which was installed in 2017 following the failure of a previous bore. The School is located approximately 2.3 km downgradient from the applicant's site at Shaws Trees Road.

Background:

The Ministry is the Government's lead advisor on the education system, shaping direction for education agencies and providers and contributing to the Government's goals for education. The Ministry's overall purpose is:

'Lifting aspiration and raising education achievement for every New Zealander.'

Amongst other matters, the Ministry has responsibility for managing all education property owned by the Crown. They also have a role in ensuring education providers have the resources and support they need to deliver services to students. The safety of students and teachers is a high priority and as such, the Ministry monitors and responds to land use applications that may have a potential impact on the operation of a school or the safety or wellbeing of teachers and students.

Under the Resource Management Act (RMA) 1991, decision makers must have regard to the health and safety of people and communities. Furthermore, there is a duty to avoid, remedy or mitigate actual and potential adverse effects on the environment. The Ministry considers there to be a potential adverse effect from the proposed activity on the safety and wellbeing of students and teachers using drinking water from the supply well at the School.

The Ministry of Education's submission is:

The Ministry opposes the application by Woldwide One Limited and Woldwide Two Limited.

The Ministry are responsible for supplying safe drinking-water to students and staff at Heddon Bush School in accordance with the New Zealand Drinking Water Standards 2008. The Ministry has concerns of the actual and potential adverse effects on the quality and quantity of the drinking-water supply of the School.

In terms of water quality, it appears long term groundwater quality data near the school and farm bores are limited. Groundwater quality testing undertaken in samples from 2 bores (E45/0060 and E45/0330) within ~2 km of the farm showed elevated nitrogen concentrations (near and or above the NZ Drinking Water Standards 11.3 mg/L). There is no apparent trend on Nitrogen concentrations over the years. Nutrients have a "lag time" between when the nutrients are applied and when they reach the groundwater. This means the ultimate effect of extra nutrients being applied to a site is not known immediately. Some effects may be apparent soon after, while others may take 10 or 20 years to show. While the application appears to address some of these concerns by the construction of a monitoring bore south of the Woldwide One Ltd and Woldwide Two Limited site to monitor groundwater quality, the application does not provide a proposed location, depth and frequency of sampling and testing and proposed trigger levels.

In terms of water quantity, the application requests an increase in their water take up to 180,000 litres per day of groundwater from three bores at a rate of 2L/s in the Waimatuku Groundwater Zone. However, the application does not include a quantitative interference assessment on other bores in the vicinity of the site. Usually the long-term drawdown from the pumping wells and its interference on other wells is calculated using a predictive model such as Theis equation and as such, a quantitative interference assessment should be undertaken in order to ascertain the effect on the School's bore.

The Ministry of Education seeks the following decision from the consent authority:

The Ministry seeks the application is refused unless:

(i) The applicant establishes that the water quality of the Heddon Bush School bore is not adversely affected by the discharge of contaminants (including Nitrogen and E.coli) from the proposed operation. If a monitoring bore is proposed as part of the operation the proposed location, proposed depth and frequency of sampling and testing and the proposed trigger levels need to be specified by the applicant.

(ii) The applicant provides a quantitative interference assessment to establish that the water supply of the Heddon Bush School bore is not adversely affected.

The Ministry wishes to be heard in support of their submission.

(Signature of person authorised to sign on behalf of the Ministry of Education)

Date: 8 May 2019

TE AO MARAMA INC.

8 May 2019

Consents Manager
Environment Southland
Private Bag 90116
Invercargill

Tēnā Koe,

RE: Submission on Resource consent application-APP-20191052

Please find attached a submission lodged, on behalf of Te Rūnanga o Oraka Aparima on Resource Consent applications by Woldwide One Limited and Woldwide Two Limited.

We trust the information contained within the submission is sufficient; however, should you wish to discuss any aspect further, please do not hesitate to contact me.

Nāhaku noa nā,

Stevie-Rae Blair
Te Ao Marama Inc.
Māori Environmental Advisor

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

To:	The General Manager Environment Southland Private Bag 90166 Invercargill 9840
Consents Officer:	Aurora Grant
Name of Submitter:	Te Rūnanga o Oraka Aparima
Prepared by:	Te Ao Marama Inc PO Box 7078 South Invercargill Invercargill 9844
Proposal:	Woldwide One Limited and Woldwide Two Limited

- Discharge Permit to discharge dairy shed effluent from up to 1500 cows and winter barn effluent from up to 1250 cows, underpass effluent and silage leachate to land via travelling irrigator at 10mm depth, slurry tanker with a trailing shoe at 2.5mm depth, umbilical system at 3mm depth, low rate pods with an instantaneous rate of 10mm/hr at 10mm depth and a low rate cannon/rain gun with an instantaneous rate of 10mm/hr at 10mm depth.
- Land Use Consent to use land for farming including an increase in cow numbers by 160.
- Water Permit to take up to 180,000 litres per day of groundwater from three bores in the Waimatuku Groundwater Zone.
- Land Use Consent to use land to use a winter barn for up to 625 cows at Woldwide One Limited, 1200 Hundred Line Road East, Otautau
- Land Use Consent to use land to use a winter barn for up to 625 cows at Woldwide Two Limited, 1200 Hundred Line Road East, Otautau

Woldwide Farm Limited (known as the Horner Block)

- Discharge Permit to discharge winter barn slurry effluent from up to 1,250 cows to land via a slurry tanker at 2.5mm depth and a nitrogen loading that shall not exceed 250 kilograms per hectare per year at Bayswater Road, Otautau.

Woldwide Runoff Limited

- Land Use Consent to use land for a farming activity

Our position:	We are opposing this application and wish to be heard in support of this submission. The TAMI submission relates to the part of the application to expand cow numbers. TAMI wishes the application to be declined. If others are making a similar submission, TAMI will consider presenting a joint case with them at a hearing. A copy of this submission has been sent to the applicant.

GENERAL POSITION

1. This submission has been prepared by Te Ao Marama Incorporated on behalf of Te Rūnanga o Oraka Aparima.
2. Te Rūnanga o Oraka Aparima (hereafter referred to as Ngāi Tahu) is supportive of development within its takiwā, provided activities are undertaken in a way that respects the environment where the activity to be undertaken does not adversely affect Ngāi Tahu cultural values, customs and their traditional relationship with land and water.
3. Ngāi Tahu understand that Woldwide One Limited and Woldwide Two Limited (herein referred to as the applicant) wish to add 160 cows to their milking platforms, to discharge farm dairy effluent to land from a maximum of 1500 cows, water permit to extract water from the Waimatuku Groundwater Zone, to discharge winter barn slurry to land and a land use consent to use land for a farming activity. Ngāi Tahu understand this is an existing activity in the catchment but the applicant wishes to expand cow numbers and to combine the discharge and water permits at the applicants dairy platforms into one consent.
4. The Ngāi Tahu ki Murihiku Iwi Management Plan ('Te Tangi a Tauira') [1] has policy that is directly relevant to the management of farm dairy effluent, water permits and discharges (section 3.5.1, 3.5.11 – 3.5.14).

Papatipu Rūnanga

5. Te Rūnanga o Ngāi Tahu Act, 1996 (the TRoNT Act) and the Ngāi Tahu Claims Settlement Act, 1998 (the Settlement Act) gives recognition to the status of Papatipu Rūnanga as kaitiaki and manawhenua of the natural resources within their takiwā boundaries.
6. The consent application proposals relate to an existing activity to which the applicant would like to expand. The takiwā of Te Rūnanga o Oraka Aparima.

Te Ao Marama Incorporated

7. Ngāi Tahu ki Murihiku formed an entity known as Te Ao Marama Incorporated, which is made up of representatives from Waihopai Rūnaka, Te Rūnanga o Awarua, Te Rūnanga o Oraka Aparima and Hokonui Rūnaka. Te Ao Marama Incorporated is authorised to represent the four Southland Rūnanga Papatipu in resource management and local government matters.

---

[1] Ngai Tahu ki Murihiku, 2008.

REASONS FOR SUBMISSION

8. Te Rūnanga o Ōraka Aparima are concerned with the current state of water quality in the region. Water quality in the region needs to be maintained and/or improved.
9. Te Rūnanga o Ōraka Aparima are opposed to this application because of the potential risks to the environment (including groundwater and surface water) and Ngāi Tahu values that it poses.
10. Te Rūnanga o Ōraka Aparima opposes this application on the grounds of current degraded state and the need to avoid the risk of further deterioration to the environment and Ngai Tahu values and cultural wellbeing.

DECISION WE WISH COUNCIL TO MAKE

11. That the application is declined

CONCLUSION

12. We wish to be heard in support of our submission.
13. We wish to be a part of any pre-hearing meeting that may be held for this application.

Nāhaku noa nā

Stevie-Rae Blair

Te Ao Marama Inc.

Māori Environmental Advisor

From: Mikayla Scott on behalf of Facility Manager
Sent: Tuesday, 7 May 2019 4:36 p.m.
To: Bronwyn Auckram
Subject: FW: Submission from Public Health South - Woldwide 1 and Woldwide 2 Ltd
Attachments: Woldwide 1 and 2.pdf; Woldwide 1 and 2 App 2.pdf

From: Tom Scott [mailto:Tom.Scott@southerndhb.govt.nz]
Sent: Tuesday, 7 May 2019 4:34 p.m.
To: Facility Manager
Subject: Submission from Public Health South - Woldwide 1 and Woldwide 2 Ltd

Hi,

Here is Public Health South's submission on the recent applications by Woldwide 1 and 2.

The second document is the second appendix to the original submission.

Take Care and Kind Regards

Tom

Tom Scott | Team Leader - Healthy Environments, Public Health South | Southern DHB
Private Bag 1921, Dunedin 9054, New Zealand | office: 03 476 9746 | mob: 027 5100062 | fax: 03 476 9858 | tom.scott@southerndhb.govt.nz

Kind – Manaakitanga | Open – Pono | Positive – Whaiwhakaaro | Community – Whanaungatanga

SUBMISSION ON AN APPLICATION FOR RESOURCE CONSENT UNDER SECTION 95 (a) OF THE RESOURCE MANAGEMENT ACT 1991

To: Environment Southland
Cnr North Rd and Price St
Waikiwi
Invercargill 9810

Submitters name: Public Health South on behalf of Southern District Health Board

1. This is a submission on an application by Woldwide One (WW1) and Woldwide Two (WW2) Limited (reference number APP-20191052) for a resource consent to discharge dairy shed effluent from up to 1500 cows, and to discharge winter barn effluent from up to 1250 cows, discharge from the underpass and silage leachate; and associated land use and water take consents.

2. **Background to submission**

The reasons for this submission are to promote the reduction of adverse environmental effects on the health of people and communities, and to improve, promote and protect their health pursuant to the New Zealand Public Health and Disability Act 2000 and the Health Act 1956. These statutory obligations are the responsibility of the Ministry of Health and in the Southland District the obligations are carried out under contract by Public Health South (under Crown funding agreements, on behalf of the Southern District Health Board). The Ministry of Health requires Public Health South to reduce any potential health risks by means including submissions, on resource consents to ensure the public health significance of effluent discharge and the effect on ground water is adequately considered by consent authorities. This application has the potential to create adverse effects from contamination of ground water on the health of people and communities.

3. **Criteria considered by PHS to assess his application.**

3(1). The proposed Southland Water and Land plan (pSWLP) which is "*...intended to provide direction and guidance regarding the sustainable use, development and protection of water and land resources in the Southland region*".

There are 18 objectives outlined in the pSWLP and objectives 1 and 6 are particularly relevant for this application and are outlined here for ease of reference:

Objective 1

Land and water and associated ecosystems are managed as integrated natural resources, recognising the connectivity between surface water and groundwater, and between freshwater, land and the coast.

Objective 6

There is no reduction in the quality of freshwater, and water in estuaries and coastal lagoons, by:

a) maintaining the quality of water in waterbodies, estuaries and coastal lagoons, where the water quality is not degraded; and

b) improving the quality of water in waterbodies, estuaries and coastal lagoons, that have been degraded by human activities.

3(2). National Policy Statement for Fresh Water

Objective A1 Water quality

To safeguard

a) the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of fresh water; and

b) the health of people and communities, as affected by contact with fresh water; in sustainably managing the use and development of land, and of discharges of contaminants

Limit setting

a) Setting limits for water quality and quantity is one of the requirements for all regional councils under the Government's National Policy Statement for Freshwater Management. Limits include restricting the amount of contaminants that can be discharged into waterways and how much water can be removed (extracted). The limit setting process is the third main component of your Water and Land 2020 and Beyond project.[1] Public Health South suggests that until proposed catchment limit setting processes are completed, the application should not be granted.

3(3). Resource Management Act

Section 5: Purpose

1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while:

   a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

   b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

   c) avoiding, remedying, or mitigating any adverse effects of activities on the environment

Section 7: Other Matters

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to—

b) the efficient use and development of natural and physical resources:

d) intrinsic values of ecosystems:

f) maintenance and enhancement of the quality of the environment:

g) any finite characteristics of natural and physical resources:

i) the effects of climate change:

j) the benefits to be derived from the use and development of renewable energy.

4. Reasons for Submission

Public Health South provides this submission for the following reasons:

A 30% increase in the number of cows is a significant increase in the load on an already degraded catchment. The application is likely to adversely impact the environment and does not meet the requirements of the above assessment criteria for the reasons outlined below.

4(1) Nitrate levels

[1] Environment Southland 2015 Water and Land and Beyond 2020. At http://waterandland.es.govt.nz/setting-limits

b) Monitoring of consented bores within a 2.5km radius of the applicant's property began in 1996. Analysis shows an average nitrate concentration of $9.5g/m^3$ which is well in excess of the background nitrate levels across Southland of 0.4-1.0g/l[1]. This level is considered appropriate for modern day background levels as this shows only diffuse inputs of NO_3-N from human activity.[2]

c) Moreover, close to half of bores used for drinking water in a 2-4 km radius of the applicant's property (data supplied by Environment Southland) exceeds 50% of the Maximum Allowable Value (MAV) for Drinking Water in NZ.[3] Since 2015 data from bores within 2 to 4 km from WW1 show that 81% of bores exceed more than 50% of the MAV in the Drinking Water Standards for NZ.

d) The international literature has emerging findings of elevated levels of nitrate in drinking water and its impacts on health. A recent Danish study[4] has associated the risk of colon cancer with increased nitrate levels in drinking water. The study found statistically significant increased risks at drinking water levels above 3.87 mg/L; this is well below the current drinking water standard of 50 mg/L. This study casts some doubt on the current drinking water standard and chronic effects, as it indicates that there are increased risks of colorectal cancer at drinking water nitrate concentrations below the current drinking water standard.

The applicant has not considered how their operation may impact on any other domestic drinking water takes in regard to contributing to an increase in nitrate levels in water. Nor have they considered how their operation will contribute to the total nitrogen loading of the catchment.

5. Cumulative impacts resulting in degradation of waterways

5(1) Waimataku

The Waimataku catchment discharges into coastal waters on Oreti Beach. There is a strong correlation between eutrophication of coastal waterways and the incidence of paralytic shellfish poisoning, neurotoxic shellfish poisoning, amnesic shellfish poisoning, ciguatera fish poisoning and various other HAB phenomena such as fish kills, loss of submerged vegetation, shellfish mortalities, and widespread marine mammal mortalities[5].

5(2) Oreti River

It is noted the Oreti River is described as being in the worst 25% of rivers of its category for total nitrogen, total oxidised nitrogen, dissolved reactive phosphorous, total phosphorous and E.coli according to the LAWA[6] website. This clearly does not align with Objective 6 of the pSWLP. This is a whole of catchment issue as key findings in the quality of Coastal Waters Report for Southland indicated the current magnitude of land use across the region, including seawater off Oreti beach is now no longer nitrogen limited. Therefore the risk of Harmful Algal Blooms (HAB) has increased markedly.

Given Oreti is the only site with long term monitoring, it is hard to know if the near coastal environments associated with the discharges from the Waiau, Mataura and Aparima Rivers are also no longer limited with regard to nitrogen. If nitrogen is no longer limited at other beaches impacted by these rivers, we have now greatly increased the risk of HAB in coastal waters.

[2] Rissmann 2012 The Extent of Nitrate in Southland Groundwaters Regional 5 Year Median (2007–2012 (June)) Technical Report

[3] Pers correspondence and report for Public Health South Chris Noakes ESR Christchurch March 2018

[4] https://www.ncbi.nlm.nih.gov/pubmed/29435982

[5] US National Library of Medicine 2009 Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States Harmful Algae. Author manuscript; available in PMC 2009 Dec 1.Published in final edited form as: Harmful Algae. 2008 Dec 1; 8(1): 39–53.

[6] https://www.lawa.org.nz/explore-data/southland-region/river-quality/oreti-river/bog-burn-ds-hundred-line-road/

The latest 2019 six monthly report from Ministry for the Environment and Stats NZ - Aotearoa NZ reports on river and groundwater trends over NZ[7]. It includes modelled indicators of river "health" such as the macroinvertebrate community index or MCI, *E coli* and Nitrate – N. For the lowland Southland area, the modelled median values for MCI 2013 – 17 summarises that in general river water quality is in fair condition only. For the modelling based on 2008 – 2017 the trend indicates that in general river water quality is either indeterminate or very likely to be worsening.

Similarly the trend indicates that for the period 2008 – 2017 E.coli levels are worsening in lowland Southland in general and very likely worsening in the upper reaches within Southland. The trends show moderate to high levels (based on median) in the lower reaches of these rivers (exceed 361.2 E coli MPN/100ml).

E coli provides a good indication of the risk associated with contracting Campylobacter as well as serving as an indicator for other enteric diseases.

While this section relates to water quality in rivers in lowland Southland, in general it is clear that agricultural intensification is contributing significantly to degraded environments in lowland Southland.

6. Health Impacts

More cattle will produce more effluent and higher loads of micro-organisms including pathogenic organisms such as Campylobacter, Cryptosporidium, Giardia, and Salmonella. These leach into the ground with irrigation and move into the aquifers. Drinking water taken from ground bores can no longer be considered secure and therefore contribute to the risk of outbreaks of disease. The Havelock North outbreak of campylobacter in August 2015 is an example of widespread illness from a water reticulation system.

Findings from the stage 2 inquiry were that '...the vast majority of New Zealand's waterborne disease burden arises not from significant outbreak events... but from underlying sporadic waterborne illness that is never linked to a particular outbreak. It is estimated that up to 100,000 people become ill in this way from consuming drinking water every year.[8]

Local notifiable disease surveillance data shows high rates of these infections in the Southern district compared to NZ as a whole. This is underestimated as many cases go undetected for a variety of reasons. Public Health submits that an increase in cows in this catchment will add pathogens to the ecosystem that in turn will add to the increasing burden of illness, and that the applicant has not taken this sufficiently into consideration in the proposed mitigations.

The issue of antibiotic resistance has been raised as one of six new environmental issues of 2017 by the United Nations. According to the World Health Organization, we may be entering a post-antibiotic era when previously treatable bacterial infections can kill and routine medical procedures that rely on antibiotic preventative treatment will no longer be possible. Once consumed, most antibiotic drugs are excreted unmetabolized, along with resistant bacteria. They can then pass either through sewage systems or more directly into water and soils, and mix with environmental bacteria in the presence of other pollutants that may add further pressure to help select for antibiotic resistance. This principle applies in agriculture as it does in human settings. Although the use of antibiotics as a livestock growth promoter has not been practiced in New Zealand, antibiotics are still used to treat animal health conditions and there is a high probability there will be bacteria in the environment relating to this application that have developed resistance to antimicrobial residues.[9]

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[7] http://www.mfe.govt.nz/node/24964/

[8] Havelock North enquiry proceedings 2017 paragraph 82 at https://www.dia.govt.nz/diawebsite.nsf/Files/Report-Havelock-North-Water-Inquiry-Stage-2/$file/Report-Havelock-North-Water-Inquiry-Stage-2.pdf

[9] UN Environment 2017. Frontiers 2017 Emerging Issues of Environmental Concern

7. Soil Characteristics

The shrinking and cracking characteristics associated with the high permeability Braxton soil types in the Waimatuku catchment are the same as those that impacted the Havelock North community.[10] These soils are prone to shrinking and cracking during drier months allowing nitrates and other contaminants to leach directly to underlying groundwater.[11] We understand this application is based on the use of Overseer® that does not apply well to the soil types applicable to this application.[12]

8. Precedent

Granting this application would set a precedent that allows other dairy farmers to make significant increases in their herd with consequent contributions to increased contamination from pathogens and nitrogen and the continued degradation of freshwater environments.

9. Regulatory Framework

This application is contrary to the Southland land and water plan objective 1 and 6; Objective A1 relating to water quality of the National Environmental Standard for Freshwater. Public Health South also considers that this application appears to promote an outcome that is contrary to the provision of Part 2 of the Resource Management Act, in that:

i) The increased intensification and conversion to dairying of existing dry stock land may increase the contamination of surface and groundwater; and therefore may not enable the people or community in the area to provide for their social, economic and cultural well-being, or for their health and safety (s5(2)).

ii) The proposed consents sought if granted will not enable the maintenance and enhancement of amenity values (s7(c)). The ability for the public to enjoy the recreational water activities and amenities down gradient of the farm(s) will potentially be impacted by the proposed consents.

iii) The National Policy Statement for Freshwater Management[13] which underpins many of the policies in the Proposed Southland Water and Land Plan states a national target for improved water quality for swimming in lakes and rivers (90% by 2040). Similarly the policy requires councils to set policy to safeguard:

   a) The life supporting capacity ecosystem processes and indigenous species including their associated ecosystems of freshwater.

   b) The health of people and communities as affected by contact with fresh water in sustainably managing the use and development of land and of discharge of contaminants.

In summary, while the application includes mitigation of effects including agricultural management practices, overall our assessment is that this application does not contribute towards meeting the above targets and objectives.

10. Position

Public Health South Southern District Health Board opposes this application.

The decision sought in the event that consent is granted, is the imposition of adequate conditions related to the mitigation of potential human health risks as described:

(i) Efforts need to be undertaken to remove E.coli and pathogens from effluent before application to pasture.

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[10] Rissmann pers. communication Jan 2018

[11] Environment Southland. Central Plains Technical Information. *Water and Land 2020 & Beyond*

[12] Aqualink (2017) Assessment of Environmental Effects prepared for Woldwide One Ltd

[13] National Policy Statement for Freshwater Management Ministry for the Environment 2014 revised 2017

(ii) Specific compliance monitoring bores are established on the property that represent an adequate reflection of groundwater quality that is impacted by the operation. As such these bores need to be shallow and at a depth that reflect water from an unconfined aquifer.

(iii) Bores need to be sampled at the beginning, middle and end of the recharge period. Analytes need to include nitrate, nitrogen and E-coli as a minimum.

(iv) The consenting authority (ES) should review the Waimatuku Catchment early in the up coming catchment limit setting process and consider withholding consent for this application until it has been completed.

(v) We support conditions relating to the Farm Management Plan including the use of hard stand for wintering and wet weather, cut and carry proposals and that effluent (subject to condition (i) above) discharge shall not be at times of saturated soil or dry conditions where there are obvious cracks.

(vi) The consent authority should consider a reduction in the herd numbers applied for or at least an increase staged over time to ensure that data from monitoring supports the assumptions made regarding the effects on groundwater.

This submitter is not a trade competitor of the Applicant for the purposes of s.308 of the Act.

This submitter will wish to be heard in support of this submission.

Dated at Dunedin 30th day of April 2019

Signed

Tom Scott

For and on behalf of Public Health South, Southern District Health Board

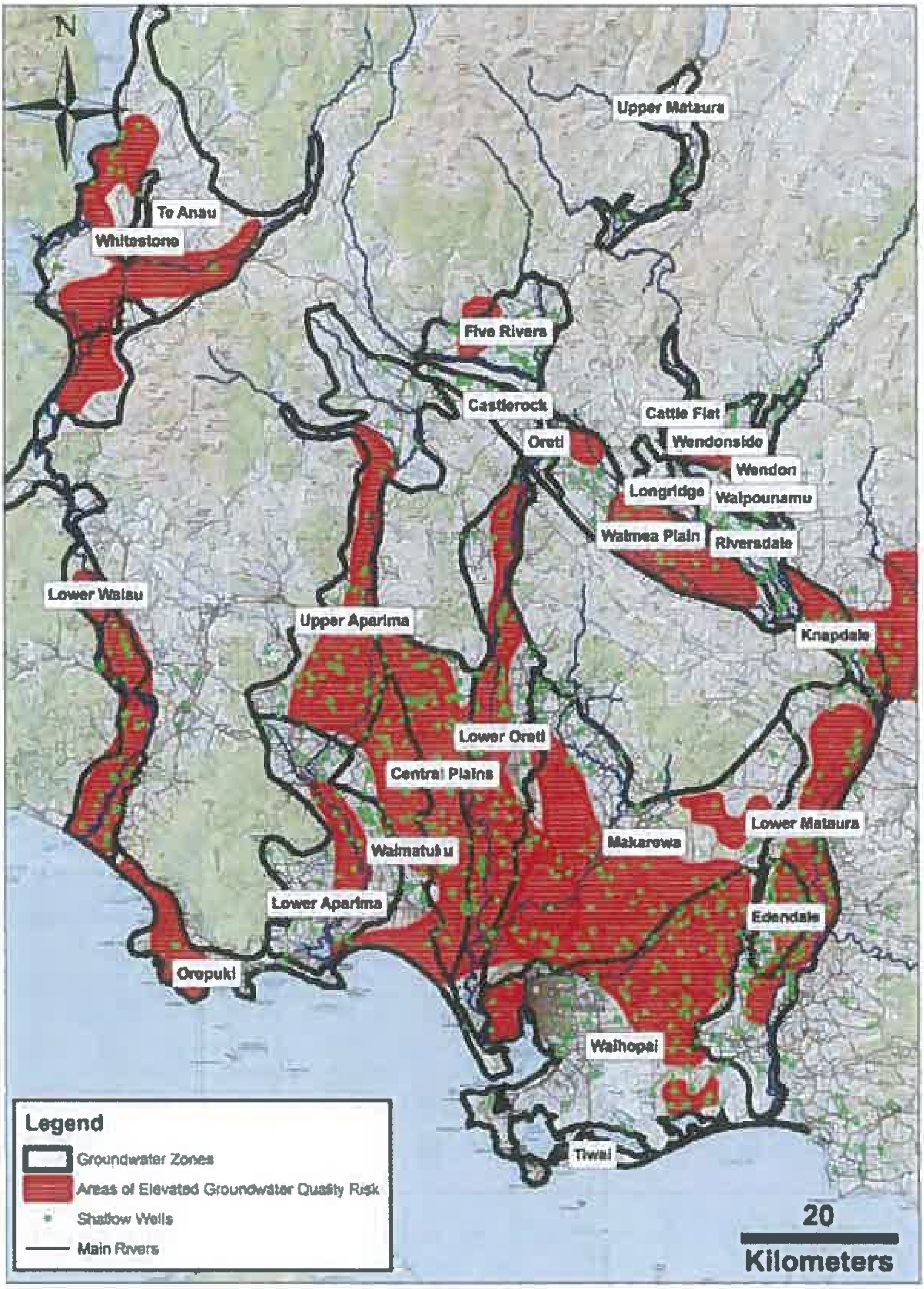
Address for service
Attention: Tom Scott

Email: tom.scott@southerndhb.govt.nz

DDI: 034769746
Fax: 034769858

Appendix 1

Nitrate Affected Groundwater in Southland – Clint Rissman 2012 The Extent of Nitrate in Southland Groundwaters Regional 5 Year Median (2007–2012 (June)) Technical Report



Appendix two: Southland District Council five year surveillance summary for three water-borne enteric notifiable diseases

Public Health South undertakes the surveillance and control of notifiable diseases in the Otago and Southland Health Districts (hereafter the Southern region). The region consists of 8 territorial authorities (TAs) including Waitaki District Council, Dunedin City Council, Clutha District Council, Gore District Council, Invercargill City Council, Southland District Council, Central Otago District Council and Queenstown Lakes District Council.

This report summarises surveillance information from Southland District Council for three notifiable enteric diseases - campylobacteriosis, cryptosporidiosis, and giardiasis that may be partially attributable to poor water quality for the five-year period 1 January 2013 to 31 December 2017.

Enteric diseases campylobacteriosis, cryptosporidiosis and giardiasis

Campylobacteriosis, giardiasis and cryptosporidiosis are gastrointestinal diseases caused by infection with the Campylobacter bacteria, Giardia parasite and Cryptosporidium parasite respectively. These organisms are routinely found in the intestinal tract and faeces of cows, sheep, deer and birds but do not necessarily cause illness in these animals. In contrast these organisms usually cause clinical illness in humans and are therefore considered as pathogens.

Each of these diseases can be transmitted to humans from contact with the faeces of infected animals and humans. Other transmission pathways may be through either contaminated water, contaminated food, and/or contact with infected animals and humans. Younger children and people who are immune-compromised are more likely to be infected, and to have more severe disease.

Faecal contamination is the primary source of pathogens in freshwater[1]. Therefore exposure to freshwater that has been polluted by faeces from various species of birds, animals and either treated or raw human sewage represents a risk to health. Faecal source tracking is a relatively new technology that allows the identification of specific faecal source groups. This in turn permits directed, efficient and cost-effective remediation efforts in the catchment such as the restriction of livestock numbers or the improvement of waste water collection and treatment. Microbial source tracking can then also be used to evaluate the efficiency of such measures[2].

The Institute of Environmental Science and Research (ESR) has developed a risk model showing that there is increased risk with increased levels of *E.coli* and that the risk of adverse health impacts was highest when there is exposure to faecal material from cows, pukeko, Canada geese and treated sewage, and lower risk following exposure to faecal material from deer, duck, and raw sewage[1].

Notifications of campylobacteriosis, cryptosporidiosis and giardiasis to Public Health South

Lake et al[3] estimated that in NZ only 1/222.3 (0.4%) of acute gastroenteritis community cases resulted in a notification. This is because some people are infected but asymptomatic, some ill people do not visit a doctor, some doctors do not report a suspected case, some doctors do not request a faecal specimen, some people do not provide a requested faecal specimen, and many potential waterborne illnesses are not notifiable.

While the numbers of notifiable diseases are known there are difficulties in estimating the true burden of notifiable diseases in NZ. It is also difficult to link sporadic cases of gastrointestinal illness such as campylobacteriosis or giardiasis to particular sources. It is accepted that the rates of gastrointestinal illness in NZ are generally underestimated.

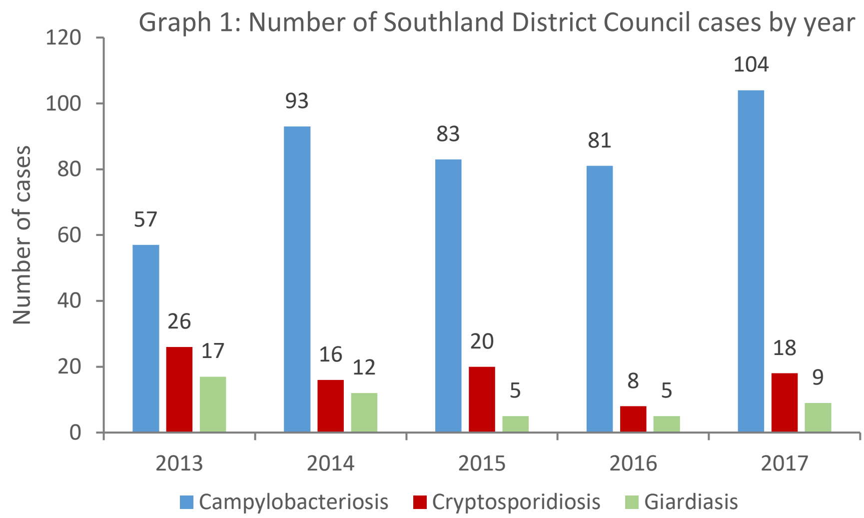
[1] "Faecal Pollution Source Risks" (Wood et al Feb 2018)

[2] "Quantitative microbial faecal source tracking with sampling guided by hydrological catchment dynamics" Reischer et al 2008

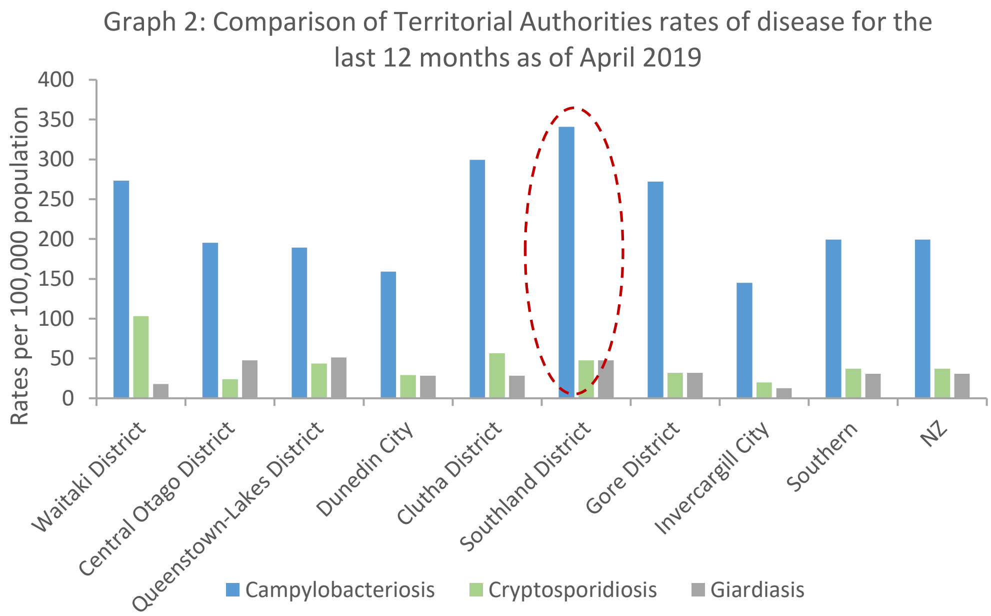
[3] "Acute Gastrointestinal Illness (AGI) Study" (Lake et al, 2009)

Between 1 January 2013 and 31 December 2017 Public Health South received 6212 reports of all notifiable disease cases. There is annual variation of disease notifications (2013:1326, 2014:998, 2015:1108, 2016:1101, and 2017:1679) with the annual average for the 5-year period of 1242 notifications.

During the report period campylobacteriosis, cryptosporidiosis and giardiasis made up 62% of total notifications for the Southern region (3826/6212). Of these, 554 (14.5%) cases were in Southland District Council with the majority being campylobacteriosis 75% (418/554) followed by cryptosporidiosis 16% (88/554), and giardiasis 9% (48/554). Notifications are shown in Graph 1.



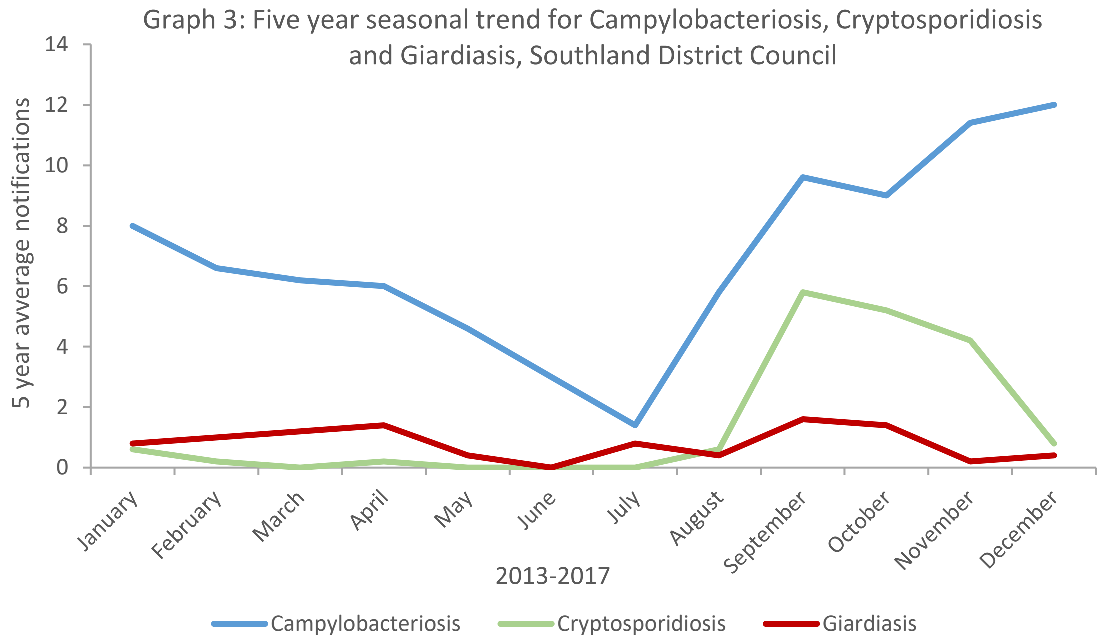
Across the whole of Otago and Southland campylobacteriosis is the most commonly notified disease. For the 12 month period to April 2019 Southland District Council has the highest rate at 340 cases per 100,000 population. This is higher than for NZ as a whole as shown in Graph 2. This also shows that rates of cryptosporidiosis and giardiasis are similar across all local authorities and NZ as a whole, apart from Waitaki District where higher rates of cryptosporidiosis are observed.



Seasonal trends

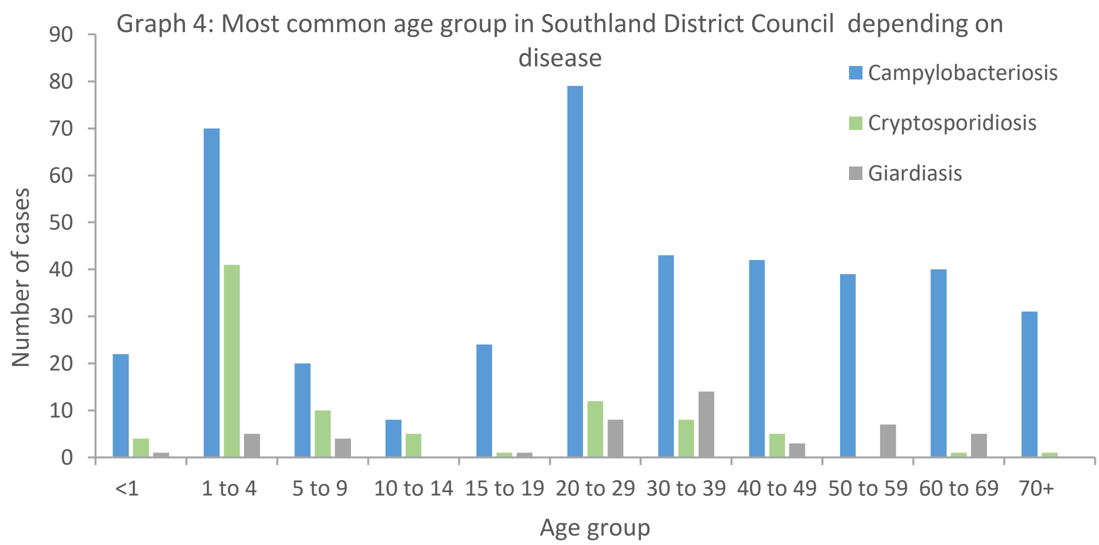
There are seasonal trends for campylobacteriosis in the Southern region starting with an increase in spring, peaking in summer and declining in autumn. This trend is also seen in Southland District Council.

For cryptosporidiosis, the regional trend is for a spring peak with few cases during the rest of the year, which is again reflected in Southland District Council. Giardiasis however does not have such distinct seasonal trend. It is relatively consistent when looking at the average number of notifications for the entire region over the 5-year period. Small peaks typically occur in April and September. However, in Southland District Council the average number of notifications over the 5-year period is more variable but the peaks have also occurred in April and September.



Age and gender information

Campylobacteriosis is more common in the 20 to 29 year old age group followed by the 1 to 4 year old age group. With cryptosporidiosis it is the 1 to 4 year olds who are most likely to be affected. For both these diseases males are more likely to be affected. Giardiasis cases are most commonly found in the 30 to 39 year old age group with a predominance of females.



Hospitalisation

Over the five year period, 47 (8%) of cases notified from Southland District Council were hospitalised which included 42 campylobacteriosis cases and 5 cryptosporidiosis cases. One campylobacteriosis case was reported to have died, however the notifiable disease was not the primary cause of death.

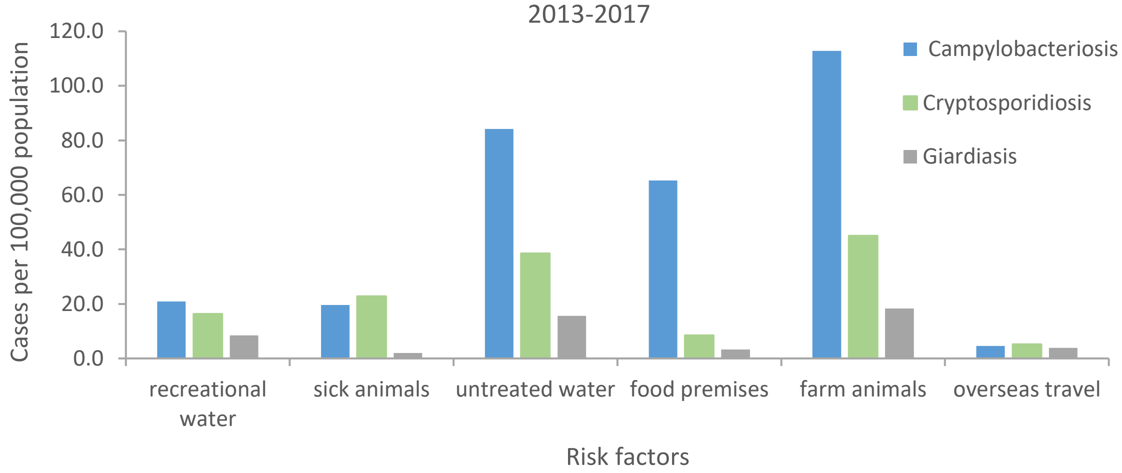
Investigation process to identify risk factors

One purpose of investigating notified diseases is to identify potential risk factors so that appropriate public health measures can be put in place. Case investigations are based on specific disease questionnaires, with questions about the known risk factors associated with a particular disease. Questions common to all three diseases include environmental exposures such as drinking water, recreational water, animal contact, travel and contact with symptomatic people. Questions relating to high-risk foods vary depending on the disease.

There are some limitations with data collection, for example, the length of time from illness to notification and the length of time from notification to investigation can result in issues of recall. For cases self-completing a questionnaire, the data may be incomplete or not completed at all despite numerous attempts to contact the case. These issues contribute to under notification of these three diseases.

In most cases multiple risk factors may be identified and without further evidence such as water or food samples, it is difficult to confirm the source of infection. Most cases do not have a confirmed source, although a probable source or multiple sources may be suspected. Graph 5 below shows the various risk factors reported for each of the three diseases within Southland District Council.

Graph 5: Southland District Council cases per 100,000 reporting on risk factors, 2013-2017



The three tables below show that contact with farm animals and untreated water are the two most common risk factors for all three diseases. They also show the number and proportion of cases for all risk factors for each disease.

Table 1: Risk factors associated with campylobacteriosis cases in Southland District Council, 2013-2017

Risk factor	Yes	No	total	%
Contact with farm animals	173	78	251	68.9%
Consumed untreated water	129	95	224	57.6%
Consumed food from retail premises	100	135	235	42.6%
Contact with sick animals	30	184	214	14.0%
Recreational water contact	32	214	246	13.0%
Contact with symptomatic people	20	219	239	8.4%
Travelled overseas during the incubation period	7	244	251	2.8%

* % refers to the number of cases who answered "yes" out of the total number of cases for which this information was known. Some cases have more than one risk factor recorded.

Table 2: Risk factors associated with cryptosporidiosis cases in Southland District Council, 2013-2017

Risk factor	Yes	No	total	%
Contact with farm animals	69	12	81	85.2%
Consumed untreated water	59	13	72	81.9%
Contact with sick animals	35	38	73	47.9%
Recreational water contact	25	52	77	32.5%
Consumed food from retail premises	13	62	75	17.3%
Contact with symptomatic people	12	64	76	15.8%
Travelled overseas during the incubation period	8	71	79	10.1%

* % refers to the number of cases who answered "yes" out of the total number of cases for which this information was known. Some cases have more than one risk factor recorded.

Table 3: Risk factors associated with giardiasis cases in Southland District Council, 2013-2017

Risk factor	Yes	No	total	%
Contact with farm animals	28	19	47	59.6%
Consumed untreated water	24	17	41	58.5%
Contact with symptomatic people	14	28	42	33.3%
Recreational water contact	13	33	46	28.3%
Travelled overseas during the incubation period	6	39	45	13.3%
Consumed food from retail premises	5	36	41	12.2%
Contact with sick animals	3	37	40	7.5%

* % refers to the number of cases who answered "yes" out of the total number of cases for which this information was known. Some cases have more than one risk factor recorded.

Conclusions

This report summarises routinely collected surveillance information available for campylobacteriosis cryptosporidiosis and giardiasis cases notified to Public Health South for the Southland District Council's area over a five year period. Campylobacteriosis cryptosporidiosis and giardiasis are the most common enteric diseases notified to Public Health South. The organisms that cause these diseases are found in the gastrointestinal tract and faeces of birds, cows, sheep and deer but do not always cause disease in these animals. However these organisms can be transmitted to humans via contact with water contaminated by animal faeces, or by direct contact with animals and/or their faeces, and by direct contact with infected humans. An increase in the number of cows on a property or intensification will contribute more faecal material to the farmed land and increase the risk of contamination of freshwater by these pathogens

Although there are some limitations to the data the following conclusions can be drawn:

1. For the 12 months to April 2019, Southland District Council had 340 cases of campylobacteriosis notified per 100,000 population. This is the highest rate in the Southern region and is associated with the highly rural nature of Southland District Council where pastoral farming especially dairy is common.

2. Cases of these three diseases contribute a significant burden of illness in the Southland District Council community with 8% of notified cases needing hospital care. As less than 1% of cases are estimated to actually be notified the true burden of disease is likely to be much higher.

3. The two most common risk factors for cases are contact with farm animals and consumption of untreated water. Most cases have been exposed to several risk factors which makes risk attribution difficult and in most cases a single source is not identified.

4. Faecal contamination is the primary cause of pathogens in fresh water, with *E.coli* used as an indicator of the presence of human pathogens. Faecal source tracking is a new technology that

enables the likely source of contamination to be identified and helps characterise the level of risk to human health. This can be used to provide efficient and cost-effective remediation efforts in the catchment like the restriction of livestock numbers.

To: The Chief Executive

Environment Southland

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Invercargill

policy@es.govt.nz

From: Mid-Aparima Catchment Group

C/O Jolene Germann (jolene@agribusiness.co.nz) – secretary

647 Otautau Nightcaps Road

RD1 Otautau 9689

Edwin Mabonga (iemabonga@xtra.co.nz) – chairman

Date: 7th May 2019

We wish to support the application of: Woldwide One Ltd and Woldwide Two Ltd [reference APP-20191052]

Trade competition:

We could not gain an advantage in trade competition through this submission.

Hearings:

We wish to be heard in support of our submission; and we would be prepared to consider presenting our submission in a joint case with others making a similar submission at the hearing.

Background:

This submission is from the Mid-Aparima Catchment Group. This group was formed in May 2016 and is a sub-catchment of the Aparima Freshwater Management Unit. Our group includes land owners and stakeholders from Otautau, north to Wreys Bush Nightcaps Road to the Wreys Bush Bridge, also encompassing the Bayswater area. We are passionate about where we live and contributing sustainably to our community. We value water quality, as well as the economic, social and cultural progression of our community and the whole of Southland.

Vision:

"To be good stewards of the environment, while maintaining economic sustainability"

Values/Purpose:

- Improve water quality in the Mid-Aparima catchment area
- Build relationships within our community – we are in this together
- To increase awareness and interest around water quality, and interest in local and national policies regarding this
- To provide creditable education, based on science, to promote best practice management
- To work productively with all other organisations involved with water quality

Goals:

- To have an inclusive group that includes members from all sectors of our community
- To represent the interests of members of our group to local and national policy makers
- To build and maintain good working relationships with policy makers and a good reputation amongst the community
- To encourage our members to be leaders with respect to technology adoption and good practice management

Catchment Group Area:

Including Otautau town, extends to Wreys Bush Nightcaps Highway, with Drummond Heddon Bush road and Scott's Gap as boundaries.

Our Reasons for Submission are:

The de Woldes are actively involved within our catchment group and we consider them to be role models for the Southland community, due to the huge focus that their farming business has on environmental sustainability. This environmental commitment was highlighted when the de Woldes were named the supreme winners of the 2013 Southland Ballance Farm Environment Awards. The judges were "impressed and inspired by the couple's commitment to reducing their environmental footprint," and stated that "the de Woldes were at the forefront of challenging the status quo through research and trialling innovative technologies."(Russell, 2013) This type of leadership and environmental stewardship is exactly what we are aiming to promote within our catchment group. Although not all of the Woldwide Farms fall within our catchment group area, we value the de Woldes as members of our catchment group.

We believe that their application will have a positive impact on the surrounding environment, especially lowland rivers and estuaries. The measures that are detailed in their application provide evidence for this, including:

- 125 incalf heifers will be wintered inside wintering barns, rather than on intensive winter grazing systems outdoors on fodder crops. No intensive winter grazing on crop or grazing of stock on pasture over winter will occur at Woldwide 1 or Woldwide 2. Intensive winter grazing outdoors is widely accepted to have a high nutrient and sediment loss; and to cause significant soil damage.(Chrystal, 2017; Horne, 2016; Monaghan, 2012)
- The wintering barns can be used as standoff pads during inclement weather throughout the season. By being able to stand animals off during cold and wet weather, the risk of nutrient loss and soil damage/erosion is significantly reduced. Strategic use of standoff pads has been found to reduce nitrogen leaching by 20% (https://www.rotoruafarmers.org.nz/gmp-feed-pad-to-stand-off-stock/). Urine deposited in late summer and autumn is more vulnerable to leaching during the winter drainage period and therefore standing cows off paddocks during this time reduces nitrogen losses.(Hanly, Horne, Hedley, & Christensen, 2014)
- No fodder crops will be planted and instead direct grass to grass cultivation will be used. This completely removes fallow periods which have the potential for high nutrient loss due to the absence of any growing plant to uptake the nutrients that have been deposited by the grazing of the crop.(McLenaghen, Cameron, Lampkin, Daly, & Deo, 1996)

The above practices more than offset the small increase of milking cow numbers that are being applied for. There will be less soil erosion and damage, less nutrient and sediment losses and the elimination of fallow periods which are risky for nutrient loss. The nutrient budgets show this but Overseer results are backed up with scientific research as discussed above.

There has been a significant capital investment from the de Woldes for this application. There has been an upgrade of the wintering barn at Woldwide One to be available to accommodate 625 animals. It is important that Environment Southland takes into account the output or the resulting effects of an application, rather than just the input details. The use of technology and proven best management practice to offset potential effects needs to be encouraged and acknowledged. The de Woldes are at the forefront of using science and technology to reduce their environmental footprint and we believe that this is captured within this application.

As a catchment group, we support this submission from Woldwide One Limited and Woldwide Two Limited as it fits our vision ("to be good stewards of the environment, while maintaining economic sustainability") and our key value (to improve water quality in the Mid-Aparima catchment area). The proposal will result in a reduction in P, N, sediment and faecal indicator organisms lost to the environment and a concurrent reduction in the resulting concentration of these contaminants in receiving waters. The overall effects on water quality will be positive. Effective capital investment and use of science and technology, as demonstrated by the de Woldes, is something that our catchment group encourages.

We wish the council to make the following decision:

Accept the application from Woldwide One Limited and Woldwide Two Limited and grant all consents that have been applied for. It is important that a 15 year term is granted given the considerable capital investment undertaken.

References:

Chrystal, J. (2017). *Dairy wintering systems in southern New Zealand : quantification and modelling of nutrient transfers and losses from contrasting wintering systems : a thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Soil Science at*

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To: The Chief Executive
Environment Southland
Private Bag 90116
DX20175
Invercargill

SUBMISSION FORM

Submission on a Notified Application for a Resource Consent

I: Ivan Graham Walter Lines (Name(s))

of: 32 Drysdale Road Invercargill (Address)

at: 0274339118 (Phone) 032188860 (Fax) ivan@agribusiness.co.nz (E-mail)

Wish to SUPPORT / ~~OPPOSE~~ / ~~submit a NEUTRAL~~ submission on *(circle one)* **the application of:**

Name: Woldwide One Limited and Woldwide Two Limited

And/or Organisation:

Application Number: APP-20191052 Location: Heddon Bush, Otautau.

My reasons for my submission are*: (State the nature of your submission and give clear reasons. Continue on attached pages if necessary)*

I am a registered farm management consultant of 32 years experience working in Southland. I am the principal of Agribusiness Consultants Ltd, Southlands largest farm management consultancy firm. I hold an honours degree in Farm Management and am registered with the NZIPIM.

The deWolde's have been clients of mine for some 20 years now so I have a very good knowledge of their business and farming abilities. In my opinion the deWoldes have an exceptional farming operation, are early adaptors of technology and improved management practices, and are highly valued leaders in the Southland farming community. They have won several awards for their farming and environmental stewardship including the Southland Ballance Farm Environment awards winners and the Lincoln University Farmers of the year.

In 2016 and 2017, the deWolde's undertook a business review which included a review of their environmental footprint in particular their wintering practices. At that stage 66% of their adult cattle and 100% of their young stock was wintered on crops outdoors. The plan identified that from an environmental point of view this was not acceptable to the deWolde's in terms of their N loss and foot print. The plan developed a strategy to increase the percentage of cows wintered indoors from 44% to 86% over a four year ~~plan~~ time frame.

Continued on attached sheet

To achieve this required significant capital investment over the whole operatio and a significant change (and industry leading) to their farm management practices. This plan included the expansion of two existing wintering barns and the building of two more (over and above their existing three) wintering barns for a capital investment in excess of $4.5m. The end goal was to have all mixed aged animals indoors leaving only a smaller number of first calvers out door. The plan reduced wintering cropping from in excess of 100 hectares per annum down to 35 hectares per annum. Much of the land currently being cropped on Woldwide One and Woldwide Two would move from winter crop production to pasture production with a significant reduction in N loss (as shown by Overseer® budgets) and environmental foot print.

To justify this investment and to use the additional feed produced (cows indoors consume less feed) an increase (small) in cow numbers. The nutrient budgets and Overseer® budgets showed a significant improvement in N loss even with the increased cow numbers.

Further environmental benefits identified included:

- less pasture damage through pugging in wet weather.
- less soil structure damage through less cultivation of soil and pugging in the winter.
- less water run off (and nutrient and sediment) through less exposed soil or pugging.
- the ability to return nutrients to the soil at times where loss to water would be significantly less.
- the ability to return nutrients to the areas from which they were removed.
- Significantly reduced artificial fertiliser requirements.
- Less wear and tear on machinery, carbon emissions and staff.
- happier animals and happier staff.

In my opinion there is no doubt that environmental outcomes will be improved with the implimentation of this business plan.

I wish the Council to make the following decision *(Give precise details, including the nature of any conditions sought)*

I wish the council/Panel to grant this application in its entirety for the following reasons:

↳ They have proven that the environmental footprint and nutrient loss of their whole operation will be improved. They are making significant investment to ensure this happens that requires a return.

↳ An increase in cow numbers is not a valid reason to reject a consent if environmental standards are improved in my opinion.

↳ The de Wolde's are genuine in their desire to improve environmental outcomes.

I, ~~am~~/am not *(choose one)* a trade competitor* of the applicant (for the purposes of Section 308B of the Resource Management Act 1991).

**If trade competitor chosen, please complete the next statement, otherwise leave blank*

I, am/am not *(choose one)* directly affected by an effect as a result of the proposed activity in the application that:

(a) adversely affects the environment; and

(b) does not relate to trade competition or the effects of trade competition.

I, do/~~do not~~ *(choose one)* wish to be heard in support of my submission.

I, do/~~do not~~ *(choose one)* wish to be involved in any pre-hearing meeting that may be held for this application.

I have served a copy of my submission on the applicant. ☑ Yes ☐ No

Signed ______________________ **Date** 8th May 2019

If you have any queries about this form or its purpose please contact the Consents Division of Environment Southland (03) 211 5115 or 0800 76 88 45.

To: The Chief Executive
Environment Southland
Private Bag 90116

Invercargill

SUBMISSION FORM

Submission on a Notified Application for a Resource Consent

I: Joanne Flett and Susan Flett *(Name(s))*

of: 138 Paterson St, Grasmere, Invercargill 9810 *(Address)*

at: 027 324 6354 *(Phone* ______ *(Fax)* flettjo@gmail.com *(E-mail)*

Wish to SUPPORT / OPPOSE / submit a NEUTRAL submission on *(circle one)* **the application of:**

Name: Abe and Anita deWolde

And/or Organisation: Woldwide Runoff

Application Number: APP-20191052 Location: ______

APP-20191140 Location: ______

My reasons for my submission are: *(State the nature of your submission and give clear reasons. Continue on attached pages if necessary)*

This submission applies to both applications referenced above as our reasons are the same.

We are the owners of the Merriburn block – 1711 Otautau Tuatapere Road which is leased to Woldwide Runoff. The lease has no right of renewal and ends in October 2021. We are happy to honour the terms and conditions of our lease. We do not agree to jeopardise our position in the future.

We are happy with the environmental practices on the block the de Woldes lease from us

- Soon after taking over the lease they initiated a meeting with Environment Southland to identify the environmental requirements for the land.
- They direct drill their kale crops
- Their winter crop paddocks are only in crop for one year and back into pasture after that (a condition of the lease agreement)
- Waterways are fenced off
- All baleage is placed on crop before the winter to avoid the use of heavy machinery in wet conditions.

I wish the Council to make the following decision *(Give precise details, including the nature of any conditions sought)*

As owners of the Merriburn block we wish the Council to exclude it from the land holding and therefore it would not be on the land use consent for farming.

I, [redacted]/am not *(choose one)* a trade competitor* of the applicant (for the purposes of Section 308B of the Resource Management Act 1991).

**If trade competitor chosen, please complete the next statement, otherwise leave blank*

I, am/am not *(choose one)* directly affected by an effect as a result of the proposed activity in the application that:

(a) adversely affects the environment; and

(b) does not relate to trade competition or the effects of trade competition.

I, [redacted]/do not *(choose one)* wish to be heard in support of my submission.

I, do/[redacted] *(choose one)* wish to be involved in any pre-hearing meeting that may be held for this application.

I have served a copy of my submission on the applicant. No ☐ Yes ☑

Signed J. E. Hill. **Date** 6/5/19

If you have any queries about this form or its purpose please contact the Consents Division of Environment Southland (03) 211 5115 or 0800 76 88 45.

Our Reference: APP-20191052
Enquiries to: Aurora Grant
Email: aurora.grant@es.govt.nz

1 April 2019

environment SOUTHLAND
REGIONAL COUNCIL
Te Taiao Tonga

Te Rūnanga o Ngāi Tahu
50 Corsair Drive
PO Box 13-046
Otautahi
Christchurch 8141

Dear Sir/Madam

Statutory Acknowledgement Area - application for discharge permits, water permits and land use consent.

Woldwide One Limited and Woldwide Two Limited have applied for resource consent to:

- use land for farming
- discharge dairy shed effluent from up to 1500 cows,
- discharge winter barn effluent from up to 1250 cows,
- discharge underpass effluent and silage leachate to land,
- discharge winter barn slurry effluent to land at the Horner Block from up to 1250 cows,
- use land for two winter barns for up to 625 cows each, and to
- take and use 180,000 liters of groundwater per day for stock water and dairy purposes

These activities are to occur at Heddon Bush, Winton, and are adjacent to the Aparima River. The Aparima River is a Statutory Acknowledgement Area under Schedule 15 of the Ngāi Tahu Claims Settlement Act 1998.

The application proposes to increase in cow numbers on an existing dairy platform, which triggers the proposed Southland Water and Land plan rule 20 – for farming. While there is an agreement in place between Te Rūnanga o Ngāi Tahu and Environment Southland to waive notification of activities such as dairy effluent discharges and water takes, there is no waiver for activities that are intensifying.

A copy of the application is appended for your reference.

Please advise us whether or not you have any concerns with the application within 10 working days from the date of this notification. If we have had no response by 11 April 2019 it will be assumed that you have no concerns.

Aside from the above, you may also note that the applicant has requested public notification. This means that, as an alternative to responding to this letter, you may make a submission on the application. The application will be notified on or around 5 April.

Please include the reference number APP-20191052 on any correspondence.

Yours sincerely

Aurora Grant
Team Leader Consents

Encl: Copy of application for resource consent dated 28 March 2019

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide Farming Group:

Woldwide One Limited and Woldwide Two Limited

27/3/2019

Application for:

- Land Use Consent for Use of Land for Dairy Farming – Replacement of **20171278-03**
- Discharge Permit – Replacement of **301663** and **20171278-01** under one discharge permit
- Water Permit – Replacement of **301664** and **20171278-02** under one water permit

Farm Location: Heddon Bush

Application prepared on behalf of applicant by:

Dairy Green Ltd

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843

Phone (03) 2154381

Email scandrettrural@xtra.co.nz

Table of Contents:

Key

ES	Environment Southland
HB	Horner Block
IWG	Intensive winter grazing
pSWLP	proposed Southland Water and Land Plan (2018)
PZ	Physiographic Zone
WW1	Woldwide One Limited
WW1&2	Woldwide One and Woldwide Two dairy farm
WRO	Woldwide Runoff – Merrivale and Merriburn blocks
WW2	Woldwide Two Limited

1. Overview

1.1 Background

Background

Woldwide One Limited (WW1) and Woldwide Two Limited (WW2) operate two adjoining dairy farms situated at Heddon Bush, Central Southland. Both dairy farms are under the same ownership structure.

WW1 currently operates under an effluent discharge permit (AUTH-301663) and water permit (AUTH-301664). Both consents were granted a 15-year term and expire in 2027.

WW2 currently operates under a land use consent for expanded dairy farming (AUTH-20171278-03), effluent discharge permit (AUTH-20171278-01) and water permit (AUTH-20171278-02). All were granted a ten-year term and expire in 2027.

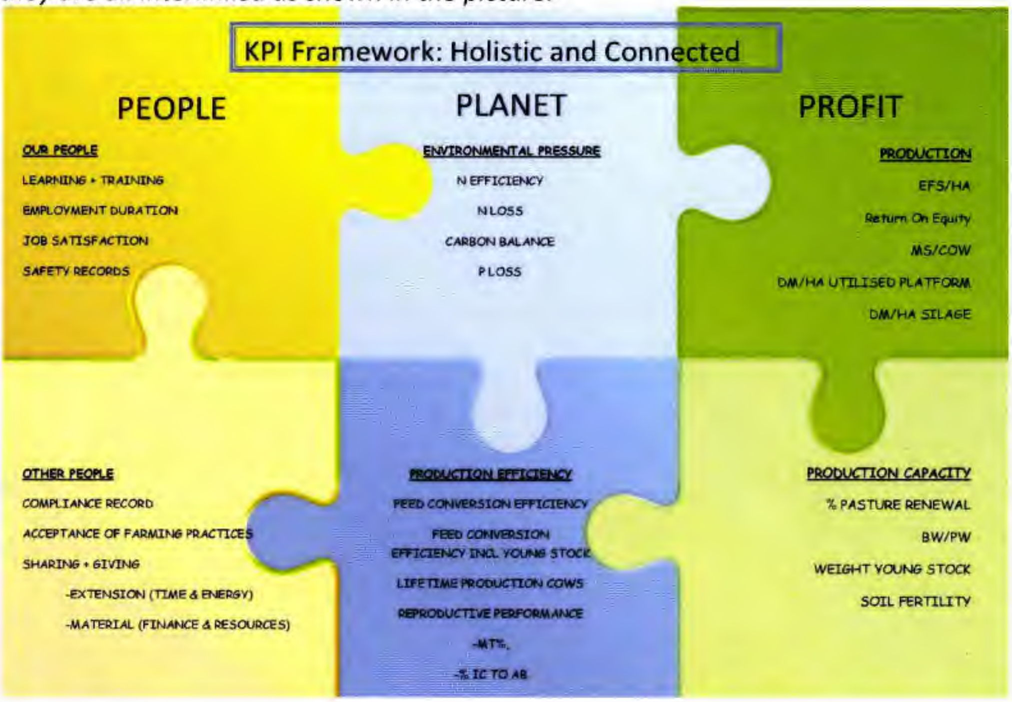
Both WW1 and WW2 utilise a nearby cut and carry block (Horner Block) to discharge pond slurry. The Horner Block is under separate ownership to the dairy platforms at WW1 and WW2 and is not part of either dairy platform. The discharge of agricultural effluent at the HB is authorised under respective effluent discharge permits for WW1 and WW2.

Both the WW1 and WW2 graze dry stock at Woldwide Runoff (WRO), which comprises the Merrivale and Merriburn blocks in the Merrivale/Western Southland area. WRO is under separate ownership to the dairy platforms at WW1 and WW2 and has significant areas under forestry.

Applicant's philosophy

In the words Abe and Anita de WW1de from the Woldwide Farming Group:

> *Sustainability (environmental, economic and social) has been at the core of all we do at Woldwide Farming group. To us these principles flow out of a desire to be good stewards, and they are all interlinked as shown in the picture.*



> *We were the first to build free stall barns in Southland to reduce outside crop wintering and we were the first (and only) ones to feed fresh grass to our cows in winter to reduce silage making losses and runoff. In 2013 we were supreme winners of the Southland Ballance Farm Environment Awards.*
>
> *Ever since we came to New Zealand we have been trying to improve the sustainability of our farms with a long decision-making horizon and an innovative mind-set. We have now come to a point in our farming career where we wish to cap our growth ambitions and truly focus on environmental sustainability. Keeping our stock off wet soils in winter is pivotal in this endeavour. We aim to have all our adult stock from all our farms indoors within five years (and work on housing all young stock after that). We believe wintering animals outside on wet soils is very damaging for the following reasons:*
>
> - *Nitrogen is lost because it is deposited on the ground (in the mud) when there are no plants actively taking it up and locking it in.*
> - *Sediment and top soil are displaced because of the following reasons:*
>   - *The ground is disturbed when it is wet*
>   - *Root structures are destroyed*
>   - *Overland flow (of Phosphate, sediment, bacteria) increases due to soil compaction*
>   - *Rain events during cropping season when soils are worked up fine and crops have not yet established can be very risky*
> - *Lots of chemicals are used in the cultivation of winter crops*
> - *It takes 85 m of wrap to produce a bale of baleage and we want to reduce our reliance on this*

We are convinced that 90 % of the environmental issues caused by farming in Southland stem from the 10 % of ground that is winter cropped. Just because something is common practice does not mean that the effects are acceptable. It is time to change this!

It needs to be kept in mind though that land- previously used for winter cropping- is vacated under our new plans and a small increase of stock numbers is needed to make up for that.

Our passionate desire is to go beyond compliance and to produce top quality food with a reduced environmental footprint. And that is the mindset behind this application.

Application history

In 2017, WW2 was granted consent for expanded dairy farming. This involved the addition of new land previously used for dairy support (i.e. SH96 and Marcel blocks) into the milking platform. In parallel with this, some land was removed from WW2's milking platform to be added to WW1's milking platform. WW2 cow numbers did not increase as part of the dairy expansion; they remained at 800. The SH96/Marcel support block, which came into WW2's milking platform as part of the expansion, had been used to graze young stock, winter graze cows/heifers on fodder crop and grow supplement (pasture silage). The discharge permit was replaced to allow for the new boundary, effluent discharge area and an increase in the size of a wintering barn. WW2's water permit was also replaced in 2017.

Agricultural effluent from WW1 and WW2 is discharged at low depth at respective dairy farms and at the Horner Block, located to the south west. The Horner Block is a cut and carry block, used to grow grass to supply various dairy farms, and receives slurry effluent from WW1, WW2 and the Woldwide Three dairy farm (which is not included in this application). The Horner Block does not graze stock.

In 2017, an application for expanded dairy farming at WW1 was submitted to Environment Southland (ES), which was publicly notified. During the notification process, the decisions version of the proposed Southland Water and Land Plan (2018) was released. Following discussions and advice from stakeholders including Environment Southland, based on many factors including how best to model pre-expansion land use, the applicants put WW1's application on hold and opted to submit a new application. The new application was submitted to ES in August 2018 and aimed to bring the WW1 and WW2 dairy farms under a single land use consent for dairy farming. The application was accepted by ES, with extensive information provided under s92 (1), at several meetings and at a site visit.

WW1&2's 2018 consent application was publicly notified by ES. An error was made during the notification process, which made the notification illegal according to legal opinion. In view of the ES error resulting in illegal public notification and following collaborative discussions on the best way forward, the applicants agreed to withdraw the consent application, address certain issues identified by ES in the s95 report and resubmit the application. This application aims to bring the WW1 and WW2 dairy platforms under a single land use consent for dairy farming and to resolve certain issues identified by ES with the 2018 application.

As is explained in section 2.1, the name of the new consent holder on the land use consent for dairy farming, the discharge and water permits will be "Woldwide One Limited and Woldwide Two Limited."

Request for public notification of application

Based on the application's history, the applicants hereby request that the consent authority publicly notify this application in accordance with s95A of the Act.

Landholding

The pSWLP defines a landholding as land held in one or more than one ownership, that is utilised as a single operating unit. The pSWLP specifies that a "single operating unit" may include, but is not limited by, effective control by any structure of ownership of the same group of people and being operated as a single business entity.

Land utilised as a "single operating unit" is defined as a landholding, and under the definition is under the effective control of the same ground of people **and** operated as a single business entity. To be part of a given landholding, both parts of the definition must be met. Where there is effective control by the same group of people, the critical test is whether land is operated as a "single business entity" or not.

HORNER BLOCK:

- The Horner Block is a nearby 160-hectare block used for cut and carry to supply various dairy farms, including but not limited to WW1 and WW2. It is used to discharge effluent from WW1, WW2 and WW3. No stock is grazed there.

- The Horner Block is owned by Woldwide Farm Limited and forms a small part of Woldwide Farm Limited's business.

- Woldwide Farm Limited trades with all Woldwide entities as well as external farms and companies.

- Woldwide Farm Limited has its own staff, accounts and management. It owns no cows or young stock, does not need WW1 or WW2 to be a successful business and is not a dairy farm.

- Woldwide Farm Limited undertakes feed trading, contracting, logistics, supply management, machine hire, office support and knowledge support.
  Some examples:
  Feed trading: silage crops, fresh grass, hay and baleage, concentrates and grain
  Contracting: ground work and pasture renewal, digger work and lane maintenance, fencing
  Winter grazing at various locations (not Horner Block): young stock and MA cows
  Logistics: carting concentrates from Bluff and Invercargill, baleage from runoff, manure from dairy farms etc.
  Supply management: trace elements, oil,
  Machine Hire: tractors, feed augers, trailers, truck, other implements
  Office support: books are kept separate
  Knowledge support

- The only service that WW1 and WW2 exports to the Horner Block is the discharge of slurry to 97 hectares of the block. Slurry is also discharged at WW1&2. Liquid effluent from the dairy sheds is only discharged at WW1&2. No grazing of cows or IWG of fodder crop is carried out at the Horner Block. The primary purpose of the Horner Block is not to support the dairy farms at WW1&2

- Although some slurry generated at WW1&2 is discharged at the Horner Block, the use of the Horner Block is not central to operations at WW1&2 dairy farm. As such, the Horner Block does not form a single business entity with WW1&2.

- Since the Horner Block is not operated as a single business entity with WW1&2, it does not form a single operating unit with WW1&2 and is therefore not part of WW1&2's landholding.

- Actual and potential effects from the discharge of slurry from WW1&2 at the Horner Block landholding are considered in the AEE for the farming activity, since they are part of the overall farming activity.

- The discharge of slurry effluent from WW1&2 at the Horner Block will be covered by a separate discharge permit. Accordingly, an application for the discharge of slurry effluent from WW1&2 at the Horner Block is included in this application.

LEGAL OPINION

Legal opinion was sought by ES in 2018 on whether the Horner Block is part of the landholding at Woldwide 1&2. Although the LO was not sought in relation to this application, the applicants believe it is relevant to this application since it addresses the same blocks of land, activities, structures and entities.

An Addendum to an original LO was provided by Wynn Williams on 8 October 2018, which clarified that the Horner Block is not considered to form a "single operating unit" with Woldwide 1&2. The LO Addendum stated (p.8) that *"It is unlikely that by only exporting one aspect of its farming operations to the Horner Block (i.e. the discharge of sludge), Woldwide 1 & 2 is utilising the Horner Block as part of a "single operating unit." This is different than if Woldwide 1 & 2 was intending to utilise the Horner Block for multiple aspects of its farming operations and if its use of the Horner Block was central to its overall farming operation. Accordingly, we consider that the Horner Block is not part of Woldwide 1 & 2's "landholding" for the purposes of their respective applications under Rule 20 of pSWLP."*

The original LO and Addendum are appended to this application. Please see for further details.

WOLDWIDE RUN-OFF (WRO)

Environment Southland hold the view that WRO forms part of the landholding at WW1&2 and while not part of this application, ES also view that WRO is part of respective landholdings at WW4 and WW5. With respect to Council's view and for this application to be accepted by Council under s88, WRO has been included in the landholding at WW1&2 and is included in the application for the use of land for farming.

It is the applicant's view that WRO is not part of the landholding for WW1&2. The applicants wish to place this issue in front of the hearing decision maker where it provides a forum and opportunity for discussion and consideration of both points of view.

Current application

The proposal seeks to add 160 cows to WW1&2, in conjunction with making several changes to the farming activity to off-set potential effects from additional cows. The applicants believe that over time there will be a cumulative reduction in contaminant loss due to the proposed land use. Holistically, they will achieve better nutrient management on farm, improved soil organic matter content/less mineralisation, improved water holding capacity and soil structure, less N accumulation at high risk times, and less pugging of soils and runoff. Consequently, they believe there will be less contaminant loss to water and less risk of adverse effects on ground and receiving surfacewaters.

A high level of investment has been required in the planning and implementing of changes, which demonstrates the applicants' commitment and determination to achieve their aim of greater environmental sustainability in the long term. Farm profitability and economic security must be maintained for this to happen; this will be achieved through milking 160 additional cows on land previously used for activities such as IWG at WW1&2.

Nutrient budget analysis shows that the proposed land use at WW1&2 has below average N loss (kg/ha/year) compared to all Fonterra dairy farms within a 20 km radius, many of whom winter some or all MA cows off farm (see section 7.3.1). The proposal includes the wintering of 1,250 cows in barns at WW1&2 and still manages to have below average N loss compared to a regional average (20 km radius); this achievement demonstrates how the applicants mitigate and minimise contaminant losses across the whole activity, which in turn mitigates and minimises effects in groundwater and receiving surfacewaters.

WRO grazes dry stock from WW1&2, among a range of other activities not related to WW1&2. Under the proposal, WRO will continue to be used to graze dry stock from WW1&2, including IWG activities. The applicants seek to continue to manage WRO sustainably, improving soils and production while minimising contaminant losses to ground and surfacewaters.

Slurry effluent from WW1&2 will continue to be discharged at very low depth to part of the Horner Block. The applicants seek to manage the Horner Block sustainably and will reduce fertiliser inputs to account for nutrients applied from slurry. They aim to maintain soils and production at the Horner Block while minimising contaminant losses to ground and surfacewaters.

Land use consent for farming

It is proposed to replace WW2's land use consent for dairy expansion (20171278-03) with a land use consent for dairy farming to include the land areas contained by both WW1 and WW2 dairy platforms and WRO. The land area of the dairy platform is not increasing. The proposed dairy platform will contain two milking sheds and two wintering barns. At an operational level, WW1 and WW2 will be run as individual dairy units. WRO will be used to run dry stock and for supplement production (among other activities not related to the farming activity at WW1&2). Only land areas at WRO linked to operations at WW1&2 will be authorised on the land use consent, e.g. forestry land will be excluded.

It is proposed to increase cow numbers milked to 1,500. Currently a total of 1,340 cows are authorised; 540 at WW1 and 800 at WW2. The proposal represents an increase of 160 milking cows or 11% overall. The increase will occur at the WW1 unit where the herd size will go from 540 to 700. Land previously used for fodder cropping/IWG at WW1&2 has been freed up by the removal of these practices and is available to graze milking cows.

It is proposed to increase the maximum number of animals (cows/heifers) wintered in barns to 1,250. The barn and effluent system have already been upgraded to cater for the additional cows and effluent.

To allow for the proposed activity, resource consent is being sought under **Rule 20 e)** of the pSWLP, for the ongoing use of the land for dairy farming including an increase in cow numbers. The expansion does not include an increase in the dairy platform's land area as all land was either within the dairy platform prior to 30 June 2016 or was authorised for dairy farming through a dairy expansion land use consent that was granted in 2017. As is described in Section 2, **this is a discretionary activity**.

The proposed activity has been considered in terms of key pSWLP policies and based on this assessment should be granted. Effects on the existing environment have been considered and assessment in accordance with Schedule 4 of the RMA. The assessment concludes that effects on receiving surfacewaters, groundwater and soils, including cumulatively, will be no more than minor due to the proposed activity.

Overseer nutrient budgets

Overseer is a useful tool to understand the nutrient interactions of a farm system based on soil properties, rainfall, drainage, feed requirements and other factors. The output from the model gives an indication of how much nutrient may be lost to the environment. Overseer nutrient budget analysis has been carried out using Overseer version 6.3.1 and using "Overseer Best Input Standards, March 2018." The increase in cow numbers will occur in parallel with significant land use changes, which act as key mitigation measures and are modelled in Overseer where possible.

NUTRIENT BUDGETS - WW1&2 DAIRY FARM Four pre-expansion nutrient budgets were prepared and one proposed post-expansion nutrient budget for 1,500 cows. The pre-expansion nutrient budgets were derived by modelling the actual lawful use of land and not by modelling consented maximums. The inputs used in pre-expansion nutrient budgets are supported with evidence, which is appended to the nutrient budget analysis report. Where the analysis report states that the land area is being increased by bringing in support land, this refers to the SH96 and Marcel Blocks, which were authorised for dairy farming as parts of WW2's land use consent granted in 2017.

All nutrient budgets model the same land areas, i.e. former WW1 and WW2 milking platforms, SH96 and Marcel blocks. Overseer predicts that:

- The average N loss will decrease slightly from 41 kg/ha/year to 40 kg/ha/year, despite an additional 160 cows; and
- The average annual P loss will remain at 0.7 kg/ha despite an additional 160 cows.

By using P loss as a proxy for sediment and microbial losses, there will be no increase in loss of sediment or microbes.

NUTRIENT BUDGETS - THE HORNER BLOCK Prior to obtaining legal opinion to the contrary, ES regarded the HB to be part of the landholding at WW1&2. Based on this, one pre-expansion nutrient budget (17/18) and one proposed nutrient were prepared for the Horner Block and submitted with the 2018 consent application. Since nutrient budgets were already prepared for the HB, they are included in this application as a useful source of information and are used appropriately in the AEE.

NUTRIENT BUDGET – WORLDWIDE RUNOFF

A 17/18 year-end nutrient budget has been prepared for WRO, provides guidance on activities and nutrient losses in the 17/18 year, and is used to inform the AEE.

Discharge and water permits

It is proposed to replace existing discharge permits (301663, 20171278-01) with a single discharge permit managing effluent from the WW1 and WW2 dairy units, and to replace existing water permits (301664, 20171278-02) with a single water permit for groundwater abstraction from both WW1 and WW2. The proposed discharge permit will allow for the discharge of agricultural effluent (dairy shed, wintering barn, silage pad and underpass) to land from 1,500 cows. **It is proposed to include the current irrigation methods in the discharge permit, i.e. travelling irrigator, trailing shoe slurry tanker, umbilical system; as well as to future proof the discharge activity by also including low rate irrigation.** The proposed water permit will allow for groundwater abstraction for dairy shed and stock drinking water for 1,500 cows.

Slurry

Existing discharge permits for WW1 and WW2 authorise the discharge of herd home slurry and effluent slurry respectively. Despite this, slurry is not defined in the pSWLP or RWP. An AgResearch study[1] classifies slurry as an effluent product with 5-15% DM content. FDE is classed as having less than 5% DM content and solid manures as having greater than 15% DM content. The material stored in the ponds at WW1 and WW2 is a slurry due to the large contribution of undiluted wintering barn effluent. Since the discharge of slurry is authorised on both existing discharge permits for WW1 and WW2 and the material stored in the ponds meets the description in the AgResearch paper, the term has been used to describe pond material in the replacement discharge permit application.

Horner Block

Existing discharge permits for WW1 and WW2 authorise discharge of agricultural effluent the Horner Block. The Horner Block currently receives agricultural effluent from three dairy farms; WW1, WW2 and Woldwide Three. It is proposed that Woldwide Three's discharge area will remain mutually exclusive.

The discharge areas currently authorised to receive effluent/slurry from WW1 and WW2 will be blocked as a single slurry receiving area. **It is proposed that the discharge of slurry effluent from WW1&2 to 97 hectares at the Horner Block will be covered by a separate discharge permit**. The Horner Block will not be authorised on the proposed discharge permit for WW1&2. The Horner Block will continue to be run for cut and carry, and as a slurry receiving area.

Land use consent for feed pad/lots - wintering barns

Under Rule 35A of the pSWLP, the use of land for two wintering barns at WW1&2 is a discretionary activity as at least one of the conditions of Rule 35A (a) is not met. Applications for consent for the use of land for two feed pad/lots accompanies this application.

[1] Houlbrooke, Longhurst, Orchiston and Muirhead (2011). Characterising dairy manures and slurries. AgResearch Report.

1.2 Property Details

Overview

WW1&2 is an existing dairy farm with required dairy infrastructure for two units and is located within both the Oreti River and Waimatuku Stream catchments at Hundred Line Road, Heddon Bush. It consists of 502 hectares of land, with an effective farm area of 479 hectares.

The slurry-receiving Horner Block is located within both the Waimatuku Stream and Aparima River catchments at Hundred Line Road, Heddon Bush and consists of 160 hectares of land, with an effective farm area of 155 hectares.

WRO is a dry stock grazing block (892 ha) for all Woldwide dairy farms, which also contains a commercial forestry operation, native bush block, commercial gravel extraction operation and land for supplement production. Activities at WRO are described in detail in the WRO section of this application.

Within the last five years, WW1&2 was managed as two dairy units (WW1 and WW2) and a support block (SH96 and Marcel Block). The SH96 and Marcel Block were authorised for dairy farming as part of WW2's land use consent for expanded dairy farming granted in October 2017. The Horner Block was used for winter grazing and heifer grazing in the past, but in recent years has been used for cut and carry, and as a discharge area.

It is proposed that two dairy units will continue to be operated at WW1&2. Cows will be milked for seasonal supply through two dairy sheds, 700 at the WW1 unit and 800 at the WW2 unit. All cows will be wintered in two existing wintering barns. The wintering barns will be used at times to house cows in the shoulders of the season and as stand-off pads during inclement weather throughout the year to reduce soil damage, pugging and runoff.

The Horner Block will continue to be used as an area to discharge slurry from two effluent storage ponds at WW1 and WW2. Pasture silage and fresh grass is harvested from the Horner Block and fed to cows at dairy farms, including but not limited to WW1 and WW2.

Table 1.1 General property details – WW1&2, Horner Block

Property details	
Dairy platform - total farm area (ha)	502
Dairy platform - effective farm area (ha)	479
Dairy platform - size of effluent disposal area (ha)	c.400
Dairy platform - stocking rate (cows/ha)	3.1
Horner Block – total area (ha)	160
Horner Block – effective area (ha)	155
Horner Block – slurry effluent area (ha) for dairy platform (WW1&2 only)	97
Legal descriptions – WW1&2 dairy platform	Part Lot 18 DP 942 Section 420 Taringatura SD Part Lot 1 DP 4092 Part Lot 18 DP 942

	Part Lot 2 DP 4092 Part Lot 1 DP 4092 Part Section 417 Taringatura SD Section 418 Taringatura SD Section 419 Taringatura SD Lot 1 DP 9925* (leased - Gavin Andrew Dykes) Lot 1 DP 14660 Lot 1 DP 14661 Lot 1 DP 451158 (leased - John Desmoulins Pine & Christina Florence Pine) Lot 1 DP 13077 (leased - John Desmoulins Pine & Christina Florence Pine) Lot 1 DP 5610 Lot 3 DP 5610 Lot 1 DP 10885
Legal descriptions – Effluent discharge area at WW1&2	Part Lot 18 DP 942 Section 420 Taringatura SD Part Lot 1 DP 4092 Part Lot 18 DP 942 Part Lot 2 DP 4092 Part Lot 1 DP 4092 Part Section 417 Taringatura SD Section 418 Taringatura SD Section 419 Taringatura SD Lot 1 DP 14660 Lot 1 DP 14661 Lot 1 DP 5610 Lot 3 DP 5610 Lot 1 DP 10885
Legal descriptions – Effluent discharge area at Horner Block	Lot 4 DP 399915

*Part of Lot 1 DP 9925 is leased by the applicants and is already within the boundary of the existing land use consent for dairy farming (see figure 1.1).

Figure 1.1 Part of Lot 1 DP 9925 within the landholding boundary at WW1&2.

Table 1.2 General property details – WRO

Property Details – WRO	
Property address	20 Gill Road – Merrivale block 1711 Otautau Tuatapere Road – Merriburn block
Property owner(s)	Woldwide Runoff Ltd
Legal Description	Merrivale Block: Part Section 7 Block XII Waiau SD Part Section 7 Block XII Waiau SD Part Section 7 Block XII Waiau SD Lot 1 DP 3537 Merriburn Lease Block: Lot 1 DP 302409 Sec 26 Merrivale Settlement No. 1 Sec 27 Merrivale Settlement No. 1
Property area (ha)	507 ha total, 321 ha effective – Merrivale 385ha total, 338 ha effective – Merriburn
Location	NZTM 1201022, 4893762 – Merrivale NZTM 1200812, 4890495 – Merriburn

Effluent

Existing discharge conditions

Agricultural effluent from WW1 and WW2 dairy operations are currently managed by way of two existing discharge permits **(301663, 20171278-01)**, which expire on the 9th of November 2027 and 18th October 2027 respectively. WW1's existing discharge consent is for a 540-cow herd milked twice a day and from herd home slurry from a maximum of 400 cows. WW2's existing discharge consent is for an 800-cow herd milked twice a day and from herd home slurry from a maximum of 640 cows. WW2's existing discharge permit also provides for effluent from an underpass and a silage pad.

The authorised discharge method at WW1 includes land disposal methods limited to maximum application depths of 10 mm and 5 mm per application. The consented discharge methods at WW2 include a low depth travelling irrigator, umbilical system and slurry tanker with a trailing shoe. The travelling irrigator has a maximum application depth per application of 10 mm. The umbilical and trailing shoe slurry tanker systems have a maximum depth per application of 5 mm.

The existing operations do not involve winter milking.

Existing FDE areas

WW2's discharge area includes 194 hectares of land at WW2, and 42 hectares of land at the Horner Block. Liquid effluent is discharged at WW2 and slurry effluent from WW2's pond is discharged at the Horner Block. Council recommended buffers are implemented at WW2, except for a buffer of 100 metres from land known as Lot 3 DP237. WW1's discharge area includes most of the milking platform and another part of the Horner Block. Council recommended buffers are implemented when discharging liquid or slurry effluent at WW1.

Existing effluent storage infrastructure

WW1 and WW2 allow for deferred irrigation when soils are near or at field capacity by storing raw effluent (slurry) in two large effluent ponds, one for each operation. Both ponds receive dairy shed effluent when soil moisture conditions are unsuitable for irrigation, and wintering barn effluent from the barns. The WW2 pond also receives silage leachate from WW2's concrete silage pad. The material in the ponds is a slurry due to the major contribution of dung and urine from the free stall wintering barns. Consequently, both ponds always have a crust.

Ancillary structures at both the WW1 and WW2 units that contain, store or treat effluent are sand traps, dairy shed pump sumps and wintering barn collection sumps.

Further information on the ponds and ancillary structures is provided in sections 2, 6 and 7.

Proposed changes to effluent management and permit

It is proposed to replace existing discharge permits **(301663, 20171278-01)** with a single discharge permit covering effluent from WW1 and WW2 at WW1&2. The proposed discharge permit will allow for the discharge of agricultural effluent (dairy shed, wintering barn, silage pad and underpass) to land from 1,500 cows; 700 cows at WW1 and 800 cows at WW2. Proposed irrigation methods are all methods described in table 1.3.

It is proposed to authorise the discharge of slurry effluent from the ponds at WW1&2 at the Horner Block through a separate discharge permit. The irrigation methods at the Horner Block will be slurry tanker with the trailing shoe and umbilical system as described in table 1.2.

Table 1.3 Proposed effluent irrigation methods

Method	Usage	Conditions
Low depth travelling irrigator	Apply dairy shed effluent to land	A maximum depth per application of less than 10 mm
Low depth slurry tanker with a trailing shoe	Apply pond slurry to land	A maximum depth per application of 2.5 mm
Low depth umbilical system	Contingency measure – apply pond slurry to land	A maximum depth per application of 3.0 mm
Low rate pods	*Future proof - Apply dairy shed effluent to land	A maximum instantaneous rate of 10 mm/hour at a depth of less than 10 mm

Low rate cannon/rain gun	*Future proof - Apply dairy shed effluent to land	A maximum instantaneous rate of 10 mm/hour at a depth of less than 10 mm

*To future proof the discharge activity, it is proposed to include low rate irrigation methods as described in the above table. This will allow the applicants to upgrade their effluent system in the future without the need to vary the discharge permit.

Overall, the proposed discharge area includes most of WW1&2 and the existing area at the Horner Block that receives agricultural effluent from WW1 and WW2, less standard buffers. Significant areas of low risk soils are available. Slurry from the ponds will be applied at very low depth via the trailing shoe slurry tanker or umbilical system at both the Horner Block and at WW1&2.

No affected party approvals are required.

No change in effluent storage is proposed. According to the Massey DESC, the 90% probability volume for 1,500 cows including wintering barn effluent and silage leachate is 6,460 m^3. The existing storage capacity is 8,032 m^3, so is sufficient to meet the above requirements. The wintering barns will house a maximum of 1,250 cows despite having capacity for 1,280. Two separate DESC reports have been run, one each for the WW1 and WW2 units respectively. This ensures that each unit has enough storage for its operation.

Wintering

WW1&2

In the past, cows and heifers have been intensively winter grazed on fodder crop and heifers also have been grazed on pasture over winter. In more recent years, cows have been wintered in barns, but in-calf R2 heifers have been IGW on fodder crop and R1 heifers have been grazed on pasture over winter. These practices are fully accounted for in respective year end nutrient budgets - please refer to section 9.3 of the nutrient budget report for details.

Under the proposal, the practices of IWG and grazing stock on pasture over winter at WW1&2 will cease. No animals will be IWG on fodder crop and no heifers will be grazed on pasture over winter at WW1&2. All cows and some heifers will be wintered in two wintering barns over June and July.

1,500 is the maximum cow number, which generally will be seen at peak milking in Oct/Nov. As is standard practice on dairy farms, cows are culled as the season progresses with the main cull occurring in May/start of June. This reduces the MA cow number significantly and accordingly, reduces the number of MA cows to be wintered from the start of June. Typically, the cull rate sits at approx. 25% with minor variation from year to year. Assuming a culling rate of 25%, then approximately 375 MA cows will be culled by the end of the season leaving 1,125 MA cows to be wintered. A maximum of 1,250 animals will be housed in the barns over June/July, leaving space in barns for 125 R2 heifers.

From May 2019, cows will also be housed in wintering barns for part of May, August and September during inclement weather as required. Early calving cows will return to pasture in August, where they calve. Late calving cows will remain in the wintering barns until they are ready to calve in September. Cows are fed freshly cut grass and pasture silage in barns. The wintering barns are also used as stand-off pads during inclement weather during the milking season.

At WW2's wintering barn, a maximum of 625 cows are housed over winter. It is proposed to increase WW1's wintering barn authorised cow number from 400 to 625, to accommodate an additional 225 animals. WW1's wintering barn has already been upgraded to meet the needs of additional animals. Effluent storage at WW1 has been increased so can accommodate effluent from additional animals in the wintering barn.

In the 17/18 winter, WW1's barn housed 400 cows and was assessed as grade 1/fully compliant at an inspection by Environment Southland.

WRO

Wintering activities include IWG by dry stock on fodder crop. Under the proposal, the annual area under IWG will not exceed 100 hectares. All R1s will be IWG at WRO. R2s will either be housed in barns at WW1&2 (c.125) or will be IWG at WRO. Please see the WRO section of the application for a detailed description of existing and proposed wintering activities.

Young stock from WW1&2

To date, grazing of young stock has been carried out as a permitted activity. The replacement rate sits at 25% with minor variation from year to year. At a 25% replacement rate, 375 R2s join the milking herd each year. Due to culling/deaths, a further 10% replacement calves are kept ensuring 375 R2s are available to join the milking herd.

R1 heifer calves leave WW1&2 to go to WRO when they reach a minimum of 90 kg live weight (~November). All R1 heifers are IWG at WRO in June/July. R1s transition into R2s, and at about 15 months of age R2s are mated.

Heifer numbers at WRO reduce by approximately 10% due to death and culling. The heifer number reduces from 417 to 375 by the time R2 heifers return to WW1&2 for calving.

To date, R2s leave WRO to be IWG over June and July at various other blocks such as SH96/Marcel and at WW5. Under the proposal, in-calf R2s are either wintered in barns at WW1&2 (c.125) or at WRO (IWG).

Existing and proposed activities at WRO are described and assessed in detail in the WRO section of this application.

Cultivation

WW1 has been dairy farmed by the applicants since 1992, and most of WW2 has been dairy farmed by the applicants since 2003. Over this time soils have been developed sustainably, which is evident in fertiliser and agronomy reports for WW1, WW2 and the Horner Block from the fertiliser supplier (Ravensdown) – see Appendix. Summer and winter fodder crop cultivation has been carried out to provide feed for cows/heifers over summer dry periods and winter respectively. It is proposed to cease the practice of growing fodder crops at WW1&2, as a key mitigation measure to off-set additional cow numbers. The re-grassing policy will meet permitted activity rules as per Rule 25, will occur by direct grass to grass cultivation and is described in respective FEMPs.

Fodder crop (kale) is grown at WRO to provide feed for dry stock over winter. Under the proposal, the area sown in fodder crop and IWG will not exceed 100 hectares. Please see the WRO section of the application for details. Cultivation practices at WRO meet permitted activity rules as per Rule 25 of the pSWLP.

Groundwater abstraction

Groundwater is abstracted from three bores at WW1&2 for use at two dairy sheds and to supply stock drinking water to 1,500 cows. The maximum daily volume of groundwater abstracted to meet the needs of 1,500 cows is 180,000 litres.

At the WW2 unit, two bores supply groundwater. One bore (E45/0083) is located to the west of the dairy shed with a second bore (E45/0727) at the north of the block, close to Wreys Bush Highway. The maximum daily volume of groundwater supplied to WW2 is 96,000 litres.

At the WW1 unit, the bore (E45/0071) is located to the west of the dairy shed and the maximum daily volume of groundwater supplied to WW1 is 91,000 litres. This represents an increase of 31,000 litres compared to the existing water permit for WW1 (#301664), which has a maximum daily take of 60,000 litres.

WRO has a stock drinking water scheme that meets permitted activity rules and does not require consent.

Table 1.4 Physical properties and information of land and water at WW1&2 and Horner Block.

Soils	**Soil Type**	**Vulnerability Factors**		
		Structural Compaction	**Nutrient Leaching**	**Waterlogging**
<u>Soil mapping on Topoclimate appears to be incorrect compared to actual soil types.</u> Topoclimate maps Braxton soils as the dominant soil type, with Pukemutu being a minor soil type. Topoclimate maps an area of Glenelg on the east. A soil survey field investigation carried out in 2017 by Scandrett Rural Limited is described in Section 5 and a separate report. It maps two dominant soil types; Braxton soils are found on the mid-west side (c.100 ha) and Drummond soils are found at the east. Drummond soils have intergrades of more shallow Glenelg soils in places. Drummond/Glenelg account for c.400 ha of soils.	Braxton	Moderate	Slight	Severe
	Drummond	Minimal	Moderate	Slight
	Glenelg	Slight	Very severe	Nil
	Waiau	Moderate	Very severe	Nil
FDE Land Classification	A – artificial drainage or coarse soil structure E – other well drained but very stony flat land Likely to be D – well drained flat land. FDE classification is primarily based on soil type. Incorrect Topoclimate mapping of WW1&2 means large areas of Braxton/Pukemutu (Category A) are mapped where a field investigation found Drummond soils (Category E).			
Characteristics of FDE Classification	A - high risk to surface water, low risk to groundwater D, E – low risk to groundwater using low depth application, low risk to surfacewater			
Topography	Flat			
Surfacewater management zone	Waimatuku, Oreti (WW1&2) Aparima (Horner Block)			
Groundwater Zone	Waimatuku, Central Plains			
Groundwater Nitrate Levels	0.1 – > 11.3 mg/L A series of nitrate concentration bands are mapped with the lowest groundwater nitrate levels at the west side (0.1 – 0.4 mg/L) and the highest to the south east (modelled >11.3 mg/L). Most groundwater underlying WW1&2 has nitrate levels of 3.5 – 8.5 mg/L, indicative of moderate to high land use impacts.			
FMU	Oreti (WW1&2)			

	Aparima (Horner Block)	
Nearest downstream registered drinking water supply	Heddon Bush School 2.3 km to the south	
Downstream Regionally Significant Wetland/Sensitive Waterbody	Drummond Peat Swamp (>10 km to south east) Bayswater Bog (>10 km to south west)	
Physiographic Zones	**Zone**	**Contaminant pathways for Physiographic Zone**
	Central Plains	When wet soils are prone to waterlogging, resulting in the installation of extensive artificial drainage networks. When dry these soils are prone to shrinking and cracking, allowing drainage to bypass the soil to the underlying aquifer. Aquifers and streams in this zone are prone to contaminant build-up as they do not experience dilution by a major river.
	Oxidising	Soil water and groundwater are well aerated, which allows nitrogen to accumulate. Oxidised soils are good at absorbing and storing water and any nitrogen it contains. During drier months, nitrogen accumulates in soil to high levels. During winter when soils are wet, any nitrogen not used by plants leaches down into the underlying aquifer (deep drainage). Artificial drainage is used where soils have low subsoil permeability to help to reduce waterlogging. Contaminant loss through artificial drains to nearby streams can be high during wetter months.

Table 1.5. Physical properties and information of land and water at WRO

Soils	**Soil Type**	**Vulnerability Factors**		
		Structural Compaction	**Nutrient Leaching**	**Waterlogging**
	Malakoff			
	Waimatuku	Slight	Moderate	Slight
	Makarewa	Moderate	Slight	Severe
	Aparima	Moderate	Moderate	Moderate

	Orawia	Slight	Moderate	Slight
FDE Land Classification	n/a			
Characteristics of FDE Classification	n/a			
Topography	Flat, rolling to steep			
Surfacewater management zone	Waiau			
Groundwater Zone	Unmapped			
Groundwater Nitrate Levels	0.01 – > 1.0 mg/L			
FMU	Waiau			
Nearest downstream registered drinking water supply	Tuatapere (~12 km to south west)			
Downstream Regionally Significant Wetland/Sensitive Waterbody	Waiau River – Te Waewae Lagoon (~20 km to south west)			
Physiographic Zones	**Zone**			
	Bedrock/Hill country Oxidising Gleyed Lignite Marine Terraces Peat Wetlands			

2. Consents

The decisions version of the pSWLP was notified on 4 April 2018. In accordance with Section 86B(1)(a) and (3) of the Resource Management Act 1991, all provisions of the Proposed Plan have had legal effect since this date. Since the Regional Water Plan (2010) and Regional Effluent Land Application Plan are still operative, all provisions in both Plans have legal effect. The provisions of these plans therefore need to be considered alongside the provisions of the pSWLP.

Consent holder name

The existing consent holders, Woldwide One Limited, Woldwide Two Limited, have changed their name to "*Woldwide One Limited and Woldwide Two Limited.*" In accordance with Section 124C of the RMA, Woldwide One Limited confirms in writing that they will not be making any future applications under as *Woldwide One Limited* on this property in accordance with Section 124C of the RMA. In accordance with Section 124C of the RMA, Woldwide Two Limited confirms in writing that they will not be making any future applications as *Woldwide Two Limited* on this property in accordance with Section 124C of the RMA. Future applications will be made on behalf of "*Woldwide One Limited and Woldwide Two Limited.*"

2.1 Consents

Consents

Table 2.1 provides a summary of proposed activities and whether resource consent is required or not. Further details are provided regarding the level of each activity in the following section.

Table 2.1

Proposed activity	Consent required	Activity level
Expansion of dairy farming through an increase in cow numbers	Yes - land use consent for farming	Discretionary activity
Discharge of agricultural effluent	Yes - effluent discharge permit – one each for WW1&2 and Horner Block	Discretionary activity
Use of land for maintenance and use of existing effluent storage facilities	No pathway through the rule but applicants agree to apply for consent as directed by decision maker.	No activity level available under the rule
Use of land for wintering barns	Yes - use of land for feed pad/lot	Discretionary activity
Use of land for silage storage facilities	No	Permitted activity
Silage leachate	No	Permitted activity
Cultivation	No	Permitted activity
Groundwater abstraction	Yes - water permit	Discretionary activity

Farming

Rule 20 of the pSWLP manages farming activities, including new or expanded dairy farming of cows. The proposed activity does not meet Rule 20 (a) (ii) (2) since cow numbers are increasing beyond the maximum number specified in the dairy effluent discharge permit that existed on 3 June 2016. Rule 20 (a) (ii) (6) is met, however, as all land was either in the dairy platform prior to 3 June 2016 or was authorised for dairy farming in November 2017.

Rules 20 (b) and (c) do not apply at WW1&2 since the proposal does not include any IWG nor will occur at greater than 800 metres above mean sea level. IWG is carried out at WRO so parts (b) and (c) apply. IWG activities at WRO meet permitted activity rules regarding areas, set-backs and other GMPs as directed by parts (b) and (c).

Rule 20 (d) is met except for (d) (ii) (1), since the dairy platform's assessment reflects the annual amount of N, P, sediment and microbial contaminants lawfully discharged on average over four years instead of over five years. A high level of evidence of land use activities during the four-year period has been supplied. Since the Merriburn Block at WRO only came under the control of the applicants though a lease agreement recently, only one nutrient budget could be provided for WRO for the 2017/18 year. Also, the scale of IWG activities of dry stock will increase at WRO, which is likely to increase contaminant losses from WRO to an extent but with minimal effects on the receiving environment. As the application does not meet all the provisions of Rule 20 (d), then Rule 20 (e) applies; **the use of land for the proposed farming activity is a discretionary activity and resource consent is required**.

Discharge activity

Agricultural effluent is defined as "effluent that is derived from livestock farming" in the pSWLP. It includes dairy shed, wintering barn, silage pad and underpass effluent since effluent generated at these sources is generated by livestock farming.

Rule 35 of the pSWLP manages the discharge of agricultural effluent to land. In this case the discharge activity at WW1&2 and the Horner Block does not meet all conditions of (a); part (i) is not met as the dairy shed services more than 20 cows; part (viii) is not met as the maximum N loading at the Horner Block will exceed 150 kg/year from effluent (maximum of 250 kg/ha). However, the maximum N loading from effluent at the dairy platform will not exceed 150 kg/year. The discharge activity does not meet part (b) (ii) since it is proposed to increase cow numbers above the maximum number specified on an existing discharge consent. **The discharge activities at both WW1&2 and the Horner Block meet all conditions described in Rule 35 (c) so are discretionary activities**.

Rule 50 of the RWP (2010) manages the discharge of agricultural effluent to land. In this case the discharge activity does not meet parts (a) or (b). It does not meet part (c) since it is proposed to increase the scale of the discharge activity through an increase in cow numbers. However, except for an increase in cow numbers, the discharge activity meets (c) part (i) in that it includes high rate irrigation to soil landscape categories A, D and E. The discharge activity meets part (d) as the scale of the activity is increasing with the increase in cow numbers and the discharge activity to soil/landscape categories A, E and D includes high rate irrigation by slurry tanker that does not exceed 5 mm depth per application. In fact, the discharge of effluent by slurry tanker does not exceed 2.5 mm depth per application. Rule 50 (d) does not specify a depth for high rate irrigation by travelling irrigator, so direction is taken from Policy 42 of the RWP. The discharge of effluent to category E land must be at less than or equal to 10 mm depth per application and at less than 50% of PAW. The travelling irrigators have been tested and apply effluent at less than 10 mm per application. The discharge of effluent must be at less than the soil water deficit for category A land and at a depth less than 50% of the soil water deficit for Category D land. The discharge of effluent to categories A, D and E land meets Policy 42 of the RWP.

Rule 5.4.6 of the Regional Effluent Land Application Plan provides for the discharge as a **discretionary activity**.

The discharge activities at WW1&2 and the Horner Block are therefore assessed as being discretionary activities.

Existing effluent storage facilities

Rule 32D of the pSWLP manages existing agricultural effluent storage facilities. Under Rule 32D (a) the use of land for the maintenance and use of existing agricultural effluent storage facilities that was authorised prior to Rule 32D taking legal effect, and any incidental discharge directly onto or into land from those storage facilities which are within the normal operating parameters of a leak detection system or the pond drop test criteria set out in Appendix P, are permitted activities provided that certain conditions are met.

WW2 STORAGE POND

WW2's pond is clayed lined and does not have a leak detection system. The material stored in WW2's storage pond is a slurry. Slurry is defined section 1 but is not defined in the pSWLP or RWP. The pond was drop tested in 2017 at the request of Council and a drop test report was submitted to Environment Southland who at the time accepted that the pond was not leaking. The drop test met all criteria set out in Appendix P, except for the unavoidable presence of a crust due to the nature of slurry stored in the pond. The 2017 drop test report was peer reviewed by a CPEng and is appended to this application.

The characteristics of slurry and liquid effluent in storage systems are quite different. Due to a much higher DM content [2], slurry has relatively low viscosity compared to liquid effluent. Slurry has self-sealing properties [3]. Whilst the process is not fully understood, self-sealing of slurry ponds/lagoons greatly reduces the risk of leakage through clay/earthen-lined ponds. Wind-driven wave action can cause bank erosion in ponds where wave energy carried by liquid damages the clay substrate. This does not arise when storing slurry since the pond surface is solid and does not move via wave action.

In the absence of operating within the normal parameters of a leak detection system or all pond drop test criteria set out in Appendix P, Rule 32D does not provide a pathway to an activity level for the use of land for the maintenance and use of an existing agricultural effluent storage pond at WW2. As such, the structure cannot align with Rule 32D. Since the pond stores slurry, which has self-sealing properties, meets all other Appendix P criteria and has minimal risk of bank erosion, the pond is very unlikely to be leaking. As such, the applicants believe the use of land for the pond at WW2 should be permitted by the Consent Authority. However, in being unable to meet all Appendix P criteria and without an avenue to an activity level within the rule, the applicants wish to place this issue in front

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[2] Houlbrooke, Longhurst, Orchiston & Muirhead (2011) Characterising dairy manures and slurries. Report prepared for Surface Water Integrated Management (SWIM), AgResearch

[3] Parker, David & Schulte, D.D. & Eisenhauer, D.E. (1999). Seepage from earthen animal waste ponds and lagoons - An overview of research results and state regulations. Transactions of the ASABE (American Society of Agricultural and Biological Engineers). 42. 485-493. 10.13031/2013.13381.

of the hearing decision maker where it can be discussed, considered and resolved. They agree to apply for consent as and when directed to by the hearing decision maker.

WW2's storage pond meets Rule 32D (a) (i) (1) in that its construction was lawfully carried out without a consent. In accordance with Rule 32D (a) (ii) (2), a visual assessment of WW2's pond was carried out by a SQP in 2018. The assessment found that the pond shows no cracks, holes or defects that would allow effluent to leak. A report certifying WW2's pond by a SQP is appended to this application.

WW1 STORAGE POND

WW1's effluent pond stores slurry and was lawfully upgraded in autumn 2018 to increase its storage capacity, install a synthetic liner and leak detection system. The pond design was certified by a CPEng as meeting Practice Note 21 standards and was approved the Council engineer in 2018. The liner is composed of 1.5 mm HDPE, overlies a leak detection drain system the specification for which was provided by a CPEng. CPEng guidance determined a suitable design to meet PN21 standards for small ponds. The leak detection system is a ring drain that terminates at a 400 mm diameter inspection well (piezo). The liner supplier confirmed that the liner was correctly installed and is not leaking. The CPEng confirms that the pond is structurally sound following the upgrade. The CPEng report was submitted to Environment Southland as required in 2018.

In meeting the aforementioned-design and construction requirements to meet Practice Note 21, we conclude that WW1's pond is operating within the normal operating parameters of a leak detection system; there is no effluent leaking from the pond. The piezo has been inspected regularly when it either has had no liquid or had liquid following heavy rainfall when the water table was high. By checking the liquid in the piezo for signs of effluent (i.e. odour and clarity), it has been confirmed that there is no effluent in the leak detection system and no effluent leaking from the pond.

In accordance with Rule 32D (a) (ii) (2), a visual assessment of WW1's pond was carried out by a SQP in 2018. The assessment found that the pond shows no cracks, holes or defects that would allow effluent to leak. A report certifying WW1's pond by a SQP is appended to this application.

We conclude that in accordance with Rule 32D of the pSWLP, the use of land for an existing effluent storage pond at WW1 is a permitted activity; resource consent is not required. However, Council's interpretation of PN21 requirements for leak detection systems differs from CPEng guidance on PN21 received during the design and construction of WW1's pond. The applicants wish to place this issue in front of the hearing decision maker where it can be discussed, considered and resolved. They agree to apply for consent as and when directed to by the hearing decision maker.

ANCILLARY EFFLUENT STRUCTURES AT WW1 AND WW2

At both WW1 and WW2, other structures that contain, treat or store effluent include a sand trap and concrete effluent sump at the dairy shed and concrete collection sump at the wintering barn. These structures have been visually assessed by a SQP and certified as having no visible cracks, holes or defects that would allow effluent to leak. A report prepared by a SQP detailing the structures is appended to this application.

An Appendix P drop test for dairy shed ancillary structures will be carried out on in the off-season. These structures cannot be diverted during the milking season. Drop testing of the wintering barn collection channel sumps will be carried out at the earliest opportunity, with drop test reports submitted to ES prior to the wintering barns being used in May 2019.

Feed pads/Lots

Rule 35A of the pSWLP manages the use of land for feed pads/lots including wintering barns. In this instance the use of land for two wintering barns at the dairy platform does not meet all conditions set out in Rule 35A (a) as each barn houses more than 120 cattle. The use of land for a feed pad/lot that does not meet one or more conditions of Rule 35A (a) is classed as a discretionary activity. Accordingly, resource consent application for the use of land for two wintering barns at WW1 and WW2 is also submitted (in a separate document) to Environment Southland.

Groundwater abstraction

Under Rule 54 (d) of the pSWLP, groundwater abstraction for 1,500 cows on the WW1&2 is a discretionary activity as a maximum of 180,000 litres per day is abstracted. This allows for 120 litres per cow per day. Under Rule 23 (c) of the Regional Water Plan, a groundwater take of 180,000 litres per day is a restricted discretionary activity provided the rate of take is less than or equal to 2 L per second; resource consent is required. **The groundwater abstraction is assessed as a discretionary activity and resource consent is required.**

Permitted activities

Silage storage - WW1 and WRO

The use of land for silage storage facilities at WW1 and WRO is a permitted activity as it meets all conditions specified in **Rule 40 (a)** of the pSWLP; resource consent is not required.

The use of land for silage storage facilities at WW1 and WRO is a permitted activity as it meets all conditions specified in **Rule 51 (a)** of the RWP (2010); resource consent is not required.

Surplus grass is harvested and generally stored as baleage at WRO, However, occasionally it may be stored as silage. Where this occurs, the applicants ensure that permitted activity rules regarding the use of land for silage storage are always met.

Both rules are met as follows:

Silage pads are situated on dry sites; the underlying substrate is well compacted and sealed (see figures 6.4 and 6.5 for the permanent pad at WW1). There is no overland flow of stormwater into silage pads and silage pads are not situated within a critical source area. Silage pads are not located on land that is made permanently or intermittently wet by the presence of springs, seepage, high groundwater, ephemeral rivers or flows of stormwater other than from any cover of the silage.

No part of any silage pad is within 50 metres of a lake, river, artificial watercourse, modified watercourse (see figure 6.6 for WW1), natural wetland or any potable water abstraction point. The nearest waterway to the WW1 pad is a fenced off open drain, which is approximately 60 metres to the east of the silage pad.

No silage pad is within 100 metres of any dwelling or place of assembly, on another landholding.
No silage pad is not within 100 metres of the microbial health protection zone of a drinking water supply site identified in Appendix J of the pSWLP, or within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J.

Cattle do not graze directly from any silage pad, rather silage is carted to cows in the wintering barn or on paddocks at WW1 and to stock on paddocks at WRO. No silage pad is located on contaminated land.

Silage storage - WW2

The use of land for a silage storage facility at WW2 meets the conditions stated in Rule 40 (a) of the pSWLP (2018), so is classed as a permitted activity and resource consent is not required. The use of land for a silage storage facility meets the conditions stated in Rule 51 (a) of the RWP (2010), so is classed as a permitted activity and resource consent is not required.

Silage leachate - WW1 & WRO

The discharge of silage leachate onto or into land at WW1 and WRO is a permitted activity as it meets all conditions specified in Rule 51 (d) of the Regional Water Plan (2010); resource consent is not required.

The activity meets Rule 41 (a) (iia), (iii) and (iv) of the pSWLP and is therefore a permitted activity and resource consent is not required. There is no discharge of leachate directly to groundwater via a pipe, soak pit or other soil bypass mechanism and there is no overland flow or ponding of silage leachate outside of the silage storage facility.

Silage leachate - WW2

In accordance with Rule 41 (a) of the pSWLP, the discharge of silage leachate onto or into land in circumstances where contaminants may enter water is a permitted activity since part (i) is met and resource consent is not required; the discharge is via an agricultural effluent discharge system authorised under Rule 35.
In accordance with Rule 50 (d) of the RWP (2010), the discharge of silage leachate at WW2 is a permitted activity since all conditions set out in Rule 50 (d) are met; resource consent is not required.

Intensive winter grazing

IWG is carried out at WRO so Rule 20 parts (b) and (c) apply. IWG activities at WRO meet permitted activity rules regarding areas, set-backs and other GMPs as directed by parts (b) and (c).

Cultivation

Cultivation at WW1&2 and WRO meets permitted activity rules described in Rule 25 of the pSWLP. Cultivation is not carried out within a bed or within 5 metres of from the outer edge of the bed of any waterways. It does not occur on land with a slope of greater than 20 degrees.

In the future, if a setback of less than 5 metres is implemented when cultivating at the WW1&2 dairy platform, the activity will meet permitted activity rules described in part (b) of Rule 25. A minimum setback of 3 metres from the outer edge of any stream bed will be implemented, cultivation will not occur more than once in any 5-year period and it will be for the purpose of renewing pasture and not for any fodder crop/IWG activity.

2.2 Duration

Consent durations of 15 years are proposed for all consents, which aligns with Woldwide One's discharge and water permit terms. Special consideration is given to Policy 40 of the pSWLP and Policies 14A and 43 of the Regional Water Plan in determining the duration. The duration sought is considered consistent with these policies given the replacement nature of consents for an activity that is already well established, has benefited from a significant degree of capital investment and is operating within limits established by its existing consents and associated conditions. Considerable investment in farm infrastructure has been made to take the final steps towards future proofing the dairying operation; eliminating winter grazing of adult cattle on beet/brassica crops from high risk soils in the sensitive Heddon Bush area altogether. The level of investment demonstrates the applicant's belief in and commitment to sustainable farming and land management. The applicants believe that their presence at this location since 1992 (over 25 years) has not had a detrimental effect on the local environment, and that the proposed changes will mean a further reduction of that impact. They are likewise committed to the sustainable management of WRO with minimal adverse effects on the receiving environment. A 15-year consent term will mean that the management of the resources under the same proven stewardship will be ensured into the future.

2.3 Proposed consent conditions

The applicants propose to agree conditions once draft conditions are issued, including the conditioning of various mitigation measures where appropriate. Draft conditions will recognise the following:

Land use consent for farming

1. The land area will include WW1&2 and WRO.

   Environment Southland regard WRO to be part of the landholding at WW1&2. The applicants hold a different view as mentioned in section 1. However, in respect of Environment Southland's view and for the application to be accepted under s88 by the consent authority, WRO has been included in the landholding in this application and therefore is included in the land use consent for farming.

2. That activities at WW1&2 dairy platform are restricted using the N output from the proposed Overseer nutrient budget as a limit. The below example can be used as guidance. Using an N output figure provides Council with certainty that N losses will not increase due to future farming activities at WW1&2, while providing the applicants with flexibility to farm according to climatic and economic conditions, and to respond to unforeseen challenges as they arise (e.g. biosecurity/*M. bovis*). An output-based consent is preferable since it allows for innovation by restricting the N loss from the whole activity at the dairy platform rather than specific activities.

3. For reasons explained in the WRO section of the application, only input-based conditions are proposed for WRO.

4. To provide additional certainty over the scale of the activity, mitigations and effects that the following inputs are conditioned:

   WW1&2:

   a. Land area;
   b. Effluent discharge area;
   c. Peak cow numbers milked (1,500); and
   d. Maximum number of cows housed in wintering barns (1,250).

WRO:

e. Land area;
f. Maximum area in winter crop (beet or brassica) to be intensively winter grazed is 100 hectares;
g. A maximum of 417 R1 heifers grazed all year round at WRO from WW1&2;
h. A maximum of 417 R2 heifers grazed all year round at WRO from WW1&2, **or**
A maximum of 417 R2 heifers grazed between August and May and during June and July in the WW1&2 wintering barns.

5. The Consent Holder shall maintain records of the following for each year between 1 June and 31 May:
    a. Fertiliser application, including rates;
    b. Supplements imported;
    c. Types of crops and total area of cropping if any;
    d. Cultivation methods;
    e. Stock units by references to type, age and breed;
    f. Effluent application areas (WW1&2 only);
    g. All other inputs to the OVERSEER nutrient budgeting model.

6. Install a new monitoring bore in the same area as bore E45/0622, to monitor groundwater quality flowing south from WW1&2.

Example – WW1&2 year-end nutrient budget:

Nitrogen Loss Rate and Nutrient Budget

1. *The Consent Holder shall ensure nitrogen losses from farming activities undertaken at the WW1&2 are maintained at or below the following nitrogen loss rate of 40 kg/ha/yr, or as amended in accordance with Condition X.*

Advice Note: *The nitrogen loss rates represent the modelled discharge of nitrogen below the root zone as modelled with OVERSEER version 6.3.1 in accordance with the OVERSEER Best Practice Input Standards as of 11 May 2018.*

The determination of whether the nitrogen loss rates have been met will be made using the nitrogen loss from the most recent year, modelling using the latest version of OVERSEER®.

2. *The Consent Holder shall prepare an annual nutrient budget for the period of 1 June to 31 May for the subject land using OVERSEER in accordance with the OVERSEER Best Practice Input Standards, or an equivalent model approved by the Chief Executive of the Consent Authority.*

3. *The nutrient budget required by Condition 2 shall be accompanied by a report that includes:*
    a. *A review of the input data to ensure that the nutrient budget reflects the farming system;*
    b. *An explanation of any differences between the budgets of the previous year; and*
    c. *A comparison of the nitrogen loss from the current year with the nitrogen loss rates in Condition 2.*

4. *The nutrient budget and accompanying report shall be provided to the Consent Authority by 30 September each year.*

5. *The nutrient budget shall be prepared by a Certified Nutrient Advisor or the budget may be prepared by suitably experienced person and reviewed by a Certified Nutrient Advisor.*

6. *The nitrogen loss rates described in Condition 2 shall be amended following the release of a new version of OVERSEER or the Best Practice Data Input Standards. Following the update of the nitrogen loss rates, the Consent Holder shall provide the updated OVERSEER files to the Consent Authority with the report required by Condition 5.*

Discharge permits

WW1&2

The below draft conditions are proposed for the discharge of agricultural effluent at WW1&2.

This consent shall be exercised in conjunction with Land Use Consent AUTH-X.

(a) This consent authorises the discharge of dairy shed effluent, wintering barn effluent, silage pad effluent and underpass effluent ("agricultural effluent") onto land, via a land disposal system consisting of two effluent storage ponds, two sand traps, two dairy shed pump sumps, two wintering barn concrete collection sumps, low depth travelling irrigator, low rate (pods and/or rain-gun) irrigation, slurry tanker with a trailing shoe and umbilical system, as described in the application (X) for resource consent dated X 2018 and further information dated X.

The activity shall be limited to:

i. *The discharge to land of agricultural effluent generated from milking of up to 1,500 cows milked twice daily;*
ii. *The discharge to land of agricultural effluent from the housing of up to 1,250 cows inside two purpose built barns;*
iii. *The discharge of agricultural effluent to land via low depth travelling irrigator, slurry tanker with a trailing shoe, umbilical system and low rate irrigation;*
iv. *The discharge of agricultural effluent to an area of no more than X hectares at the WW1&2 dairy platform as per the plan attached as Appendix 1;*
v. *The discharge of effluent from a 1,200 m^2 silage pad; and*
vi. *The discharge of effluent from a 200 m^2 underpass.*

***Advice note**: "Effluent slurry" refers only to the contents of the effluent storage ponds. "Agricultural effluent" refers to effluent from all sources (the dairy shed, yard, barns, ponds, silage pad and underpass).*

(b) This consent excludes the discharge of effluent from winter milking from June 20 to July 20 (winter milking refers to cows milked to supply a winter milking contract), or from any feed pad/calving pad/structure not listed in condition 2(a).

2. *The discharge authorised by this consent shall not exceed the following rates and/or depths at any time:*

(a) *For the travelling irrigator: A maximum depth of less than 10 millimetres for each individual application;*
(b) *For the slurry tanker with trailing shoe: A maximum depth of 2.5 millimetres for each individual application;*
(c) *For the umbilical system: A maximum depth of 3.0 millimetres for each individual application; and*
(d) *Low rate system: a maximum depth of 10 millimetres for each individual application, and a maximum rate of 10 millimetres per hour.*

3. *The maximum loading rate of nitrogen from effluent onto any land area as a result of the exercise of this consent shall not exceed:*
   (a) *150 kilograms of nitrogen per hectare per year at the dairy platform.*

4. *The minimum return period for the discharge of effluent to land shall be no less than 28 days.*

5. *Effluent shall not be discharged within:*
   (a) *20 metres of any surface watercourse;*
   (b) *100 metres of any water abstraction point;*
   (c) *200 metres of any place of assembly or dwelling not on the subject property;*
   (d) *20 metres from any property boundaries.*

Where there is inconsistency between the plan attached as Appendix 1 and the conditions of this consent, the conditions of this consent shall prevail.

6. *The application of effluent to land shall not occur when:*
   (a) *the moisture content of the soils is at or above field capacity,*
   (b) *soils within the discharge area are 'cracked'; and*
   (c) *during wind conditions that may result in odour or spray drift beyond the property boundary.*

Horner Block

The below draft conditions are proposed for the discharge of agricultural effluent at the Horner Block.

1. *The discharge of effluent slurry to an area of no more than 97 hectares at the block known as the "Horner Block" as per the plan attached as Appendix 1.*

2. *The discharge authorised by this consent shall not exceed the following depths at any time:*
   a. *For the slurry tanker with trailing shoe: A maximum depth of 2.5 millimetres for each individual application; and*
   b. *For the umbilical system: A maximum depth of 3.0 millimetres for each individual application.*

3. *The maximum loading rate of nitrogen from effluent onto any land area as a result of the exercise of this consent shall not exceed:*
   a. *250 kilograms of nitrogen per hectare per year at the Horner Block (Lot 4 DP 399915).*

i. *The annual slurry volume applied at the Horner Block shall be recorded and reported to the Consent Authority upon request.*

Other conditions for land use, discharge and water consents – to be agreed with Consent Authority once draft conditions are issued.

3. Statutory Considerations

3.1 Statutory considerations:

Environment Southland must consider the following matters when they consider an application. The application is consistent with all of these relevant plans and policies because effects on water quality and quantity and the soil resource should be less than minor.

Resource Management Act 1991:

- The provisions of section 104 of the Resource Management Act 1991;
- Part 2 of the Resource Management Act;
- The applicant's assessment of effects on the environment;
- The provisions of Sections 104B, 104C, 105 and 107 of the Resource Management Act 1991.

Schedule 4 of the RMA requires that an assessment of the activity against the matters set out in Part 2 and any documents referred to in Section 104. Sections 104B and 104D of the Act set out the matters that, subject to Part 2, the Consent Authority must have regard to when considering an application for discretionary activities. Sections 105 and 107 set out additional matters the Consent Authority must have regard to when considering applications to do something that would otherwise contravene Section 15. An assessment of each of these matters follows:

Part 2 of the RMA

The activity is considered to represent an efficient use of natural resources that will give rise to significant positive benefits in terms of providing for the social and economic wellbeing of the applicants and the wider regional economy. There is, however, the potential for adverse effects on the environment to arise, including on water quality. However, it is considered that the effects of the activities have been adequately identified and assessed in the Assessment of Environmental Effects in Section 7 below and that such effects will be no more than minor.

Section 6 of the RMA lists the matters of national importance that a Consent Authority shall recognise and provide for when considering applications for resource consent. The relevant matters under Section 6 to this proposal are considered to be:

(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
(c) the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga:

It is considered that the proposed activities do not impact directly on the coastal environment, wetlands, and lakes and rivers and their margins, although there is potential for adverse effects on the wider receiving environment which is inclusive of some of these features. However, as is discussed in Section 7 below, the actual and potential adverse effects of the activities are considered to be no more than minor.

Section 7 of the Act lists a number of other matters that a Consent Authority must have particular regard to when considering applications for resource consent. The matters in Section 7 that are considered relevant to this application are:

(a) kaitiakitanga:

(aa) the ethic of stewardship:

(b) the efficient use and development of natural and physical resources:

(c) the maintenance and enhancement of amenity values:

(d) intrinsic values of ecosystems:

(f) maintenance and enhancement of the quality of the environment:

(g) any finite characteristics of natural and physical resources:

(h) the protection of the habitat of trout and salmon:

For the reasons discussed in Section 7 of this report below, the proposal is considered consistent with relevant provisions of Section 7 of the RMA.

Section 8 sets out a Consent Authority's responsibilities in relation to the Treaty of Waitangi. The proposal is considered consistent with the provisions of all regional planning documents, including Te Tangi oTauira, and Sections 6(c) and 7(a) of the Act. Therefore, the proposal can also be considered consistent with Section 8 of the Act.

To avoid repetition, the following documents have been grouped together under common headings in the sections that follow.

The final part of this section of the application focuses on why the activity is consistent with key policies in the proposed Southland Water and Land Plan (2018).

Table 3.1: Ngai Tahu Values

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives C1, D1 • Policies C1, D1
Southland Regional Policy Statement 2017	• Objectives TW.2, TW.3, TW.4 and TW.5 • Policies TW.3, TW.4 and TW.5
Regional Water Plan 2010	• Objective 9C • Policy 1A
Regional Effluent Land Application Plan 1998	• Objectives 4.1.4, 4.1.5 • Policies 4.2.4, 4.2.7,4.2.8, 4.2.9

Proposed Southland Water and Land Plan 2018	• Objectives 3, 4, 5, 15 • Policies 1, 2, 3
Te Tangi a Tauira:	• Whole Document

Tangata Whenua values have been considered when preparing this application including reference to Te Tangi a Tauira (Iwi Management Plan). The principles of protection of the mauri of the water and mana of the land while minimising adverse effects on mahinga kai will continue to be recognised and have regard to in the exercise of the consents and the operation of the dairying activity. There are no known wahi tapu, ancestral sites, heritage sites or other taonga associated with the landholding.

Table 3.2 Water Quality

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives A1, A2, B1, B2, B3, B4, • Policies A3, A4, B5, B6, B7
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2 • Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.2 • Policies 4.2.3, • Rule 5.4.5
Regional Water Plan 2010	• Objectives 3,4,8 • Policies 1, 4, 6, 7, 13
Proposed Southland Water and Land Plan 2018	• Objectives 1, 2, 6, 7, 8, 9, 13, 18 • Policies 5, 10, 13, 14, 15, 16, 17, 18, 39A, 40
Te Tangi a Tauira	• Policies 1, 4, 5, 6, 11, 16, 17, 18

Dairy and dry stock farming are carried out following good management practices relevant to the physiographic zones present at the WW1&2 (Oxidising and Central Plains) and WRO (Bedrock/Hill Country, Gleyed, Oxidising, Peat Wetlands, Lignite Marine Terraces). These practices are recommended by Council and are implemented on farm to mitigate the risk of adverse effects on water quality from contaminants transported via artificial drainage, deep drainage and overland flow where relevant. Deep drainage and artificial drainage are recognised by the applicants as key contaminant pathways at WW1&2 and are managed as such. Artificial drainage and overland flow are recognised as key pathways at WRO, with deep drainage also a risk but to lesser extent. Good management practices and specific mitigation measures implemented on farm are described in this application (sections 6, 7, WRO section), and in the Appendix N Farm Environmental Plans for the WW1 and WW2 units and for WRO.

At WW1&2 there will be no increase in contaminant loss and no increase in effects on receiving water quality due to additional cows. This expansion will be achieved through the implementation of key mitigation measures to off-set additional cows, alongside the implementation of a suite of good management practices. Practices such as IWG, which generally have high rates on N loss to receiving ground and surfacewaters, are being eliminated from a sensitive area in Central Southland.

At WRO, proposed activities will result in minimal adverse effect on receiving waters.

At WW1&2 and the Horner Block, the discharge is to land rather than water and is undertaken in a manner to minimise adverse effects on water quality. Good management practices for the management of the effluent system and mitigation measures have been included in the application and respective Farm Management Plans. By only irrigating effluent to land when ground conditions are less than field capacity, and by ensuring that irrigation of effluent to land does not result in the soils reaching field capacity, the risks of leaching through the soil profile or via overland flows are mitigated. The use of very low depth irrigation, as discussed in the AEE, should reduce the risk of exceeding a soil's infiltration rate, thus preventing ponding and surface runoff of freshly applied effluent (slurry). The recommended buffer zones from waterways are adhered to when applying effluent.

Table 3.3 Water Quantity

Regulatory Document	Relevant Sections
National Policy Statement for Freshwater Management 2014	• Objectives A1, A2, B1, B2, B3, B4, • Policies A3, A4, B5, B6, B7
Southland Regional Policy Statement 2017	• Objectives WQUAN.1 and WQUAN.2 • Policies WQUAN.1, WQUAN.2, WQUAN.5, WQUAN.6, WQUAN.7 and WQUAN.8
Regional Water Plan 2010	• Objectives 5,7,8 and 9 • Policies 21, 22, 23, 28, 29, 30, 31, • Rules 16C, 23, 50
Proposed Southland Water and Land Plan 2018	• Objectives: 7, 9, 11, 12, 18 • Policies 20, 21, 22, 23, 25, 42
Te Tangi a Tauira:	• Policies 1, 4, 5, 6, 11, 16, 17, 18

The groundwater take reflects standard volumes for a dairy farm at WW1&2. The proposed volume of take is consistent with Environment Southland's guidelines of 120 litres per day per cow, which is considered reasonable for the intended end use. The maximum groundwater take is 180,000 litres per day, allowing for 120 litres per day per cow for 1,500 cows.

Groundwater is abstracted for dairy shed use and stock drinking water from three bores at the landholding. The rate of take does not exceed 2 L/sec and should not result in more than minimal stream depletion and interference effects.

Table 3.4 Soil Health and Effluent Management

Regulatory Document	Relevant Sections
Regional Policy Statement for Southland 2017	• Objectives WQUAL.1 and WQUAL.2 • Policies WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.7, WQUAL.8, WQUAL.12
Regional Effluent Land Application Plan 1998	• Objectives 4.1.1 • Policies 4.2.1, 4.2.2
Regional Water Plan 2010	• Policy 41 • Rule 49
Proposed Southland Water and Land Plan 2018	• Objectives 13, 13A, 14, 15, 18 • Policies 5, 17, 33 • Rule 32D, 35, 40, 41
Te Tangi a Tauira	• Policies 4, 7, 8, 9, 11, 13, 14, 15

The applicants seek to ensure the life supporting capacity of the soil is safeguarded, along with the sustainability of the soil ecosystem by utilising land treatment of effluent without significant adverse effects. At WW1&2, soils are suitable for effluent irrigation and the discharge follows current good management practice, which is described in Section 6 and in the FEMP. These include practices of a general nature and those specific to the key contaminant transport pathways for the physiographic zones.

Two existing storage ponds allows for deferred storage of dairy shed, wintering barn and silage pad effluent until the soil moisture content is suitable for irrigation. The land disposal area meets the best practice recommendation of 8 hectares per 100 cows. The nutrient loading of soils will not exceed 150 kg N/hectare at WW1&2 dairy farm and 250 kg N/hectare at the Horner Block. The higher strength nature of slurry has been recognised and fully considered in the AEE. Slurry from the ponds will be applied at a maximum depth of 2.5 millimetres per application using the slurry tanker with the trailing shoe to avoid overloading soils with nutrients and microbes. This system is sustainable in the long term and allows the effluent to be used both as a fertiliser and a soil conditioner.

In addition to the matters in Section 104 of the Act, when considering an application for a discharge permit a Consent Authority must also have regard to Section 105. As is discussed in the assessment under Section 7, it is considered that provided the discharge is undertaken in accordance with the conditions of the consent and the best practice management techniques outlined in Section 6 of the application and in the FEMP, the adverse effects of the activity should remain no more than minor. The best method for dealing with effluent from the dairy operation is considered to be discharging to land.

There are not considered to be any matters under Section 107 of the Act that would require the Consent Authority to decline the application for discharge permit.

3.2 Proposed Southland Water and Land Plan (2018)

The application meets the relevant objectives and policies described in the pSWLP (2018). The policies are numerous; however, the following policies are particularly relevant because of their focus on good practice management in the appropriate physiographic zones; effects including cumulatively, on water quality and quantity, and the soil resource should be less than minor.

Objectives and Policies relevant to land-use and discharges at WW1&2 & Horner Block

- **Objectives 6, 7, 8, 9, 13, 18**
- **Policies 5, 10, 13, 14, 15, 16, 17, 18, 39A, 40**

Policies 5 and 10 are physiographic zone policies. Policy 5 gives direction on the land located in the Central Plains physiographic zone; Policy 10 gives direction on land located the Oxidising physiographic zone.

Under **Policy 5.1**, adverse effects on water quality from contaminant loss via artificial drainage and deep drainage in the Central Plain's physiographic zone must be avoided, remedied or mitigated by the implementation of good management practices. The Central Plain's physiographic zone is mapped as a major physiographic zone at both the WW1&2 dairy farm and Horner Block. The applicants implement a wide range of good management practices at both locations to mitigate contaminant loss via artificial drainage and deep drainage, which is demonstrated in section 6 and 7 and in the FEMPs. They have been leaders in the dairy industry in Southland, being the first to build free wintering barn stalls to reduce outside crop-based wintering, and the first to feed fresh grass to cows in winter to reduce silage making losses and run-off.

In order to meet **Policy 5.2,** this application and accompanying FEMPs have particular regard to adverse effects on water quality from contaminants transported via artificial drainage and deep drainage.

Policy 5.3 gives direction to decision makers on generally not granting resource consent for additional dairy farming of cows or additional winter grazing where contaminant losses will increase as a result of the proposed activity. *Note: Much of the following assessment also applies to Oxidising land.*

In the absence of making other changes to the farming system, an additional 160 cows would be expected to increase contaminant losses from the activity. However, other changes are being made, such as the phasing out of IWG at WW1&2 and increased capacity and use of the wintering barns. Overseer nutrient budget analysis has been carried out to determine pre-expansion nutrient N and P losses. In the absence of a suitable alternative method, P loss has been used as a proxy for sediment and microbial loss, as they generally move from land to water in a similar way (i.e. via overland flow, and via artificial drainage at times). The post-expansion nutrient budget includes an additional 160 cows. Several key mitigation measures will be implemented and are modelled in Overseer, to ensure that nutrient losses (and by proxy sediment and microbial contaminants) will not increase post expansion. Some measures are not modelled in Overseer but will also mitigate contaminant losses and associated effects. Collectively the changes will lead to increased soil organic matter content, increase soil water holding capacity, improved soil structure and less accumulation of N in high risk soils at high risk times. This should reduce the risk of contaminant loss to groundwater via deep cracks that potentially can form in Braxton soils due to swell/shrink properties, which is a risk not particularly addressed by Overseer. A field investigation by M. Killick from Environment Southland in January 2018 showed that Braxton soils at the landholding may not in fact form deep cracks due to soil, pasture type and management, which reduces the background risk of contaminant loss to groundwater in the Central Plains PZ to a degree.

The applicants will provide Environment Southland with certainty that contaminant losses will not increase through the implementation of consent conditions and by submitting a year-end Overseer nutrient budget annually. As the proposed activity will not result in an increase in contaminant losses (N, P, and by proxy sediment and microbes), the application is in line with Policy 5.3 and should be granted.

Under **Policy 10**, adverse effects on water quality from contaminant loss via deep drainage, and via artificial drainage and overland flow where relevant, in the Oxidising physiographic zone must be avoided, remedied or mitigated by the implementation of good management practices. The Oxidising physiographic zone is mapped as a major physiographic zone at WW1&2 and the Horner Block with Oxidising areas generally found on the east side of the dairy platform where free draining soils are found. Due to the nature of its topography and soils, artificial drainage or overland flow pathways are not believed to be a particular risk for Oxidising areas. Deep drainage of contaminants, particularly nitrate loss to groundwater, is a risk for Oxidising areas and must be managed under Policy 10.

The assessment provided in Policy 5 relating to the management of the risk of contaminant loss via deep drainage to groundwater also applies to the management of Oxidising soils. Rather than repeating the policy assessment, please see the above assessment provided for Policy 5.1, 5.2 and 5.3. Improved soil structure, better nutrient management and particularly less N mineralisation and N accumulation at high risk times will see less nitrate loss to groundwater via deep drainage in Oxidising areas. Oxidising soils do not have similar swell/crack properties as Central Plain's soils, so the risk of deep crack formation and subsequent by-pass drainage to the underlying aquifer is not believed to be a risk for Oxidising soils. As has been explained in Policy 5.3 above, potential contaminant losses from additional cows will be off-set through the implementation of several key mitigation measures. This will result in a small reduction in N and P loss. The applicants will provide Environment Southland with certainty that contaminant losses will not increase through the implementation of consent conditions and by submitting a year-end Overseer nutrient budget annually. Under Policy 10, the proposed activity should be granted.

Policy 13 gives direction on the management of land use activities and discharges. In line with Policy 13.1 the proposed expansion will better enable the applicants to provide for their social, economic and cultural well-being. The increase in herd size by 160 will allow changes in management practice to be made, whilst also operating a profitable and sustainable business model. The maintenance of a profitable and sustainable business model is central to the success of the business, and provides social, economic and cultural benefits to the applicants, their employees, families and whanau, and to the wider community. In the context of an agricultural-based local economy, the use and development of land and water resources at WW1&2 for primary production should be recognised. In line with Policy 13.2, land use activities and discharges (point source and non-point source) are managed to enable the achievement of Policies 15A, 15B and 15C.

In line with **Policy 14,** the discharge is to land and there is no discharge to water.

Policy 16 gives direction on farming practices that affect water quality.

Policy 16.1 (a) discourages the establishment of new dairy farming of cows in close proximity to Regionally Significant Wetlands and Sensitive Waterbodies. The nearest Regionally Significant Wetland is Dunearn Wetland, located approximately 4 km to the north west. As the direction of ground and surfacewater flow is to the south, there is no risk to water quality at Duneran Wetland from the proposed activity. Drummond Peat Swamp is located approximately 12 km to the south east of WW1&2, and Bayswater Peat Bog is located approximately 10 km to the south west of the property. Neither Drummond Peat Swamp nor Bayswater Peat Bog are *in close proximity* to the dairy farm so have little or no risk due to the proposal. Under Policy 16.1 (a) the proposed activity can be established.

Policy 16.1 (b) ensures that until the development of freshwater objectives under FMU processes, applications to establish new, or further intensify existing dairy farming of cows, or to intensify winter grazing activities will generally not be granted under certain situations. The situations relate to different effects on and measures of water quality. This application is for an increase of 160 cows (11%) on land that has been dairy farmed for between 17 and 26 years to date, or on land that has been used for dairy support and was consented for dairy farming in October 2017. As such this application is not to establish new dairy farming of cows but is to intensify through an increase in cow numbers.

In parallel with additional cows, it proposed to implement many key mitigation measures, such as the removal of all winter and summer fodder cropping, removal of IWG, expansion of size and use of wintering barn facilities and more efficient use of N fertiliser at WW1&2. The cessation of IWG is an important mitigation in a sensitive part of Central Southland since it has high N loss, especially where free draining soils are sown in fodder beet and subsequently IWG. IWG is specifically included in Policy 16 as an activity that affects water quality. The removal of this practice from WW1&2 means that cultivation practices will move to direct grass to grass methods in a sensitive area, with less disturbance of soil structure and less mineralisation processes occurring. This will lead to increased soil organic matter content and water holding capacity and reduce N loss to ground and surfacewaters over time. It is explained in the following three paragraphs why the proposed further intensification of existing dairy farming should be granted in this instance.

Policy 16.1 (b) (i) gives direction on generally not granting further intensification of existing dairy farming of cows where the adverse effects, including cumulatively, on the quality of groundwater and receiving surface waterways such as rivers, wetlands and estuaries cannot be avoided or mitigated. Section 7 of the application provides an in-depth assessment of effects (AEE) of the proposed activity on groundwater and receiving surface waters. The AEE addresses the potential for adverse effects on already elevated groundwater to the south east of WW1&2, on groundwater to the south including at Heddon Bush School, which has a registered bore for drinking water supply and on receiving surfacewaters including the Waimatuku Stream, Estuary, Lower Oreti and New River Estuary. The assessment includes contaminants N, P, sediment and microbes and their related effects in receiving waters, with P used as a proxy for sediment and microbes and supports the conclusion that adverse effects, including cumulatively, from the whole activity at WW1&2 will be mitigated.

Policy 16.1 (b) (ii) gives direction on generally not granting further intensification of existing dairy farming of cows where existing water quality is already degraded to the point of being over-allocated. There is a high degree of variation in existing groundwater quality in the area, with an area to the south east of WW1&2 showing high groundwater nitrate concentrations, above the New Zealand Drinking Water Standard of 11.3 ppm. Particularly, groundwater at an ES monitoring bore at Boyle Road to the south east has shown high nitrate-N concentrations, indicative of groundwater degradation due to land use effects in the area, such as IWG on free draining soils. This matter is assessed in depth in the AEE.

Groundwater flow for much of WW1&2 is believed to be to the south[4]. Groundwater quality measured at the southernmost bore (E45/0622) shows relatively low levels of nitrate, as does a bore located ~2.3 km due south at Heddon Bush School (1.8 – 2.0 ppm in 2017/2018). Bore E45/0622 is an indicator of groundwater quality at the base of WW1&2. It should capture the cumulative effect of land use on water quality in the groundwater stream to the north, upstream of groundwater flow including some Braxton and Drummond soils. If deep cracks form in Braxton soils, then contaminants such as nitrate can bypass the soil matrix and move to groundwater or move via subsurface drains into surfacewaters. Water quality at bore E45/0622 does not show evidence of nitrate reaching groundwater via this process, as despite occasional well-head contamination issues, nitrate levels have been consistently low at the bore. In conjunction with the low nitrate levels measured at the Heddon Bush School bore,

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[4] Hitchcock (2014). Characterising the surface and groundwater interactions in the Waimatuku Stream, Southland (Thesis, Master of Science). University of Otago. Retrieved from http://hdl.handle.net/10523/5087

data from bore E45/0622 indicate that groundwater groundwater flowing south from WW1&2 is not degraded to the point of being overallocated.

There is an increasing gradient in groundwater nitrate concentration from west to east towards Terrace Creek, which flows approximately north to south, and is located approximately 1 km beyond the eastern boundary of WW1&2. This concentration gradient is reflected by data from other bores at WW1&2 (E45/0665 and E45/0727), where the increasing gradient corresponds to a transition from heavier to lighter soils towards the east. Average groundwater nitrate concentrations at these two bores are considerably lower than concentrations seen further east and south east beyond the boundary. Due south of WW1&2, groundwater nitrate levels are predominantly low for approximately 10 km, which includes the area around Heddon Bush School.

Based on the above factors in conjunction with changing on farm practices, it is proposed that under Policy 16.1 (b) (ii), the activity should be granted. The cumulative effect of changing on farm practices over time, should see a further reduction in nitrate loss to groundwater at WW1&2. The applicants believe that farming under the current system, with a maximum of 1,340 cows but using practices such as IWG causes more cumulative loss of N to groundwater due to increased N accumulation and more mineralisation of N in soils and more soil damage. They propose to install a new bore at the south of WW1&2, which will be used to monitor groundwater quality over time. They are prepared to use data from the bore to inform future decision making. In this case, granting this application to increase cow numbers by 160 will allow the applicants to facilitate these management changes, which cumulatively should cause less N loss to groundwater and degradation of groundwater.

Policy 16.1 (c) gives direction on processes after the development of freshwater objectives under FMU processes. As freshwater objectives have not yet been developed, this policy does not apply at the present time.

Policy 16.2 gives direction on farming activities, including existing activities.

Under **part (a)**, all such activities are required to implement a farm environmental management plan (FEMP), as set out in Appendix N. The applicants implement a FEMP as set out in Appendix N, so meet part (a) of Policy 16.2.

Under **part (b)**, sediment run-off risk must be actively managed by identifying critical source areas (CSAs) and implementing practices such as setbacks from waterbodies, riparian planting, sediment traps, preventing stock from entering the beds of surface waterbodies and limiting the duration of exposed soils. WW1&2 and the Horner Block are predominantly flat with minimal CSAs. Where CSAs are found close to where tiles have outfalls to surface drains, they have been mapped and are actively managed to minimise the risk of sediment loss. See FEMPs for locations of CSAs. Practices such as fencing off waterways are implemented and have been for many years as part of the Dairy Accord. Stock do not have access to waterways at any time. Farm infrastructure such as tracks, lanes and sheds can act as critical source areas following periods of prolonged rainfall, where water can pool and move via overland flow to waterways, carrying contaminants such as sediment and microbes with it. Farm infrastructure is managed to ensure that surface drainage does not flow via overland flow directly into waterways, but is directed through pasture or riparian strips, where run-off is filtered, and sediment and microbes are trapped before reaching waterways. The applicants endeavour to limit the duration where soils are bare as much as possible and under the propoal, fallow periods will be eliminated. This will help to further reduce the risk of sediment run-off further.

Under part (c) of Policy 16.2, collected and diffuse run-off must be managed, as well as leaching of nutrients, microbial contaminants and sediment through the identification and management of CSAs *within individual properties*. The applicants manage their farm layout, infrastructure, soil types, drainage, CSAs and overall farming system to control and minimise collected and diffuse run-off, leaching of nutrients, microbial contaminants and sediment from such sources. These are explained in the FEMPs. Particularly, lanes close to waterways are appropriately managed to avoid the runoff reaching waterways.

Policy 17 gives direction on agricultural effluent management.

In line with Policy 17, significant adverse effects on water quality from the operation of, and discharges from, the effluent management system at WW1&2 and the Horner Block are avoided.

Other adverse effects are also avoided, remedied or mitigated. The effluent management system, including storage ponds, low depth and very low depth irrigation systems, follows best industry practice for effluent storage and discharge given the nature of soils and topography at WW1&2 and at the Horner Block. The systems have been designed, constructed and located in accordance with best industry practice including the relevant practice notes and guidelines, and systems are maintained and operated in accordance with best practice guidelines. By only irrigating effluent to land when ground conditions are at less than field capacity, and by ensuring that irrigation of effluent to land does not result in soils reaching field capacity, the risks of nutrient rich effluent leaching through the soil profile or moving via overland flow are mitigated.

The slurry tanker with the trailing shoe will apply slurry at depths of less than or equal to 2.5 mm per application to allow for the higher nutrient loading in slurry. It can apply slurry at depths as low as 1 mm per application, which further minimises the risk of adverse effects and increases the number of irrigation days available. It applies slurry directly on the ground, which minimises the risk of adverse odours. The recommended buffer zones from waterways are adhered to when applying effluent, effluent is not discharged over tile drains when the soil is at or near field capacity nor is effluent applied to areas where cracks in the top soil have formed.

The effluent receiving area is sufficiently large to ensure that the N loading to land from dairy shed effluent and slurry does not exceed 150 kg N/hectare at WW1&2, and that it does not exceed 250 kg N/hectare at the Horner Block. Applying a higher N loading from slurry at the Horner Block allows nutrients in slurry to be used efficiently as fertiliser with reduced risk of N loss to groundwater. This is because plants take up N efficiently from slurry applied at very low depth while N fertiliser application is reduced accordingly to ensure the input of N overall is sustainable and does not lead to leaching losses. Importantly, since there is no grazing of stock at the Horner Block there are no urine patches, which otherwise leach N at high rates from urine, slurry and fertiliser.

In line with **Policy 18**, all stock is excluded from waterways.

The range of the good management practices implemented on farm, result in improved integrated management of freshwater through good dairy farm land management practices. This is in line with **Policy 39A**.

In line with **Policy 40**, the applicants seek a term of 15 years for the activities, which aligns with Woldwide One's discharge and water permit terms. There is good certainty regarding the nature and scale of the activity going forward; there will be an increase in cow numbers as well as implementation of good management practices and specific mitigation measures to ensure that the activity is sustainable in the long term. Considerable investment in farm infrastructure has been made to take the final steps towards future proofing the dairying operation at WW1&2; eliminating IWG from a sensitive part of Central Southland altogether. The level of investment demonstrates the applicant's belief in and commitment to sustainable farming and land management. The applicants believe that their presence at this location since 1992 (over 25 years) has not had a detrimental effect on the local environment, and that the proposed changes will mean a further reduction of that impact. A 15-year consent term will mean that the management of the resources under the same proven stewardship will be ensured into the future while allowing the applicants to operate a sustainable farming and business model. As 2013 supreme winners of the Southland Ballance Farm Environment Awards, their commitment to operating a sustainable farming model has been demonstrated.

Objectives and Policies relevant to land-use at Woldwide Runoff (WRO)

- **Objectives 6, 7, 8, 9, 13, 18**
- **Policies 6, 10, 11, 13, 16, 18**

Policies 6, 10 and 11 are met ensuring adverse effects on water quality from contaminants are avoided, remedied or mitigated:

- Required GMPs are implemented to manage adverse effects on water quality from contaminants transported via artificial drainage, overland flow, deep drainage and lateral drainage.
- FEMPs and respective applications have considered the aforementioned-contaminant pathways.

Policies 10 (3) and 11(3) give direction to decision makers on **generally** not granting resource consents for additional dairy farming of cows or additional IWG where contaminant losses will increase as a result of the proposed activity in the Oxidising and Peat Wetlands PZs respectively. In assessing whether the proposal is in line with guidance provided in these policies, some considerations are relevant:

- The term **generally** is used, which is understood to mean "broadly" "in most cases" or "without regard to particulars or exceptions." By including the term **generally**, the policies clearly allow for situations where resource consent can be granted where contaminant losses from additional cows or additional IWG increase in these PZs. In accordance with the intent of the RMA, consent can reasonably be granted be granted where effects on the receiving environment are shown to be minimal.
- WRO is not a dairy farm.

- WRO is a dry stock farm supporting five dairy farms, including WW1&2. It predominantly grazes R1 and R2 heifers with a small number of carryover cows and mating bulls. It has large areas under forestry, both commercial and indigenous.
- Under the proposal, IWG at WRO is operating at a permitted activity level. The applicants are not required to apply for resource consent for IWG activities at WRO since they meet permitted activity rules set out in Rule 20.
- However, WRO is part of WW1&2's landholding and will be on WW1&2's land use consent for farming, although many activities at WRO do not relate to the farming activity at WW1&2. Some farming activities at WRO will be conditioned on WW1&2's land use consent for farming.
- The proposal will maintain a similar stocking rate to the current rate but will see an increase in IWG activities at WRO, which is expected to result in a small increase in contaminant losses, predominantly via artificial drainage and overland flow pathways. Only a portion of these losses can be attributed to IWG of dry stock from WW1&2.
- Increasing IWG at WRO will see its removal from more sensitive catchments in Central Southland, where there is greater land use intensity and elevated groundwater nitrate levels.
- The applicants propose to limit the area under IWG annually at 100 hectares, which caps it at the permitted activity level under Rule 20.
- The AEE demonstrates that the proposed activity at WRO, including an increase in IWG, will have minimal effect on the nutrient loading in receiving waters and accordingly will have minimal effect on the Waiau catchment and Te Waewae Lagoon.
- The AEE demonstrates that there is minimal risk to groundwater at WRO due to the proposal, including from additional IWG activities.

In view of the above considerations, the applicants believe the decision-maker should grant resource consent for the proposed farming activity on Oxidising and Peat Wetlands PZs.

Policy 13 gives direction on the management of land use activities and discharges. In line with Policy 13.1 the proposal will better enable the applicants to provide for their social, economic and cultural well-being. The proposed land use at WRO will allow the applicants to sustainably manage the land while operating a profitable and sustainable business model. The maintenance of a profitable and sustainable business model is central to the success the business, and provides social, economic and cultural benefits to the applicants, their employees, families and whanau, and to the wider community. In the context of an agricultural-based local economy, the use and development of the land and water resources at WRO for primary production should be recognised. In line with Policy 13.2, land use activities and discharges (non-point source) are managed to enable the achievement of Policies 15A, 15B and 15C.

Policy 16 gives direction on farming practices that affect water quality.

WRO is not in close proximity to any regionally significant wetlands or sensitive waterbodies identified in Appendix A.

The AEE demonstrates how adverse effects on receiving waters, including cumulatively, due to proposed activities at WRO will be avoided or mitigated. Existing water quality in the Waiau catchment is not degraded to the point of being overallocated.

WRO operates under a farm environmental management plan, as set out in Appendix N. Sediment runoff risk is actively managed by identifying CSAs, implementing practices including setbacks from waterbodies, limits on areas or duration of exposed soils and the prevention of stock entering the beds of surface waterbodies. The individual layout, topography, soils and drainage properties of both Merrivale and Merriburn blocks are identified and managed by the applicants.

In line with **Policy 18**, all stock is excluded from waterways at WRO.

Having assessed the matters above, it is considered that both the application for the expansion of dairy farming, the discharge and the water abstraction are generally in accordance with the relevant policies and objectives of the documents set out above, and having regard to Section 104, the proposal achieves the purpose of the RMA.

4. Notification

Section 95A of the Act requires that the Consent Authority must publicly notify an application if the applicant has requested that the application be publicly notified. *The applicant hereby requests that the application be publicly notified.*

5. Receiving Environment

WRO's receiving environment is described in the WRO section of the application.

5.1 Soils

WW1&2 - soils

WW1&2 - soils

Topoclimate soil data shows that WW1&2 primarily overlies Braxton soils, with intergrades of Pukemutu soils in places. Topoclimate maps some areas of shallow stony Glenelg soils on the east side.

Topoclimate mapping of soils types for appears to be incorrect. Mr. John Scandrett (Scandrett Rural Limited) carried out a field investigation and has mapped soils at the WW1&2. Please refer to the appended report prepared by Mr. Scandrett for methodology, results and conclusions from the soil type and boundary field investigation. Mr. Scandrett dug at total of 28 test holes during his field investigation at WW1&2.

Mr. Scandrett reports that the west of WW1&2 overlies predominantly Braxton soils, and mid to east predominantly overlies Drummond soils. This is shown in figures 5.1, 5.2-5.4. Glenlg soils are found at the north east, north of Wreys Bush Highway.

The findings from the field investigation are supported by on-farm observations by the applicants, who report there is no subsurface drainage at the mid-east of WW1&2. Soils found mid-east are free-draining, which is characteristic of Drummond and Glenelg soil types and not of Braxton soils, which have been mapped by Topoclimate for much of the area. ***Braxton soils are less extensive than mapped on Topoclimate.***

Findings from the 2017 soil field investigation with support from applicant's knowledge from over 25 years of farming the land, provides a more accurate map for WW1&2 than is provided by Topoclimate, which sought to update Soil Bureau Bulletin 27 maps and is incorrect for land at WW1&2. The soil information and map from the 2017 field investigation have been adopted in this application as they truly reflect land at WW1&2. As such, they form the basis of the nutrient budget analysis and AEE. However, for Council to adopt the evidence from the field investigation, certain conditions must be met. Mr. Scandrett has extensive knowledge of and experience in working with soils but is not a qualified pedologist. Since Mr. Scandrett is not a qualified pedologist, we do not formally request that Council adopt his evidence over what is mapped. Council should recognise that Topoclimate mapping of soils at WW1&2 is incorrect, and informally accept the Mr. Scandrett's evidence as the best soil information available for WW1&2.

Figure 5.1 Soil types and boundaries at the WW1&2 according to field investigation by J. Scandrett, January 2017. Map sourced from Environment Southland.

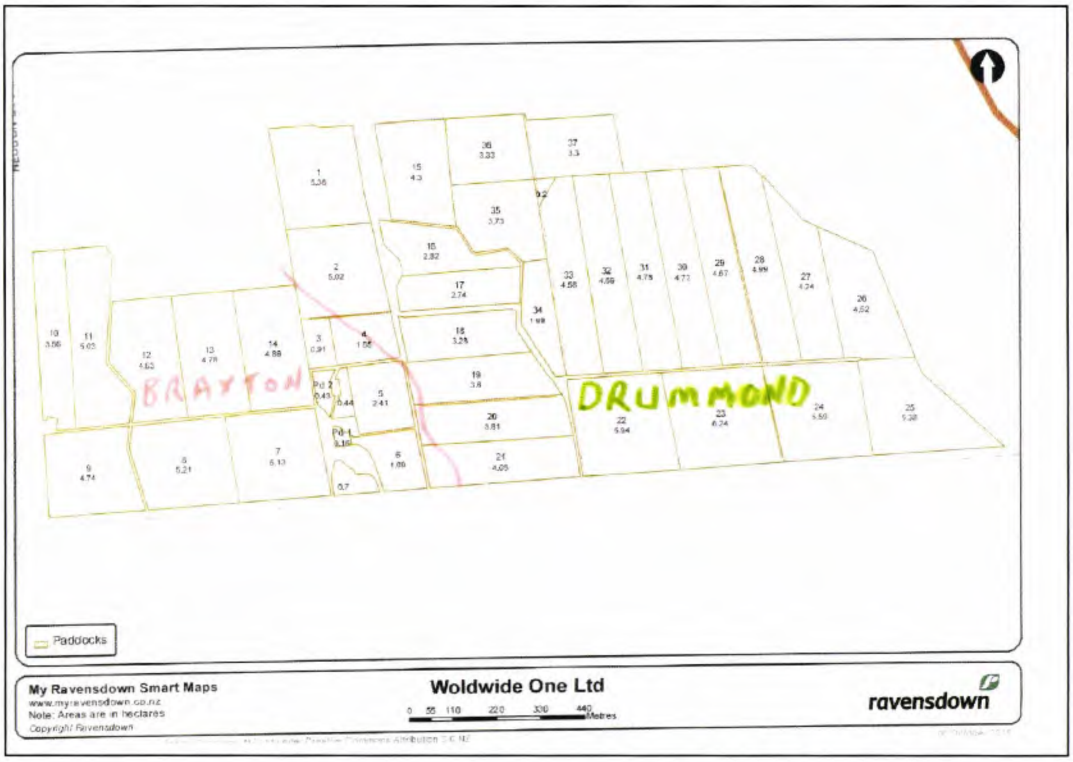

Figure 5.2 Soil mapping of WW1 area (note: this is an historic farm map).

Figure 5.3 Soil mapping of WW2 area (note: this is an historic farm map).

Figure 5.4 Soil mapping of former SH96 and Marcel blocks, now part of the WW1&2 (note: this is an historic map).

Soil vulnerability factors

Braxton soils have moderate risk of structural compaction, slight risk of nutrient leaching and severe risk of waterlogging. Drummond soils have minimal risk of structural compaction, moderate risk of nutrient leaching and slight risk of waterlogging. Glenlg soils have slight risk of structural compaction, very severe risk of nutrient leaching and nil risk of waterlogging.

Braxton soils types – swell/crack characteristics

Braxton soils have swell/crack properties. They can become waterlogged in wet conditions so tend to have subsurface drainage installed. They can crack during dry summer conditions. Deep cracks can provide a pathway for contaminants to reach groundwater via bypass drainage to the underlying aquifer. A site investigation of cracking soils was carried out in January 2018 by Environment Southland. The report by Michael Killick is appended to this application. Several sites were investigated, with some soils showing cracks (10 mm wide or less, with most cracks in the range of 2 – 4 mm wide) and others showing no cracks. The investigation occurred during a prolonged drought, with relatively high temperatures so if large/deep cracks were to form, they would have been expected to form in January 2018. Mr. Killick concluded:

> *It seems reasonable to conclude that the occurrence of very large cracks such as feature in some anecdotes about the soils (e.g. 'to reach your arm into') would now be rare in the soils observed for this investigation, and might not occur. Continued development or changes in management of the soils e.g. the ongoing effects of drainage, or conversion from sheep to dairy, may have influenced the historical pattern of soil behaviour. Or it may be that occurrences of Braxton soils other than those described here, crack more.*

Horner Block – soils

Topoclimate mapping of soils at the Horner Block shows that Braxton/Pukemutu soils are found on the east side, Drummond/Glenelg soils are found mid farm, and Waiau/Tuatapere soils are found on the west side towards the Aparima River. See figure 5.5 for Topoclimate mapping of soils at the Horner Block.

Braxton and Drummond soil properties are described in the previous paragraph. Pukemutu soils have very severe risk of structural compaction, slight risk of nutrient leaching and severe risk of waterlogging. Waiau soils have moderate risk of structural compaction, very severe risk of nutrient leaching and nil risk of waterlogging.

Figure 5.5 Topoclimate mapping of soils at the Horner Block (approximate boundary is outlined in red).

FDE risk

According to Beacon, the soil FDE Risk categories for WW1&2 comprise both Category A (artificial drainage/coarse soil structure) and Category E (other well drained but very stony flat land). See figure 5.6 for Beacon mapping of soils FDE risk at the dairy platform. Braxton soils are classed as Category A land and Glenelg soils are classed as Category E land.

Given the presence of Drummond soils, there are likely to be areas of Category D (well drained flat land) land, although these are not mapped on Beacon. Since Braxton soils are less extensive than mapped on Topoclimate, there is in fact less area of Category A land and more area of Category E and D land than mapped on Beacon.

The Horner Block comprises both Category A soils and Category E soils (see figure 5.6).

The soil FDE risk for both WW1&2 and the Horner Block comprise areas of both low and high risk for effluent discharge assuming low depth irrigation. These soils are suitable for dairy farming and receiving effluent provided that their vulnerabilities are recognised and that they are managed appropriately.

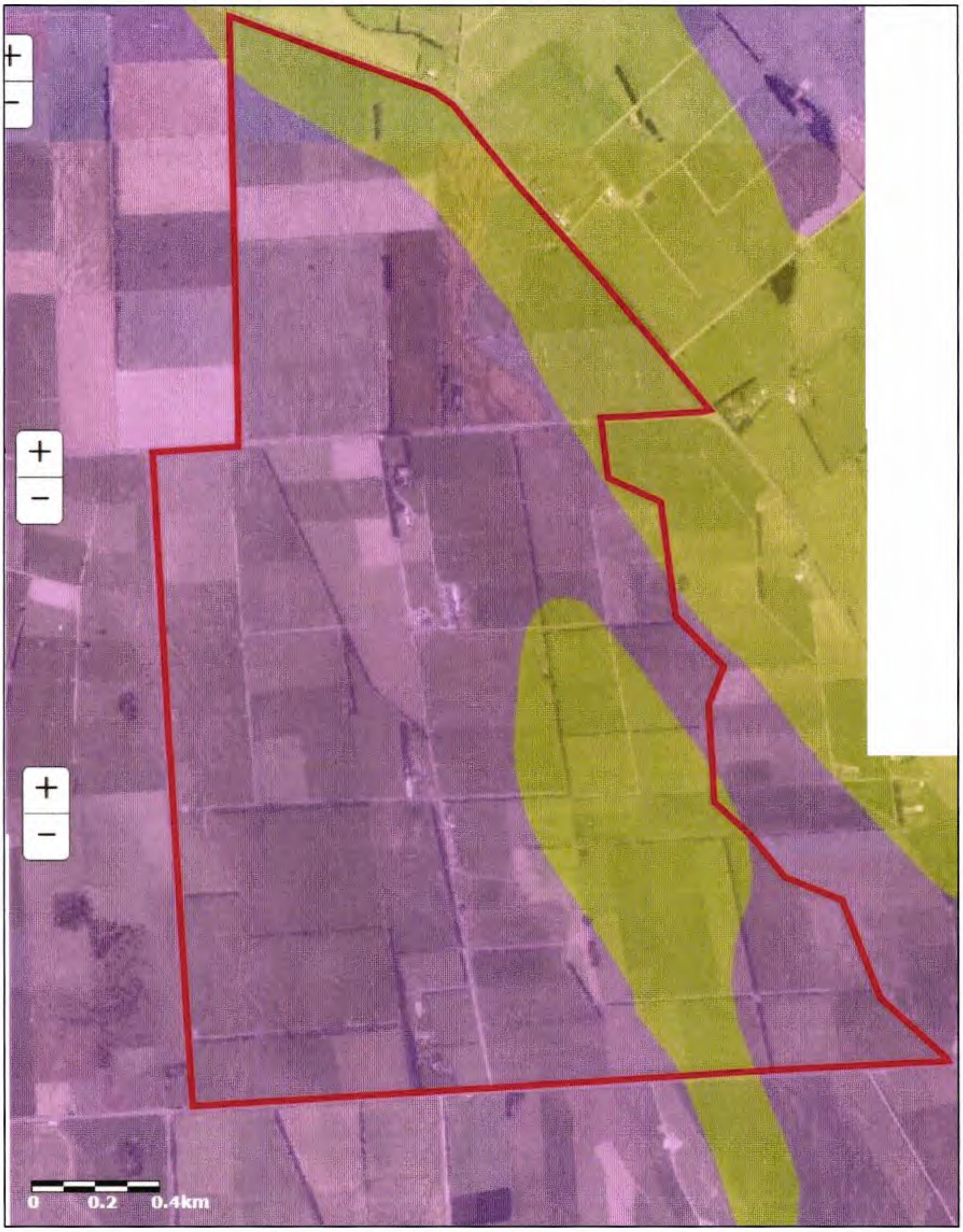

Figure 5.6 Soil FDE risk for the WW1&2 (approximate boundary is outlined in red).

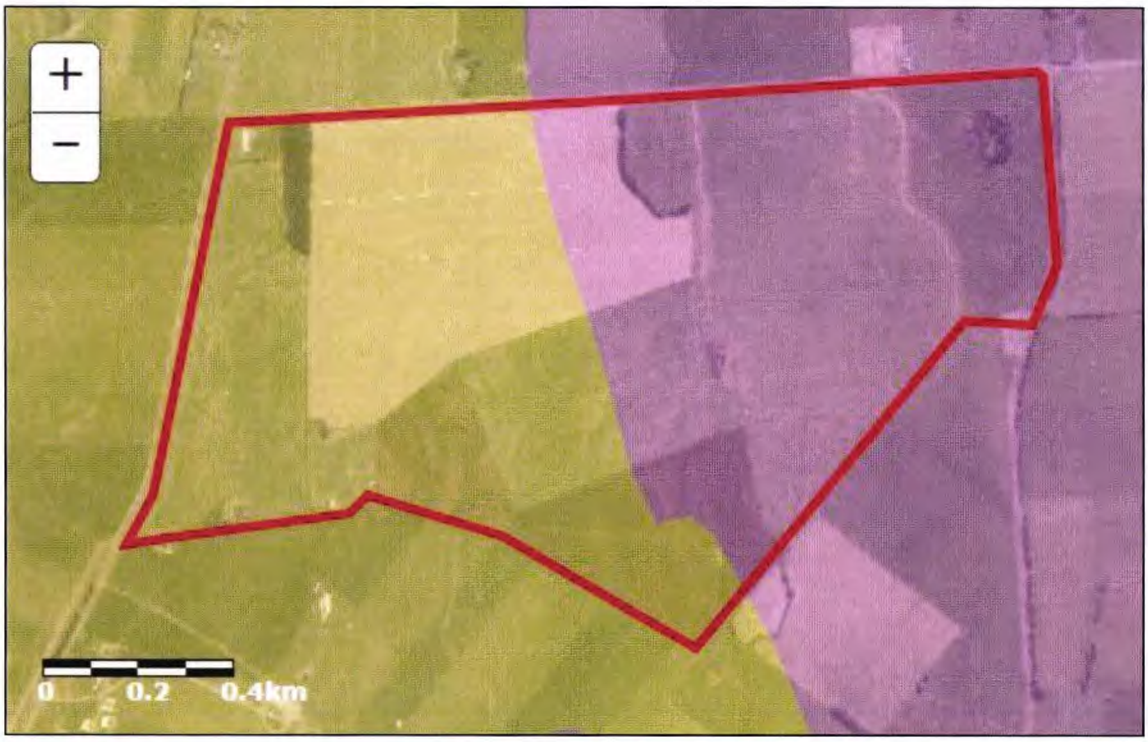

Figure 5.7 Soil FDE risk for the Horner Block (approximate boundary outlined in red).

Table 5.1. Physical properties of soils.

Soil type	Profile drainage	Plant readily available water	Potential rooting depth	Rooting restriction
Braxton	Poor	High	Deep	Limited subsoil aeration during sustained wet periods
Drummond	Well drained	High	Deep	No significant restriction
Glenelg	Well drained	Moderate-low	Shallow	Gravelly and cemented subsoil
Waiau	Well drained	Moderate	Slightly deep	Extremely gravelly subsoil

5.2 Surface water

The dairy platform lies in both the Waimatuku Stream and Oreti River catchments (see figure 5.7). The Horner Block lies predominantly in the Waimatuku Stream catchment, with its westernmost area lying in the Aparima River catchment (see figure 5.8).

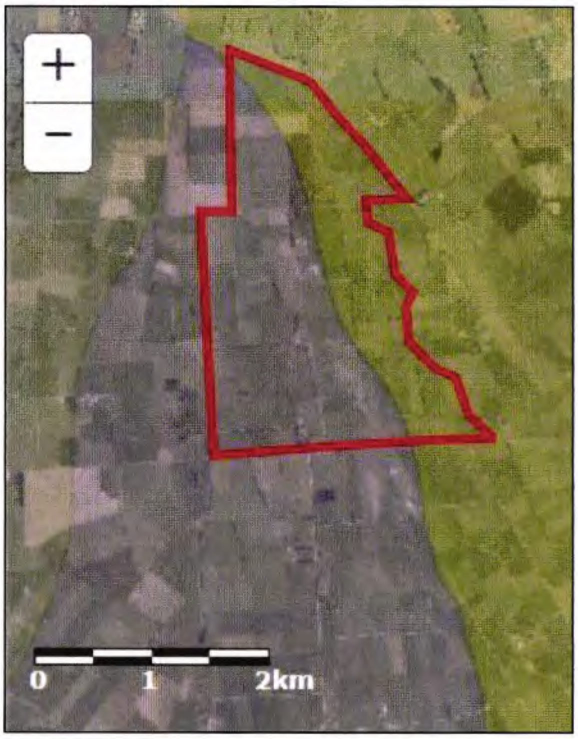

Figure 5.8 Major catchments: Waimatuku (mid-west) and Lower Oreti (east); approximate boundary is outlined in red.

Figure 5.9 Horner Block; Waimatuku Stream (mid-east), Aparima (west); approximate boundary outlined in red.

Minor catchments

Minor catchments for WW1&2 are Terrace Creek, Oreti River and Middle Creek.

Minor catchments for the Horner Block are Middle Creek and the Waimatuku River.

Waterways are best described as surface drains. Riparian buffers are fenced off and vegetated with good grass cover.

See the accompanying FEMPs for the location of major tiles.

WW1&2 -surfacewater

Waterways generally flow in a north to south/southeast direction (see figure 5.10), are fully fenced off and culverted (see figure 5.11). One waterway flows along the eastern boundary, on to Terrace Creek to the south east and eventually to the Oreti River. Two waterways flow through the centre, on to Middle Creek and eventually the Waimatuku Stream to the south.

Subsurface drainage is installed at the west with outfall to surface drains. Subsurface drainage is only installed in heavier Braxton type soils except for one tile drain at the north east of Wreys Bush Highway. Subsurface drains (tiles) generally underlie hollows, which may act as critical source areas close to surface drains in times of prolonged heavy rainfall.

Horner Block

One waterway bisects and flows to Middle Creek to the south.

There is one swale at the Horner Block, which is found in a paddock that is not grazed by stock.

Figure 5.11 Waterway at the WW1 dairy unit.

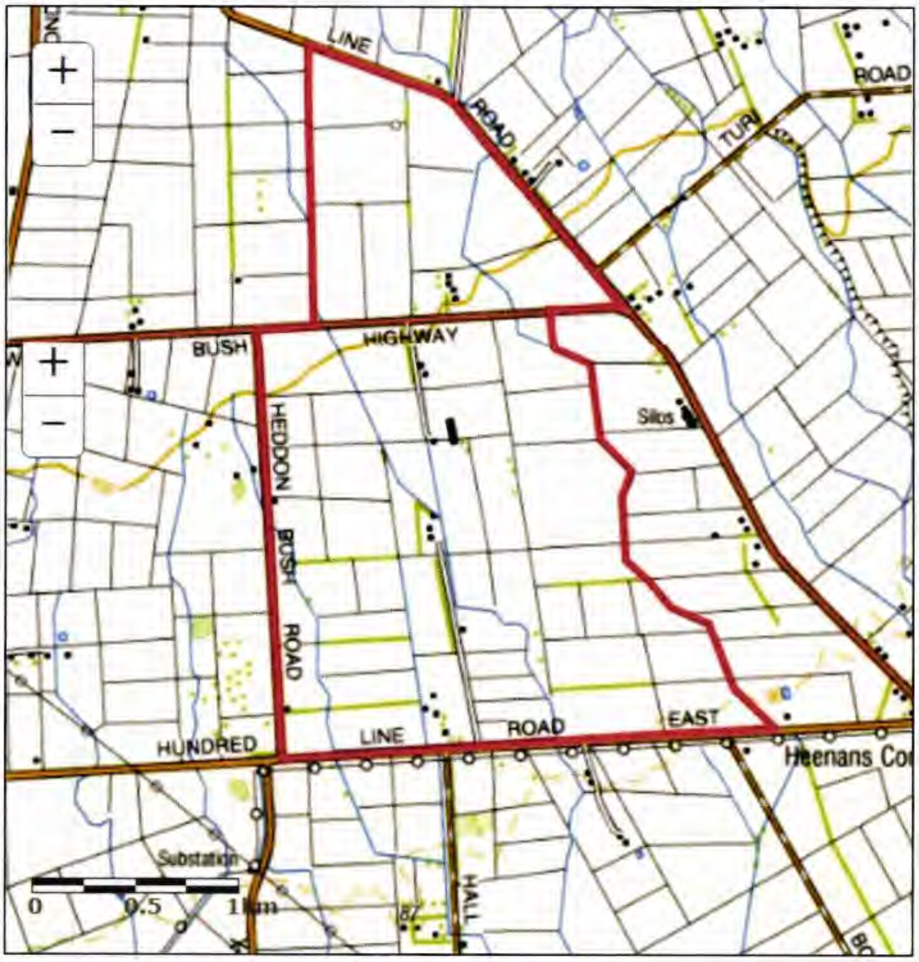

Figure 5.10 Topomap (with approximate boundary outlined in red).

Waimatuku Stream catchment

Most of WW1&2 and Horner Block are located at the northern most end of the Waimatuku Stream catchment according to Beacon. The Waimatuku Stream flows into the sea at Waimatuku Estuary in the Oreti Beach embayment. The Waimatuku Stream is located between the Oreti and Aparima catchments. Its headwaters are fed by a large swamp area (the Bayswater Peat Bog) with small springs in the Drummond district also contributing to the base flow. The catchment contains a variety of land uses including dairy farming, and dry stock farming. According to LAWA, the Waimatuku Stream was channelised in the 1920s. It typically has moderate flows, with few flood or extreme low flow events because of base flow contributions from swamp and spring areas.

SOE monitoring – Lower Waimatuku Stream

The closest downstream SOE water quality monitoring site for which data could be obtained in the Waimatuku catchment is the Waimatuku Stream at Lorneville Riverton Highway so it has been used as a reference. The Lorneville Riverton SOE monitoring site is classified as a lowland rural site. It is a lower-catchment site so captures the entire Waimatuku Stream catchment above Waimatuku Township.

Data obtained from The Land and Water website show evidence of cumulative effects on water quality for the Waimatuku Stream at the Lorneville Riverton site. The 5-year median black disc value is in the worst 50% of like sites. The 5-year median *E. coli* value of 450 n/100 ml is in the worst 25% of like sites with a very likely improving ten-year trend. When assessed against the National Objective's Framework (NOF), the 5-year median *E coli* score is ranked in Band E. 5-year median concentrations for both Total Nitrogen and Total Oxidised Nitrogen are in the worst 25% of like sites, **however, both have a very likely improving ten-year trend.** The Total N 5-year median concentration is 3.65 g/m^3, which is above the ANZECC guideline of 0.614 g/m^3. The Total Oxidised N 5-year median concentration is 3.0 g/m^3, which is above the ANZECC Guideline value of 0.44 g/m^3 but below New Zealand Drinking Standards Maximum Acceptable Level (MAV) of 11.3 g/m^3 for nitrate nitrogen. When assessed against the NOF, the Total Oxidised Nitrogen value is classed in Band C; water quality at this site is considered "suitable for the designated use," but there may be effects on growth of up to "20% of species, mainly sensitive species such as fish." The 5-year median is below the National Bottom Line median of 6.9 g/m^3 for nitrate. The 5-year median DRP value shows meaningful degradation over ten years, with a value of 0.0425 g/m^3 is in the worst 25% of like sites. However, Total P shows a likely improving ten-year trend.

The closest downstream SOE site for which ecological data could be obtained in the Waimatuku catchment is the Waimatuku Stream at Rance Road. This SOE monitoring site is downstream of the water quality monitoring site at Lornville Riverton Highway and is close to the Waimatuku Estuary. The 5-year median MCI score was classed as fair, although there is evidence of a decreasing trend in recent years. The 5-year median Taxonomic Richness score was 20, with evidence of a slight increasing trend in more recent years. The median %EPT score was 40% over the same five-year period, with a slight drop in later years.

The nearest National Objectives Framework (NOF) site is the *Waimatuku Stream at Lorneville Riverton Highway* site. NOF water quality indicators show that generally water quality is fair to poor at the site (see figure 5.12 below). The MCI score is fair. Slime algae/periphyton is indicative of high nutrient levels or significant natural flow/habitat disruption at the site. The *E. coli* score indicates "low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion (such as wading and boating)." The Total Oxidised Nitrogen score indicates that there may be an impact "on the 20% most sensitive species."

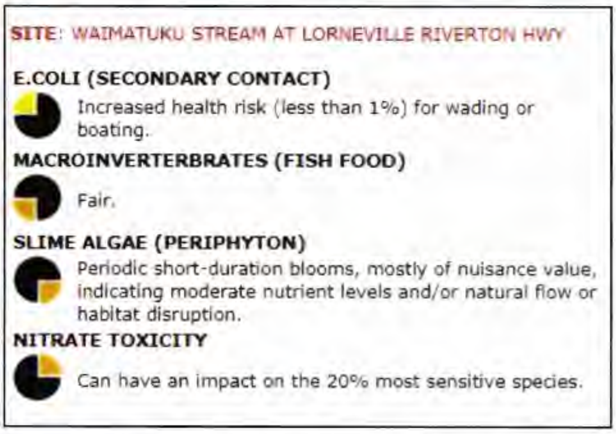

Figure 5.12 NOF indicators for *Waimatuku Stream at Lorneville Riverton Highway* site.

The lower catchment SOE site for the Waimatuku Stream shows evidence of land use in the catchment with high levels nutrients and contaminants dominating. This relates to the intensity of land use in the catchment, local hydrology, attenuation of nutrients and the physiographic land types found in the catchment. Artificial drainage and deep drainage to shallow aquifers, as well as the low to moderate denitrification potential of some soils and aquifers, and the lack of a major river for diluting contaminants are factors that combine to produce this outcome. The Waimatuku catchment has shown recent improvement for nutrient N, with the 5-year median concentration for both Total N and Total Oxidised N decreasing over the last two reporting years. This is significant as it indicates that N losses and related effects in the catchment may recently have started to decrease.

Waimatuku Estuary

Coastal waters (the Waimatuku Estuary and coastal waters at the Oreti Beach Embayment) are the receiving environments for the Waimatuku Stream and catchment. The Waimatuku Estuary is a small, shallow, "tidal river mouth" estuary that drains to the sea through a sand dominated barrier beach and modified marram grass duneland. It has relatively small intertidal flats, while the estuary mouth periodically constricts, naturally reducing flushing and according to a 2012 study[5] has "very elevated nutrient inputs make the estuary highly susceptible to eutrophication as the assimilative capacity of the estuary is very quickly exceeded when the mouth is constricted. Currently, despite most catchment inputs flowing directly to the sea, nuisance macroalgal growths (e.g. *Ulva intestinalis*) are common, particularly in summer in the middle estuary, while algal blooms also occur at the mouth and along Oreti Beach." The major threat to the estuary is eutrophication due to elevated nutrient inputs, exacerbated by periodic mouth constriction to the sea and consequent restricted flushing.

A 2018 Fine Scale Monitoring and Macrophyte Mapping study[6] reported that" Despite receiving a high nutrient load from both riverine and groundwater sources......., when its mouth is open for exchange with the sea, the Waimatuku has a relatively low susceptibility to eutrophication. This is primarily because of its highly flushed nature, given that it is strongly channelised with very few poorly flushed areas, and has high freshwater inflow. However, the assimilative capacity of the estuary with regard to nutrients is very quickly exceeded when the mouth is constricted. Since monitoring began in 2008, the estuary mouth has been driven approximately 1 km to the east by long shore drift, potentially further constricting the mouth, restricting flushing, and therefore increasing the likelihood of eutrophication issues. Currently, nutrients retained in the estuary contribute to the growth of attached macrophytes and associated nuisance macroalgae, while the presence of elevated chlorophyll a levels at times may be attributable to phytoplankton blooms in saline bottom waters and from freshwater sources upstream of the estuary."

Lower Oreti catchment

The easternmost part of the property is found in the Lower Oreti Catchment. Surfacewater drainage from the eastern side of the property flows via Terrance Creek to the Lower Oreti River below the Oreti Plains.

The Oreti catchment is Southland Region's third largest. It runs from the Thomson Mountains in the north of the region to the New River Estuary. The upper catchment maintains much of its natural qualities and is internationally renowned for its trophy brown trout fishing. The mid and lower reaches of the Oreti catchment have been substantially modified for drainage, flood control and channel clearance work. Oreti River tributaries, such as the Winton and Waikiwi Streams and the Makarewa River, are each subject to point-source discharges of effluent from industry and municipal sewage treatment. Potential impacts to water quality may also arise through tile drain and non-point source discharges. In addition, stock access to waterways, drainage maintenance and gravel extraction activities can adversely affect water quality in the Oreti River.

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[5] Stevens & Robertson (2012). Waimatuku Estuary 2018. Fine Scale Monitoring and Macrophyte Mapping

[6] Robertson & Robertson (2018). Waimatuku Estuary 2018. Fine Scale Monitoring and Macrophyte Mapping

SOE monitoring – Lower Oreti River

The closest current SOE water quality monitoring site downstream of the property is at the Oreti River at Wallacetown. This SOE monitoring site is classified as a lowland rural site with a gravel bed and is the lowest SOE site in the Aparima River catchment. It is a lower-catchment site so captures the entire Oreti River catchment above Wallacetown Township.

Data obtained from LAWA's website show evidence of cumulative effects on water quality for the Oreti River at the Wallacetown site. The median black disc value (1.815 m) is in the best 50% of like sites with an indeterminate ten-year trend. The 5-year median *E. coli* value of 130 n/100 ml is in the worst 50% of like sites with a likely improving ten-year trend. When assessed against the National Objective's Framework (NOF), the 5-year median *E coli* score is ranked in Band D. Median concentrations for both Total Nitrogen and Total Oxidised Nitrogen are in the worst 25% of like sites, however, trend analysis is unavailable for both N parameters. The Total N median concentration is 1.13 g/m^3, which is above the ANZECC guideline of 0.614 g/m^3. The Total Oxidised N median concentration is 0.94 g/m^3, which is above the ANZECC Guideline value of 0.44 g/m^3 but well below New Zealand Drinking Standards Maximum Acceptable Level (MAV) of 11.3 g/m^3 for nitrate nitrogen. When assessed against the NOF, the annual median Total Oxidised Nitrogen value is classed in Band B; water quality at this site is considered "suitable for the designated use," and is regarded to have high conservation values; it is likely to have some effect on growth of up to 5% of species. The annual median DRP value of 0.006 g/m^3 is in the best 50% of like sites, however no trend analysis is available.

The closest downstream SOE site for which ecological data could be obtained in the Oreti River catchment is the *Oreti River at Wallacetown*. The 5-year median MCI score (95) was classed as fair. The 5-year median Taxonomic Richness score was 21. The 5-year median %EPT score was 40%.

The nearest National Objectives Framework (NOF) site is the *Oreti River at Wallacetown* site. NOF water quality indicators show that generally water quality is reasonable to fair at the site (see figure 5.13 below). The MCI score is fair. Slime algae/periphyton is indicative of high nutrient levels or significant natural flow/habitat disruption at the site. The *E. coli* score indicates "minimal risk of infection for wading or boating." The Total Oxidised Nitrogen score indicates that there may be an impact "on the 5% most sensitive species."

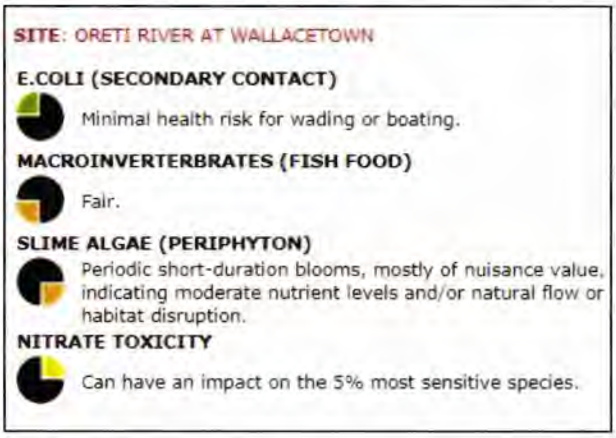

Figure 5.13 NOF indicators for *Oreti River at Wallacetown* site.

The lower catchment Oreti River shows evidence of land use in the catchment with elevated nutrients and contaminants dominating, as well as impacts on biological indicators. This relates to some point source discharges from sewage treatment plants and industry, the intensity of land use in the catchment, local hydrology and the physiographic land types found in the catchment. Artificial drainage and deep drainage to shallow aquifers, as well as the low to moderate denitrification potential of some soils and aquifers are factors that combine to produce this outcome.

New River Estuary

The New River Estuary and coastal waters are receiving environments for the Oreti River and catchment. New River Estuary is a relatively large estuary, which receives the Oreti and Waihopai Rivers, and their tributaries. According to a 2012 Fine Scale Habitat Mapping study[7] "eutrophication and sedimentation have been identified as a major issue since at least 2007-8." The major threats to the estuary are eutrophication due to elevated nutrient inputs and elevated sediment inputs. Eutrophication triggers nuisance micro and macro algal growth. Conditions in the well flushed central basin and lower estuary are reasonable, however, gross nuisance algal conditions and sulphide rich sediments are causing problems in more sheltered, poorly flushed areas.

A 2018 Macro Algal Monitoring study[8] concluded that the "estuary is eutrophic, with conditions consistently worsening since monitoring commenced in 2001. The area of the estuary with gross eutrophic conditions has now expanded from 23ha in 2001 (1% of the estuary) to 428ha in 2018 (15% of the estuary). This has caused a significant loss of dense (>50% cover) high value seagrass from the estuary (a 94% loss in the Waihopai Arm). In short, the estuary is exhibiting significant problems associated with excessive macroalgal growth and likely represents the largest impact of this type to have occurred in a NZ SIDE estuary. Unless nutrient inputs to the estuary are reduced significantly, it is expected that there will be a continuation of these difficult to reverse adverse impacts within the estuary."

New River Estuary is the receiving environment for Invercargill City, which includes urban, industrial and storm water discharges.

Aparima River catchment

The westernmost part of the Horner Block is found in the Aparima River Catchment. The Aparima River is the smallest of Southland's four main catchments. It extends from the Takitimu Mountains west of Mossburn to the Jacobs River Estuary at Riverton and the headwaters drain alpine, native tussock and forested land. According to LAWA, the upper Aparima catchment maintains much of its natural qualities, whereas the mid and lower reaches have been substantially modified for drainage, flood control and channel clearance work. The catchment contains a variety of land uses including dairy farming, and dry stock farming. Major tributaries include the Hamilton Burn in the upper reaches and the Otautau Stream in the lower reaches, which is known to have poor water quality. According to LAWA, the main pressures on water quality in the Aparima catchment are due to dairy farm intensification as drain networks in the lower catchment can discharge degraded water to receiving streams. Overland flow and nutrient loss from wintering practices contribute significantly, particularly when soils are saturated. Flood and drainage works also potentially impact water quality in the Aparima catchment.

[7] Robertson & Stevens (2012/1013). New River Estuary. Report prepared for Environment Southland.
[8] Stevens (2018). New River Estuary 2018 Macroalgal Monitoring. Report prepared for Environment Southland.

SOE monitoring – Lower Aparima River

The closest current SOE water quality monitoring site is at the Aparima River at Thornbury. This SOE monitoring site is classified as a deep, fast flowing lowland rural site with a gravel bed and is the lowest SOE site in the Oreti River catchment.

As is evident on LAWA's website, key SOE indicators for the Aparima River at Thornbury indicate that the lower catchment river is in reasonable health with trends for most indicators showing improvement. This includes trends for visual clarity, *E.coli*, nitrogen and phosphorous. The 5-year median turbidity and black disc visibility values are in the best 50% of like sites. The 5-year median *E. coli* value is 130 n/100 ml and is in the worst 50% of all lowland rural sites. *E coli* is classed in band D for the National Objectives Framework (NOF). The 5-year median Total Phosphorous concentration was 0.014 g/m^3, which is below the ANZECC Guideline value of 0.033 g/m^3. It is in the best 50% of all lowland rural sites. Dissolved Reactive Phosphorous (DRP) median concentration was 0.006 g/m^3 and is below the ANZECC Guideline value of 0.01 g/m^3. It is in the best 50% of all lowland rural sites. The median Total Nitrogen concentration was 0.91 g/m^3 putting it in the worst 50% of all lowland rural sites and slightly above the ANZECC Guideline value of 0.641 g/m^3 for this indicator. The Total Oxidised Nitrogen median concentration was 0.665 g/m^3 putting it in the worst 50% of like sites. It is slightly above the ANZECC Guideline value of 0.444 g/m^3 for nitrate nitrogen. Total Oxidised Nitrogen is classed in band B for the National Objectives Framework (NOF), and is assessed as being "suitable for designated use" but there may be growth effects on up to 5% of species. No ecological data for the Aparima River at Thornbury SOE site were available at the time of writing.

The closest downstream SOE site for which ecological data could be obtained in the Aparima River catchment is the *Aparima River at Thornbury*. The 5-year median MCI score (100) was classed as good. The 5-year median Taxonomic Richness score was 16. The 5-year median %EPT score was 43.8%.

The nearest National Objectives Framework (NOF) site is the *Aparima River at Thornbury* site. NOF water quality indicators show that generally water quality is reasonable to fair at the site (see figure 5.14 below). The MCI score is fair. Slime algae/periphyton is indicative of high nutrient levels or significant natural flow/habitat disruption at the site. The *E. coli* score indicates "minimal risk of infection for wading or boating." The Total Oxidised Nitrogen score indicates that there may be an impact "on the 5% most sensitive species."

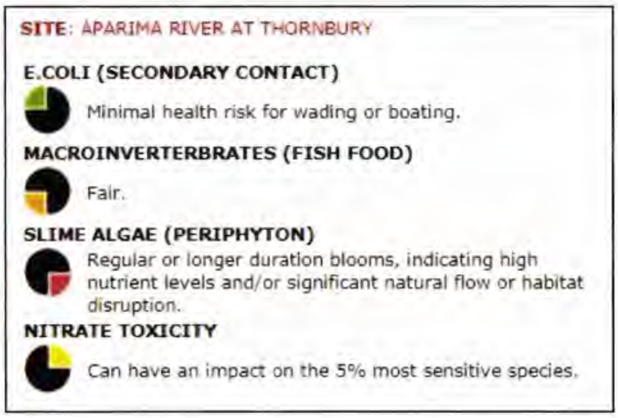

Figure 5.14 NOF indicators for *Aparima River at Thornbury* site.

The lower catchment SOE site for the Aparima River shows evidence of land use in the catchment with slightly elevated levels of N and some contaminants present. This relates to the intensity of land use, local hydrology and the physiographic land types found in the catchment. Artificial drainage and overland flow, as well as the low to moderate denitrification potential of some soils and aquifers are factors that combine to produce this outcome. Wintering practices in the wider catchment have also been identified as a factor for the Aparima River catchment.

Jacobs River Estuary

The Aparima River is part of the Jacobs River Estuary catchment, which is considered a sensitive environment due to the accumulation of nutrients and sediment. Jacobs River Estuary is a medium-sized (720 ha) tidal lagoon estuary near Riverton. Broad scale and fine scale monitoring studies (Stevens & Robertson 2003, 2007-2011, 2013) have indicated variable levels of eutrophication and sedimentation across the estuary, with some parts being highly muddy and anoxic, eutrophic and having associated nuisance algal growth. The most recent study in 2013 revealed that "although large sections of the lower estuary remain in good condition, there has been a significant decline in estuary quality since 2003, and especially over the past five years. In particular, the poorly flushed parts of the Aparima and Pourakino arms were excessively muddy, had high nuisance macroalgal growths, and contained poorly oxygenated sediments with toxic sulphides. These gross eutrophic areas are displacing high value seagrass beds and stressing saltmarsh habitat." Other values that were identified in the study as being adversely affected by the degrading estuary were biodiversity, aesthetic, amenity and recreational values.

Regionally Significant Wetlands

There is one Regionally Significant Wetland in the vicinity of the property; Dunearn Wetland is approximately 4 km to the north east of the property. Given drainage from the property is in a southerly direction, no further description of Dunearn Wetland is required.

Two Regionally Significant Wetlands lie south of the property; Bayswater Peat Bog lies approximately 10 km to the south west of the property, and Drummond Peat Swap lies approximately 12 km to the south east of the property. Both are remnant peat bogs, which once had a much greater extent in Southland.

Bayswater Peat Bog

The Bayswater Peat Bog is classified as a "lowland rushland shrubland on peat domes" peatland and is representative of peatland ecosystems, which formerly had a much greater extent in Southland[9]. Raised bogs such as the Bayswater Bog are rainfed, i.e. they derive their water and nutrients solely from rainfall. They are characterised by plants and animals adapted to the waterlogged and nutrient-poor conditions. On the Southland Plains they are dominated by peat-forming species such as *Empodisma minus* (wire rush) and Sphagnum moss species, which are characteristic of the flat, poorly drained areas.

AEE on Bayswater Peat Bog

Surfacewater drainage from both WW1&2 and the Horner Block is in a southerly direction towards Middle Creek (and Terrace Creek further east). Bayswater Peat Bog lies to the south west of the property. Middle Creek flows approximately 5 kilometres to the east of Bayswater Peat Bog (see figure

[9] Clarkson (2003). Significance of peatlands in Southland Plains Ecological District, New Zealand. DOC Science Internal Series 116.

5.15). As surfacewater drainage does not flow in the direction of Bayswater Peat Bog, the risk of adverse effects on Bayswater Peat Bog from the proposed activities (land and discharge) is considered to be less than minor.

Furthermore, water at the 210-hectare raised bog is only derived from rainfall. As such the risk to water quality at the Bayswater Bay is further lowered. Surfacewater drainage in the vicinity of the Bog, drains through land surrounding the Bog, and on to the Waimatuku Stream; it does not drain through the Bog itself.

Groundwater flow in the Waimatuku Groundwater Zone is due south[10] and does not flow towards Bayswater Peat Bog but flows in a southerly direction to the east of the Bog. Furthermore, Hitchcock refers to a report by Robertson (1983), "*previous analysis of groundwater levels in the bog concluded that the water table domes with the bog but is a separate system is probably fed by rainfall*." Hitchcock found that that groundwater in the Waimatuku GW zone is recharged from the Bog. The risk of adverse effects related to groundwater on Bayswater Peat Bog from the proposed activities (land use and discharge) is considered to be less than minor.

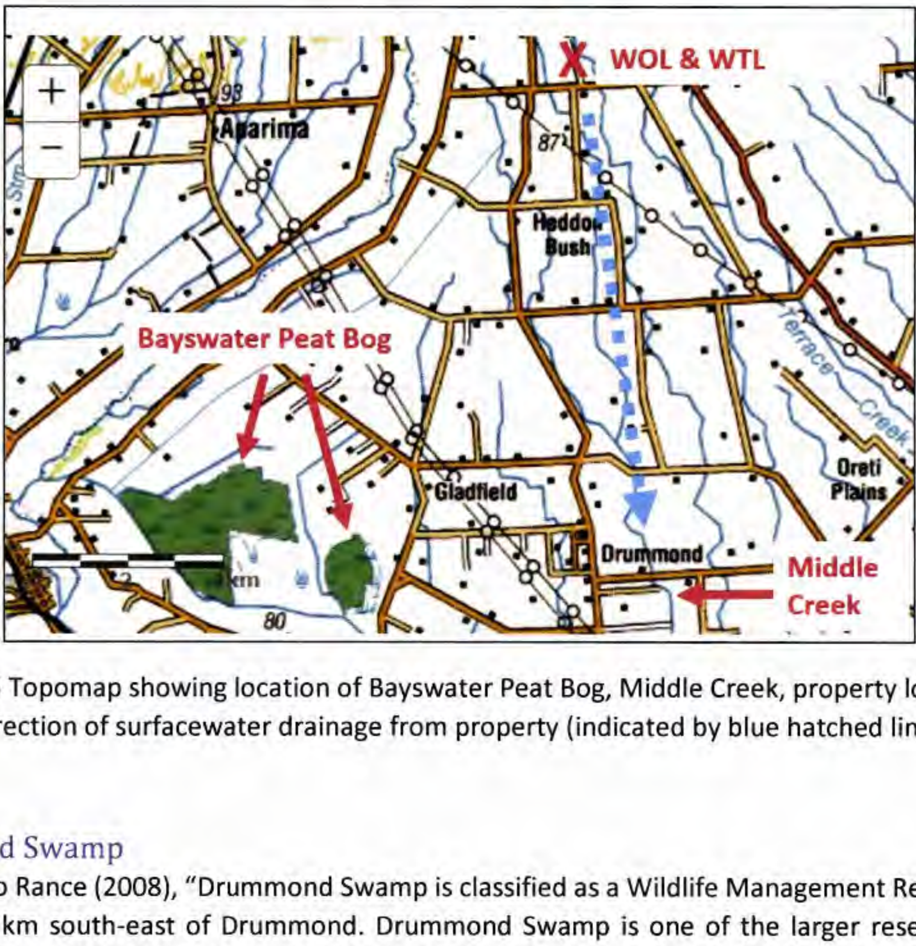

Figure 5.15 Topomap showing location of Bayswater Peat Bog, Middle Creek, property location and direction of surfacewater drainage from property (indicated by blue hatched line).

Drummond Swamp

According to Rance (2008), "Drummond Swamp is classified as a Wildlife Management Reserve and is located c.4 km south-east of Drummond. Drummond Swamp is one of the larger reserves on the Southland Plains (256.42ha). It is one of only two peatland reserves on the Southland Plains." The wetland is intact and has a modified central area due to a former gull colony. The major management challenge is weed control, with several weeds present; gorse, grey willow, silver birch, service berry, rowan and blackberry are examples of weed species present. The peatland plant community is dominated by wirerush (*Empodisma minus*), as well as tangle fern (*Gleichenia dicarpa*), sphagnum

[10] Hitchcock (2014). Characterising the surface and groundwater interactions in the Waimatuku Stream, Southland. MSc Thesis. University of Otago.

moss (*Sphagnum cristatum*) and swamp inaka (*Dracophyllum oliveri)*. A copy of Rance's report is appended to the application.

AEE on Drummond Swamp

Surfacewater drainage is in a southerly direction towards Middle Creek (and Terrace Creek further east). Drummond Swamp lies to the south east of WW1&2 (see figure 14.16). Middle Creek flows approximately 1 kilometre to the west of Drummond Swamp. An un-named tributary of Middle Creek flows from WW1&2 to within 330 metres (west) of Drummond Swamp, where it flows along Kennedy Road (see figure 14.17). As surfacewater drainage flows close to but not through Drummond Swamp, the risk of adverse effects relating to surfacewater on Drummond Swamp from the proposed activities (land use and discharge) approximately 12 kilometres to the north west is considered to be minor.

Drummond Swamp is also a peat bog, and on that basis is expected to derive its water from rainfall. This further lowers the risk to Drummond Swamp from surfacewater drainage from surrounding land use as drainage does not flow through the Swamp itself. It is noted that Rance (2008) discusses pest plants, pest animals and fire as risks to Drummond Swamp.

There is a lack of specific information available on groundwater interactions at Drummond Swamp. Groundwater underlying is unlikely to flow to the Swamp, however, there is some uncertainly around this given the location of the Swamp and Ww1&2, and the lack of information of groundwater interactions at the Swamp. A study by Hitchcock (2014) on the Bayswater Bog referred to a study by Robertson (1983) and reported that *"previous analysis of groundwater levels in the bog concluded that the water table domes with the bog but is a separate system is probably fed by rainfall."* Since Drummond Swamp is a similar system and is partly in the same groundwater zone, it is reasonable to draw a similar conclusion. Hitchcock found that groundwater in the wider aquifer is recharged from the Bog. It is likely to also be the case for Drummond Swamp, i.e. Drummond Swamp discharges to the wider groundwater resource. The effect on Drummond Swamp due to groundwater related effects from the proposed activities (land and discharge) is minor.

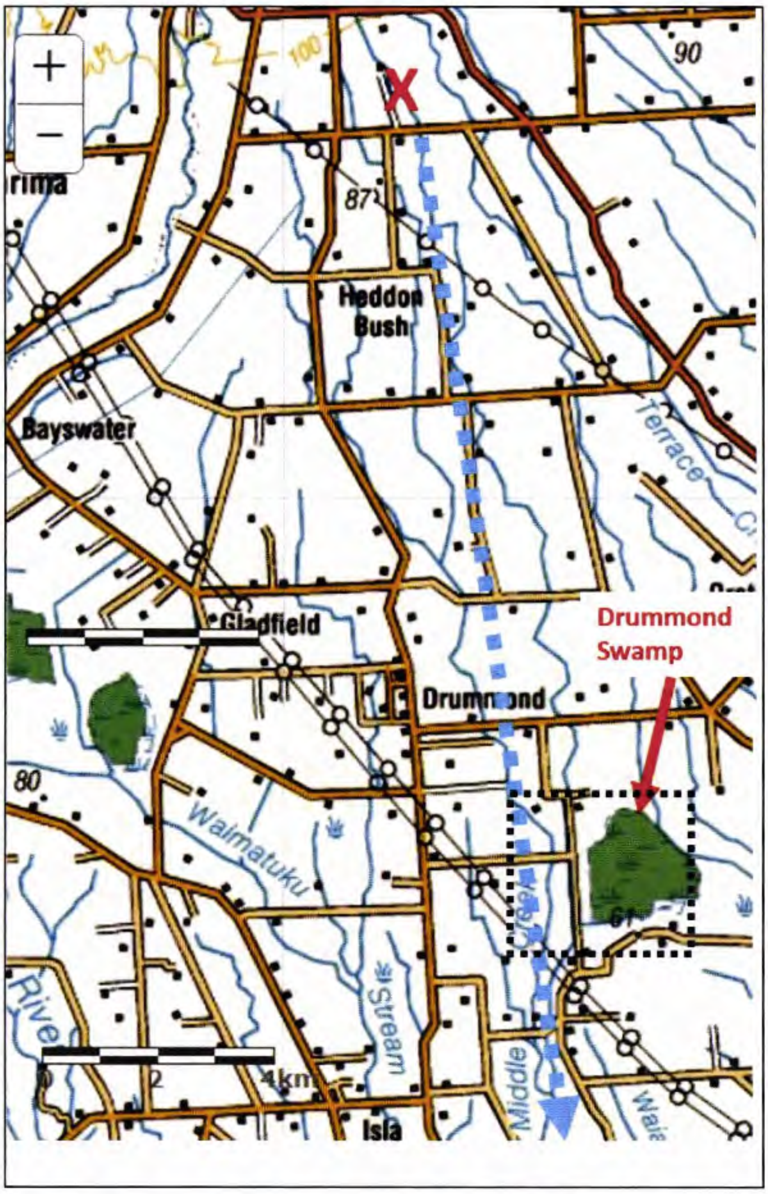

Figure 5.16 Topomap showing location of Drummond Swamp, Middle Creek, property location and direction of surfacewater drainage from property (indicated by blue hatched line). Se figure 5.17 for area around Drummond Peat Swamp.

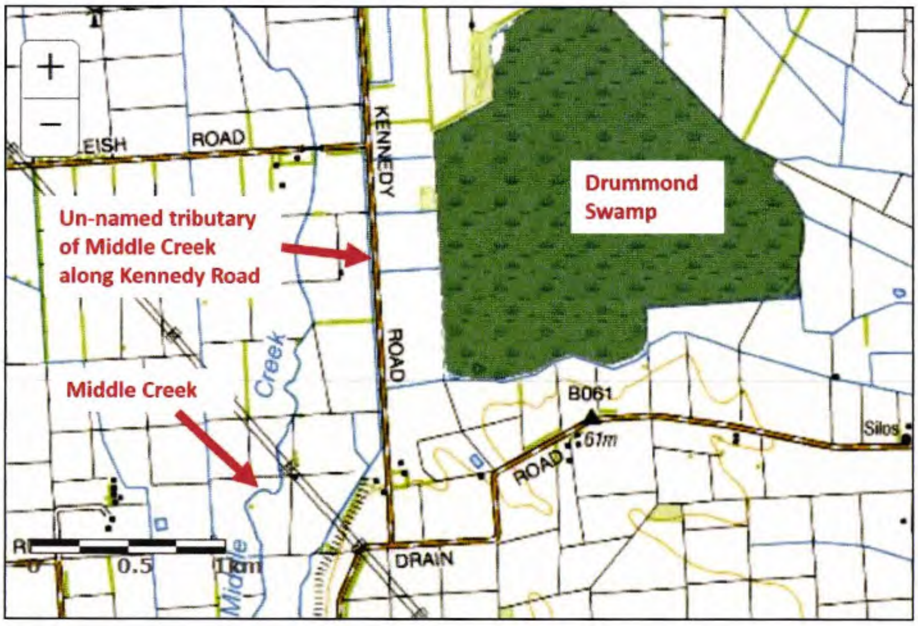

Figure 5.17 Topomap showing location of Drummond Swamp, Middle Creek and un-named tributary of Middle Creek adjacent to Kennedy Road.

5.3 Groundwater

Most of WW1&2 and Horner Block overlie the Waimatuku Groundwater Zone. Heddon Bush School 2.3 kilometres to the south also overlies the Waimatuku Groundwater Zone. The eastern WW1&2 overlies the Central Plains Groundwater Zone. The western part of the Horner Block overlies the Upper Aparima Groundwater Zone.

In this section, all three groundwater zones are firstly described. Following this, groundwater nitrate and groundwater microbial contaminants in the vicinity of WW1&2 and Horner Block are described.

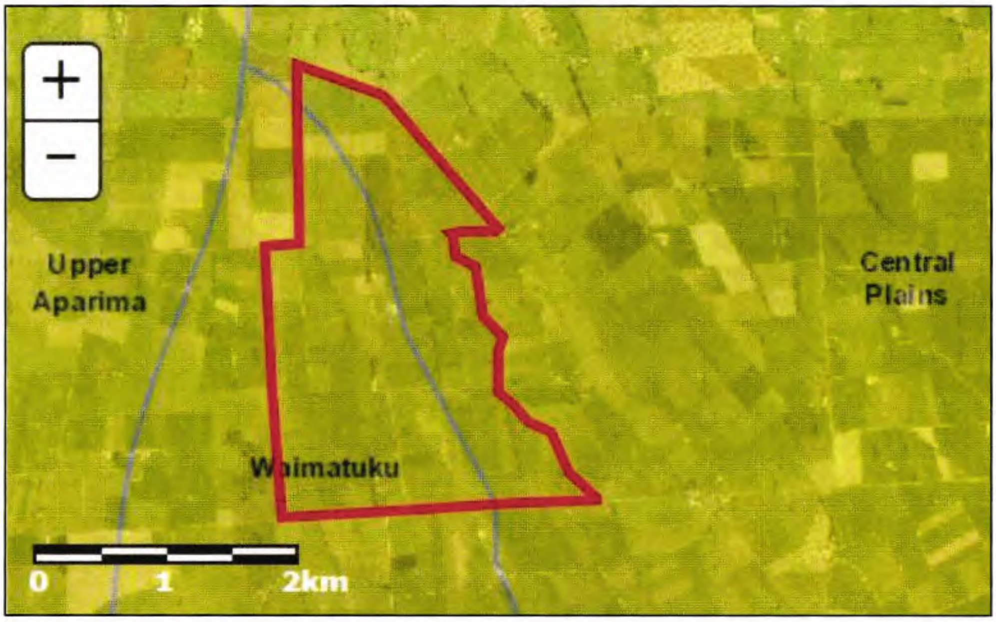

Figure 5.18 Groundwater zones in the vicinity of the WW1&2 dairy platform (approximate boundary is outlined in red).

Figure 5.19 Groundwater Zones at Horner Block (approximate boundary outlined in red).

The Waimatuku Groundwater Zone

The Waimatuku Groundwater Zone is classified as a lowland aquifer type according to Environment Southland's Information Sheet and has low allocation status. The diagram below gives a schematic cross section of the Waimatuku Groundwater Zone; recharge to the Waimatuku groundwater zone is principally derived from rainfall recharge. Annual land surface recharge is estimated to be 467 mm/year. According to Environment Southland, available flow gauging and water quality information suggest that shallow groundwater makes a significant contribution to baseflow discharge in the Waimatuku catchment with recharge circulating relatively rapidly through upper levels of the unconfined aquifer and discharging via the local stream network. Groundwater circulation through deeper levels of the aquifer system is likely to be relatively slow and follow the more general southward topographic gradient.

According to Environment Southland's Information Sheet, groundwater quality in the Waimatuku Groundwater Zone is generally good, although it does vary according to source aquifer and location. Some areas of elevated nitrate concentrations are observed in shallow groundwater reflecting infiltration from surrounding land use.

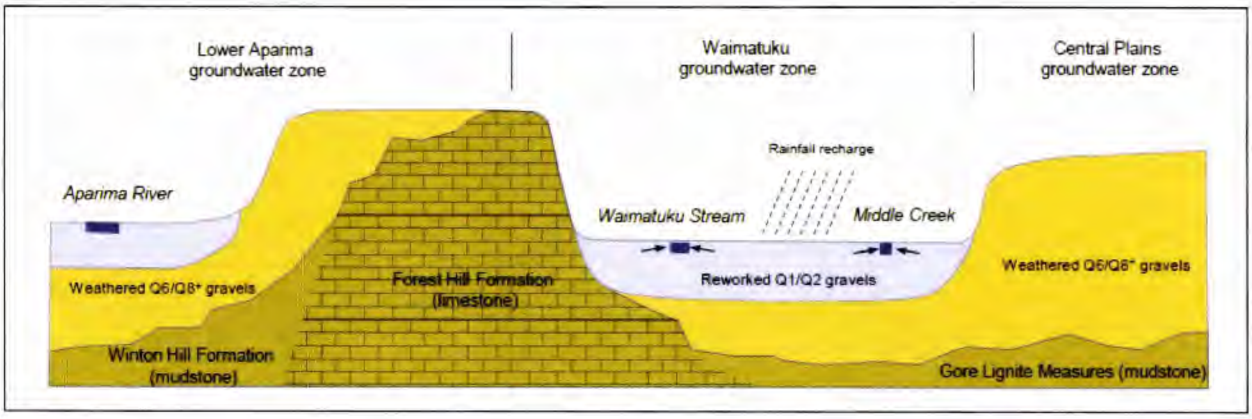

Figure 5.20 Schematic cross-section of the Waimatuku Groundwater Zone[11]

Groundwater flow

Hitchcock characterised surface and groundwater interactions in the Waimatuku Stream catchment in a master's thesis[12]. The study reported that from Wreys Bush down to Drummond "groundwater flow is from north to south down the catchment." See figure 4.7 in Hitchcock's thesis for a map depicting groundwater flow in the Waimatuku Catchment. Heddon Bush School, which has a bore for drinking water supply (HED001), is c.2.3 km due south of the WW1&2 dairy platform (see figure 5.21) and lies in the Waimatuku Groundwater Zone. Based on Hitchcock's report, groundwater underlying much of WW1&2 flows south, so flows in the direction of Heddon Bush School.

An estimate of the average linear velocity of groundwater moving south was calculated by hydrologist Mark Flintoft from Aqualinc Limited (personal communication). Using a porosity of 0.3, K of either 26 or 2,600 m/day, an average linear velocity of 0.5 to 40 m/day was estimated. Mr. Flintoft has stated that the figure provided is an approximation of linear velocity. In the absence of other references for the velocity of groundwater in the area, this estimate can be used to approximate groundwater movement.

Land use in wider area since 1980s – potential for effects on GW

The WW1 dairy unit was established in 1992 and the WW2 dairy unit was officially established in 2003. Land use activities in the wider area since the 1980s (if not before) include sheep farming, dairy farming, intensive winter grazing of dairy stock and cereal cropping. Dairy farming has expanded since the mid-2000s. In line with land use activity in the Central Southland area, cereal cropping was formerly a significant activity with cereal crops (barely/grain) typically being grown and harvested annually. Sheep farming and cereal cropping often went together on individual farms. Cereal cropping reduces soil organic matter content and water holding capacity so has relatively high N loss to water. IWG of fodder crops also has relatively high N loss to water. The presence of these activities in the area during the 1980s, 1990s and beyond is of note when considering N loss to groundwater, lag times and groundwater flow. Over decades, these activities can be expected to have lost N to groundwater where free draining soils are found or where there is an alternative pathway to groundwater (e.g. bypass drainage via deep cracks in Braxton soils). N signals in groundwater from these activities would be expected to have been seen for some time in the Waimatuku zone if they were present.

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[11]Waimatuku Gourndwater Zone Information Sheet. http://gis.es.govt.nz/apps/groundwater/zones/Waimatuku.pdf

[12] Hitchcock (2014). Characterising the surface and groundwater interactions in the Waimatuku Stream, Southland. MSc Thesis. University of Otago.

Using the estimate for groundwater movement of 0.5 to 40 m/day, land use effects on groundwater due to the WW1 and WW2 dairy platforms and prior activities such as intensive winter grazing and cereal cropping, if they are present will have been seen at the Heddon Bush School area for some time.

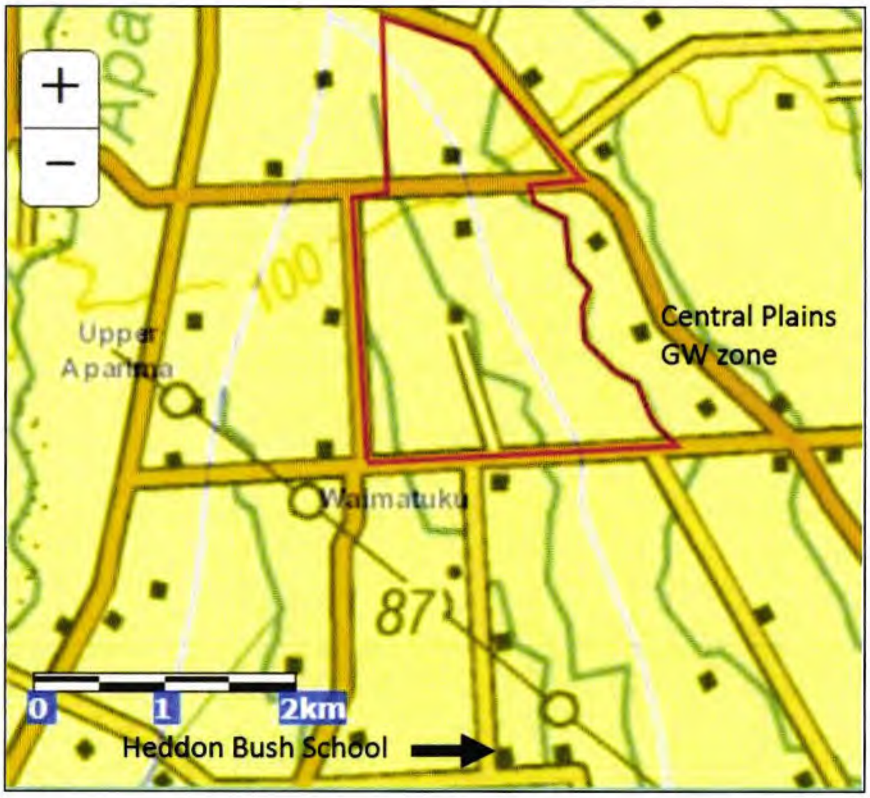

Figure 5.21 Topomap showing groundwater zones and location of Heddon Bush School (approximate WW1&2 boundary outlined in red).

Central Plains Groundwater Zone

The Central Plains Groundwater Zone is classified as a lowland aquifer type according to Environment Southland's Information Sheet and has low allocation status. The diagram below gives a schematic geologic cross section of the Groundwater Zone. Recharge to the underlying groundwater zone is primarily via rainfall infiltration with some infiltration of runoff along the lower slopes of the Tauringatura Hills. Mean annual land surface recharge in the Groundwater Zone is estimated to be 470 mm/year. According to Environment Southland's Information Sheet, groundwater quality in the Central Plains Groundwater Zone is generally good, although it does vary according to source aquifer and location. There are some "hotspot" areas where nitrate values are particularly high.

There are no Central Plains Groundwater Zone registered drinking water supplies within 10 kilometres of the property.

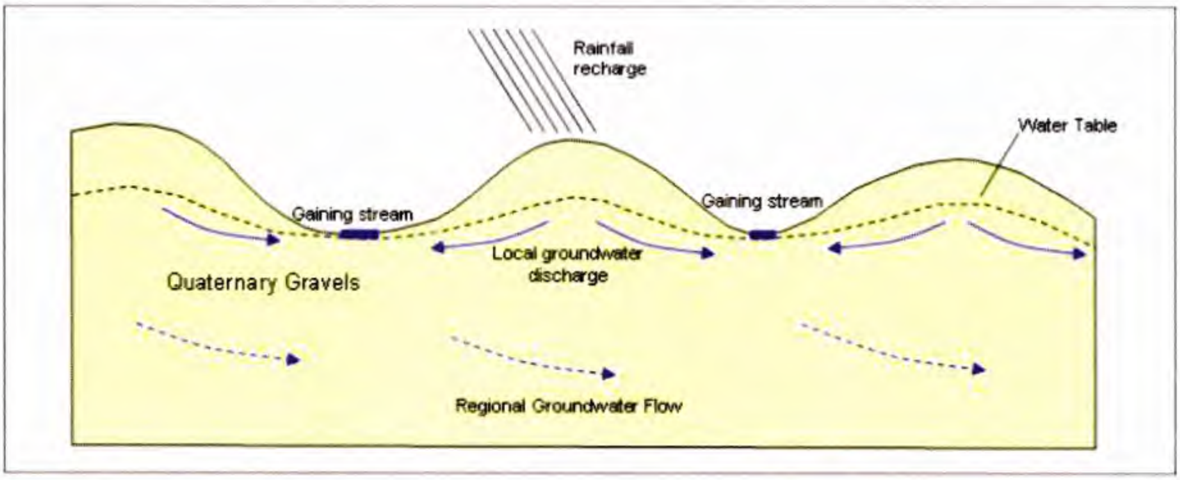

Figure 5.22 Schematic cross-section of the Central Plains Groundwater Zone[13]

Groundwater drainage occurs via the numerous small streams which cross the Central Plains groundwater zone. This drainage is aided by extensive mole, tile and artificial drainage networks which act to both intercept soil drainage and control the water table. By this mechanism a large portion of annual recharge is rapidly routed from the catchment with a much small component of deeper groundwater flow following the overall catchment drainage.

Upper Aparima Groundwater Zone

The Upper Aparima Groundwater Zone encompasses the flat-lying portion of the Upper Aparima River catchment. It is a terrace aquifer type and according to Environment Southland's Information Sheet, has low allocation status. Terrace aquifers are recharged by direct rainfall recharge and infiltration of runoff from the surrounding hills and streams, which drain the hills. There is limited riparian recharge from the Aparima River except along the riparian margins. Mean annual land surface recharge in the Aparima groundwater zone is estimated at 417 mm/year. Groundwater is discharged into the Aparima River via spring-fed streams or throughflow through the unconfined aquifer along the riparian margin of the river. The Aparima River is largely influent over much of the reach upstream of Wreys Bush, reflecting drainage of groundwater from the surrounding terrace aquifers. Groundwater quality is generally good, although it does vary according to source aquifer and location. There are minimal "hotspot" areas where nitrate values are particularly high.

There are no Upper Aparima Groundwater Zone registered drinking water supplies located within 35 kilometres of the property.

[13] Central Plains Groundwater Zone Information Sheet. http://gis.es.govt.nz/apps/groundwater/zones/Central_Plains.pdf

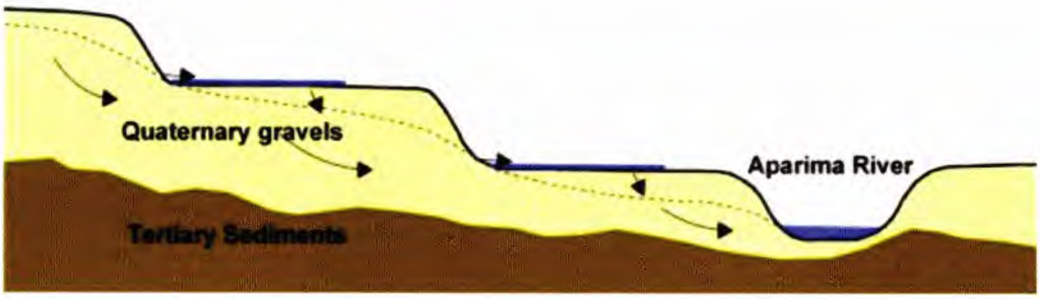

Figure 5.23 Schematic cross section of The Upper Aparima Groundwater Zone[14].

Groundwater lag times

Shallow groundwater lag times for nitrate response in Southland were estimated in a 2014 study prepared for Environment Southland[15]. 0 – 1 years was reported as an estimate of the time taken for the percolation of water through the unsaturated zone and reach the water table. The study reports that localised nitrate effects on groundwater can be expected within one year in the vicinity of WW1&2 and the Horner Block. 3 - 5 years was reported as the "total lag time" in the area (see figure 12 of report). 2.5 – 3 years was reported as an estimate for the time taken for a year of rainfall recharge to mix with the shallow aquifer.

Groundwater Nitrate – dairy platform

Groundwater in gravel deposits is susceptible to nitrate leaching. This reflected in the observed gradient in groundwater nitrate concentrations; groundwater nitrate concentrations are low at the west (0.4 – 3.5 g/m^3) and increase towards the east (3.5 – modelled >11.3 g/m^3) where lighter soils are found. See figure 5.24. Most of Ww1&2 is modelled as having groundwater nitrate levels in the range of 1.0 – 8.5 g/m^3, indicative of minor, moderate to high land use impacts.

Groundwater nitrate levels south of WW1&2, overlying the Waimatuku Groundwater Zone, are generally low, in the range of 0.01 – 8.5 g/m^3.

There is a nitrogen "hotspot," where groundwater nitrate levels regularly exceed New Zealand Drinking Water Standard's MAV of 11.3 ppm centred at Boyle Road/Heenans Corner immediately to the south east of WW1&2 and overlying the Central Plains Groundwater Zone (see figures 5.24, 5.26, 5.27).

[14] Central Plains Groundwater Zone Information Sheet. http://gis.es.govt.nz/apps/groundwater/zones/Central_Plains.pdf

[15] Wilson, Chanut, Rissman & Ledgard (2014). Estimating time lags for nitrate response in shallow Southland groundwater. Technical report prepared for Environment Southland.

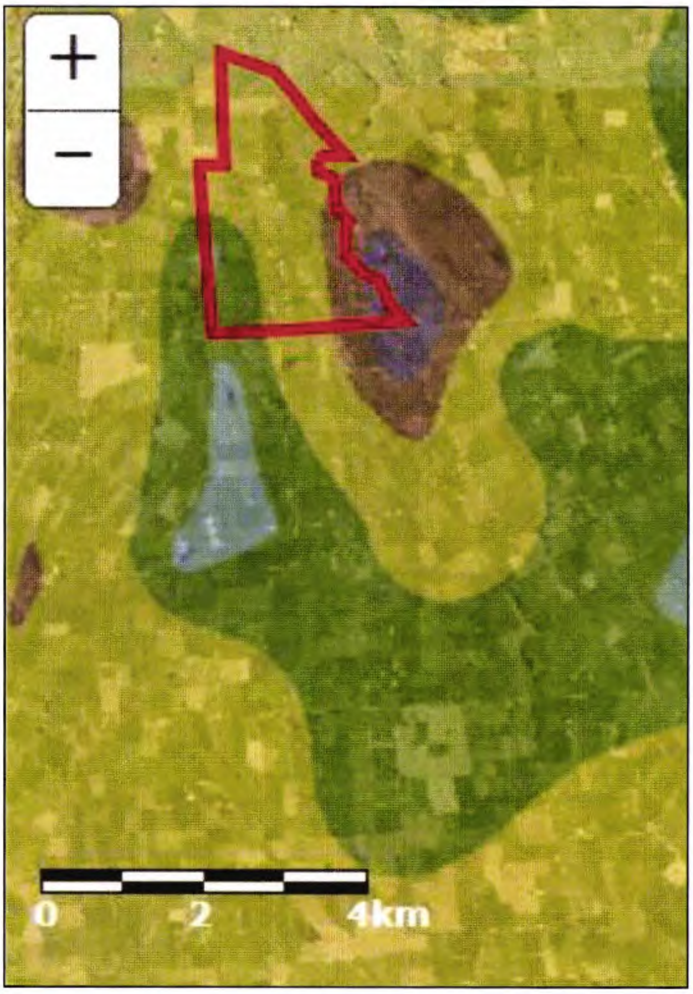

Figure 5.24 Groundwater nitrate levels in the vicinity of the WW1&2 (approximate boundary is outlined in red).

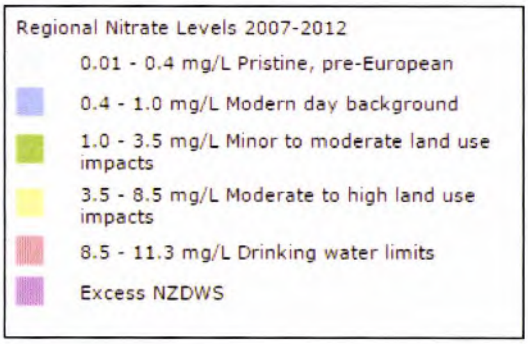

Figure 5.25 Key to groundwater nitrate levels

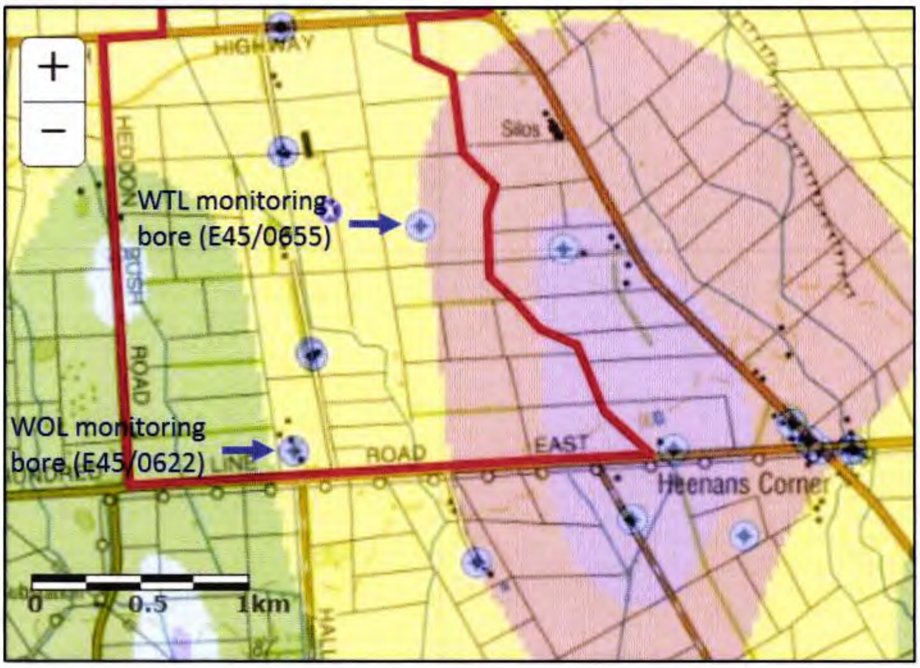

Figure 5.26 Topomap with groundwater nitrate levels showing low levels at the west and the hotspot centred at Heenans Corner to the east. The location of two bores used for monitoring are also shown.

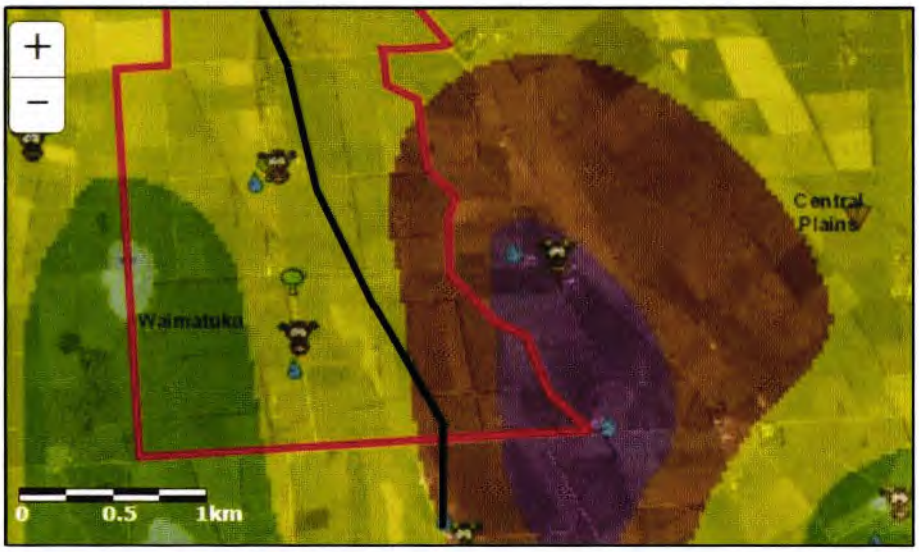

Figure 5.27 Aerial photo with groundwater nitrate levels and groundwater zones (black line indicates boundary between groundwater zones). The nitrate hotspot is in the Central Plains Groundwater Zone.

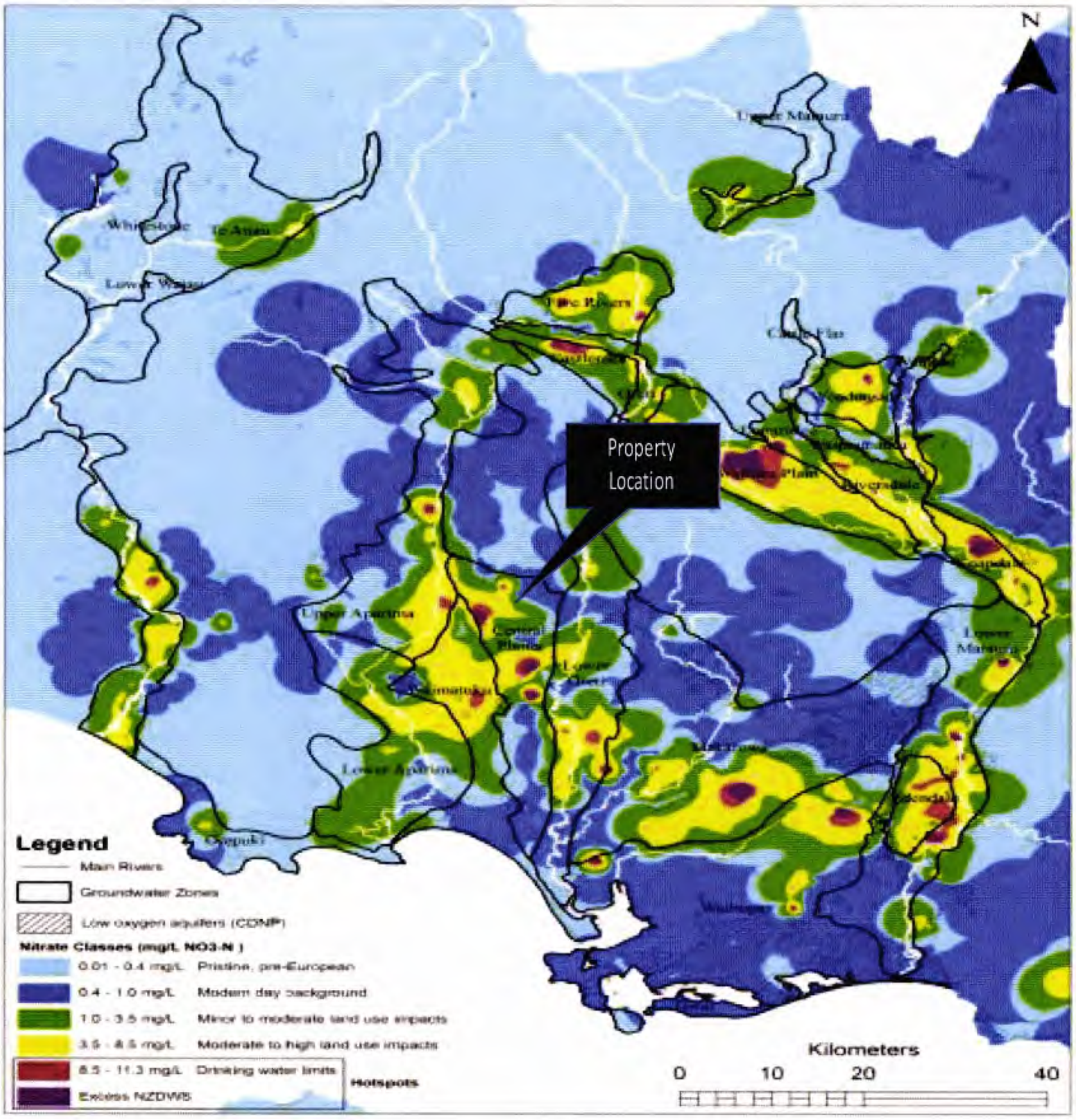

Figure 5.28 Classed NO3-N map for Southland's managed groundwater zones.[16]

[16] Rissman (2012). The Extent of Nitrate in Southland Groundwaters. Regional 5 year median (2007-2012). Technical Report.

Figure 5: Spatial distribution of Combined Denitrification Potential (CDNP)(Aquifer Sensitivity) for the *Southern Southland* Region. ***Where, blue lines delimit regional groundwater zones. Note the: (i) predominance of low to very low Combined Denitrification Potential aquifers across the major groundwater zones; (ii) occurrence of high to very high CDNP values associated with sections of the Makarewa, Waihopai and Chatton groundwater zones, and; (iii) thin margins of marine-terrestrial aquifers of intermediate CDNP along the Southland coast.***

Figure 5.29 Map showing modelled denitrification potential[17]

Monitoring bores

Two bores located at WW1&2 are monitored by Environment Southland for water quality; one at the south of the WW1 dairy unit (E45/0622)/Waimatuku Groundwater Zone, and one at the south east of the WW2 dairy unit (E45/0665)/Central Plains Groundwater Zone. See figure 5.26 for the location of the bores.

WW1 BORE (E45/0622)

The WW1 bore is mapped on Beacon in the Waimatuku Groundwater Zone. The bore used to monitor WW1's groundwater quality was not drilled as a monitoring bore; it is an old domestic well. It comprises a 90 cm vertical concrete pipe with a hole in the side to let the alkathene through. It is possible for birds or rodents to enter the well along the pipe, fall in and drown, which has happened in the past. Furthermore, the well's top pipe is flush with ground level, and soil in the vicinity has high organic matter content from long grass and woody shrubs in the area. Due to its design and unprotected nature, it is likely to experience frequent localised contamination especially during/following heavy rainfall, as surfacewater can flow down into the wellhead carrying organic material with it. If decaying birds (starlings) or rodents are in the well, these also will cause localised contamination. Given these factors, ***the WW1 bore is unsuitable for use as a monitoring bore,*** and data collected from the well may be unlikely to reflect wider groundwater quality. This is particularly the case for *E.coli* data, which will be more corrupted than nitrate data from localised contamination.

[17] Rissman (2011). Regional Mapping of Groundwater Denitrification Potential and Aquifer Sensitivity. Technical Report.

Figure 5.30 WW1 bore (E45/0622) used for groundwater quality monitoring.

WW2 MONITORING BORE (E45/0622)

The WW2 bore was drilled as a monitoring bore and is mapped on Beacon in the Central Plains Groundwater Zone.

NITRATE TRENDS FOR BORES MONITORED AT DAIRY PLATFORM

The WW1 bore (E45/0622) has been sampled by Environment Southland twice per year since 2013 and the WW2 bore (E45/0665) has been sampled by Environment Southland twice per year since 2015 (see figure 5.31 below). Despite the unsuitability of the WW1 well for use as a monitoring bore, it has been included in the following analysis for nitrate. See appendix for raw data.

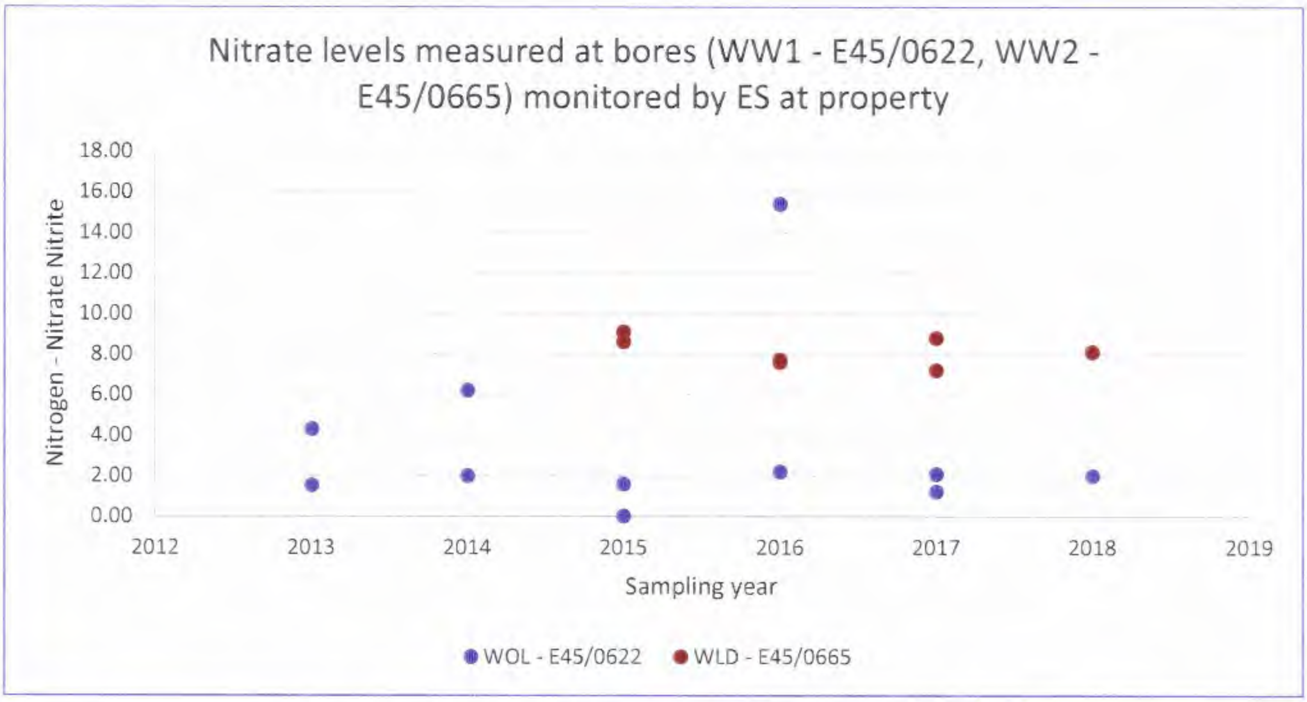

Figure 5.31 Groundwater nitrate concentrations at two bores monitored by Environment Southland WW1&2.

Except for one outlying result, groundwater nitrate levels at the WW1 bore (E45/0622) are generally low (< 3.5 g/m^3) since 2015. Given its position as an outlier in the dataset, the high 2016 result is likely to have been due to localised contamination of the bore. Bore E45/0622 is a shallow bore (3 m deep) and except for localised contamination issues, should indicate recent land use effects including cumulative effects on upstream groundwater. Groundwater nitrate levels sampled at the bore generally are low and indicate minor to moderate land use effects. Results in 2017/2018 were less than or equal to 2.1 g/m^3.

Groundwater nitrate levels measured at the WW2 monitoring bore (E45/0665) are more elevated, with a mean value of 8.16 g/m^3 over the sampling period. This reflects a general trend in the area, with higher groundwater nitrate concentrations found progressively towards the east in the Central Plains Groundwater Zone, underlying lighter soils. Longitudinal datasets for a limited number of bores located to the east and north east of WW1&2 on lighter soils show this trend. The WW2 monitoring bore has a depth of 6.5 metres and is found in the Central Plains Groundwater Zone.

ENVIRONMENT SOUTHLAND MONITORING BORE AT BOYLE ROAD

An Environment Southland monitoring bore is located on Boyle Road to the south east of WW1&2 and in the Central Plains Groundwater Zone.

Groundwater is monitored at different depths (3 m, 6 m, 9 m, 12 m, 15 m). Well ID E45/0768 measures water quality at 3 metres depth and well ID E45/0771 measures water quality at 12 metres depth. Longitudinal datasets are available for both well IDs, starting in 2005 until the present (2018).

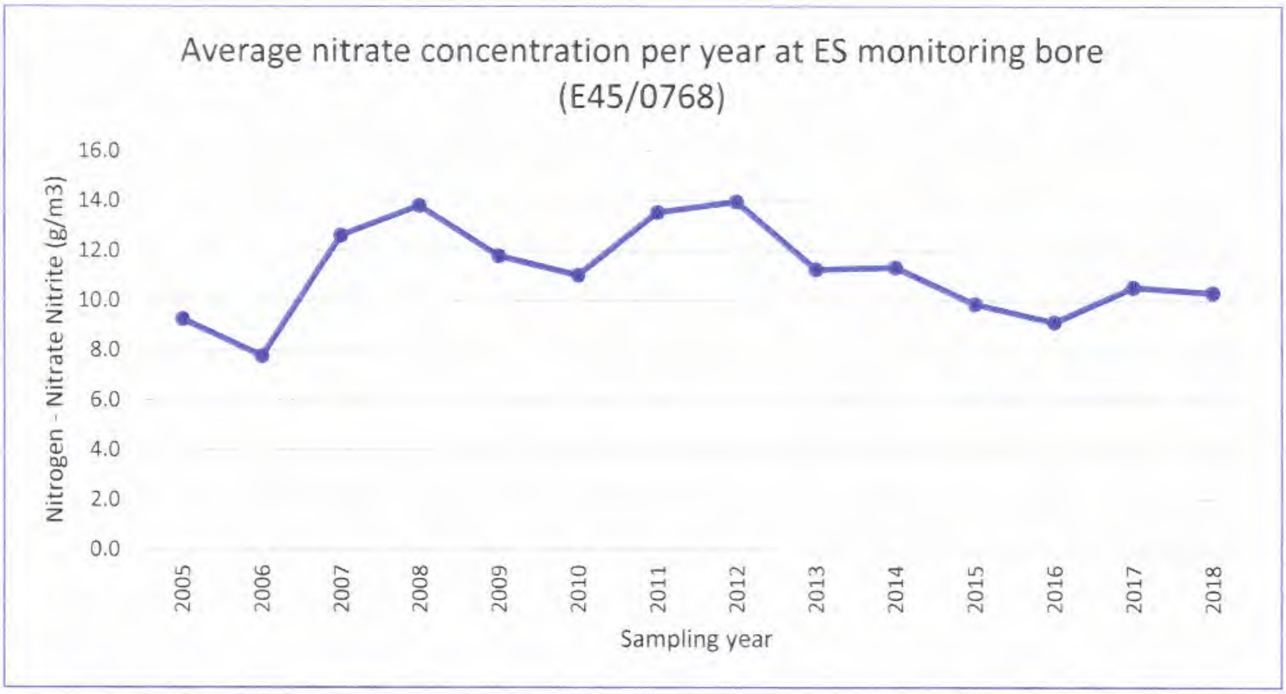

Figure 5.32 Groundwater nitrate concentrations at the ES monitoring bore (E45/0768) at Boyle Road to the south east of WW1&2 and in the Central Plains Groundwater Zone.

Groundwater nitrate levels at the Environment Southland's Boyle Road bore are generally at or above the New Zealand Drinking Waters MAV of 11.3 ppm. As this bore is also a shallow bore (3 metres depth), it is an indicator of recent land use effects and has been included here (rather than the 12-metre depth bore at the same site). Nitrate levels at the bore should be indicative of the cumulative effect of recent land use activities on upstream groundwater, which includes dairy, sheep and beef and cropping activities at numerous properties.

Comparatively groundwater nitrate levels at the two monitoring bores at Ww1&2 are lower than at the Boyle Road bore, with the WW1 data being distinctly lower and likely to reflect a different groundwater stream in the Waimatuku Groundwater Zone. The WW2 data are indicative of moderate to high land use effects in the Central Plains Groundwater Zone but are lower than the shallow bore data from the ES Boyle Road monitoring bore. The WW2 monitoring bore is likely to measure shallow groundwater quality underlying free draining soils at the east side of WW1&2, which is in the Central Plains Groundwater Zone.

Nitrate at registered drinking water supply – Heddon Bush School

Heddon Bush School overlies that Waimatuku Groundwater Zone. The bore for water supply at Heddon Bush School (E45/0718) was drilled in 2017 to a depth of 14.9 metres. It has been tested for nitrate levels since it was drilled although no recent nitrate* testing has been carried out by the school. Heddon Bush School bore testing carried out by Dairy Green Limited in December 2017, January and March 2018, returned nitrate concentrations of 1.8 – 2.0 ppm, which are indicative of minor to moderate land use effects and are well below the NZ Drinking Water Standards MAV for nitrate of 11.3 ppm. See the Appendix for laboratory results from the testing of Heddon Bush School bore by Dairy Green Limited.

*Note: The bore supply at Heddon Bush School is tested for microbial contaminants four times per year.

Groundwater Nitrate – Horner Block

Groundwater nitrate levels in the vicinity of the Horner Block are lower on the east side (1.0 – 3.5 g/m^3) and higher on the west side (3.5 – 8.5 g/m^3) towards the Aparima River (see figure 5.31). This corresponds with the heavier soil types found on the east side and lighter soils found on the west side respectively.

Figure 5.33 Groundwater nitrate levels in the vicinity of the Horner Block (approximate boundary is outlined in red).

Microbial contamination of groundwater

E.coli is widely used as an indicator of faecal contamination of water, including groundwater. *E.coli* is believed remain viable for up to three months in groundwater[18]. Groundwater sampling in the vicinity of WW1&2, including at the WW1, WW2 and ES Boyle Road bores, have generally been negative for *E.coli* (<1 MPN/100 ml). However, at times there have been positive *E.coli* results (1 or >1 MPN/100 ml).

The *E.coli* data from the WW1 bore (E45/0622) are flawed due to localised contamination relating to poor well design; this may have been the case for some other bores in the area also. In these situations, rainfall washes organic material including microbes, close to the bore site down into the well. This causes localised contamination and disappears beyond the zone of reasonable mixing. In the case of the WW1 bore, some decaying birds/rodents in the well may also be responsible for some contamination, which has been observed by the applicants in the past. Since the WW1 bore is likely to suffer frequent localised microbial contamination, *E. coli* data from samples collected at the well

[18] Edberg, Rice, Karlin and Allen (2000). *Escherichia coli*: the best biological drinking water indicator for public health protection. Journal of Applied Microbiology 2000, 88, 106S – 116S.

are dubious and unlikely to reflect wider groundwater quality. For this reason, the WW1 bore has been excluded form figure 5.34.

Where positive *E.coli* results are not due to contamination/poor wellhead design, they are an indicator of the presence of faecal microbes in groundwater from drainage events, albeit to a low level and relatively short lived generally.

Figure 5.34 plots *E.coli* results from the WW2 bore from 2015 to 2018. *E.coli* results fluctuate between negative for E.coli (<1 MPN/100 ml) and 548 MPN/100 ml. It is noted that the ES Boyle Road bore was positive for *E.coli* in November 2017 (5 MPN/100 ml) but was negative on other sampling dates.

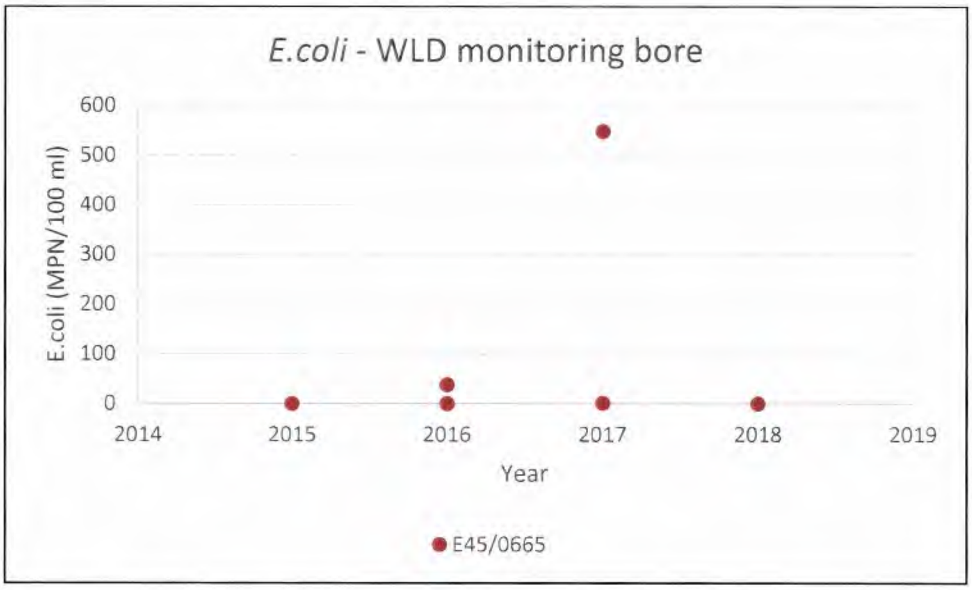

Figure 5.34 *E. coli* sampling at WW2 monitoring bore.

The ES monitoring bore at Boyle Road had some relatively high *E.coli* counts between 2006 and 2008 (e.g. 80 MPN/100 ml in April 2008) as well as many negative results (<1 MPN/100 ml). It was generally negative for *E.coli* in 2009 (< 1 MPN). There was a lack regular *E. coli* testing between 2010 and 2012. Quarterly testing by ES began in 2013, with all tests being negative for *E.coli* (<1 MPN/100 ml) with the exception of March 2014 and December 2017, which had 2 MPN/100 ml and 5 MPN/100 respectively.

No *E.coli* data are available for bores in the vicinity of the Horner Block within the last ten years.

According to school principal, Ms. E Hamilton, the bore at Heddon Bush School (E45/0718) is tested every three months since and has consistently been negative for *E.coli* (counts of <1 MPN/100 ml). Recent test results for the bore are included in the Appendix. Results show no evidence of faecal contamination of the registered drinking water supply at Heddon Bush School.

5.4 Physiographics

Both WW1&2 and Horner Block are identified as being located primarily within the Central Plains and Oxidising physiographic zones. Given the remapping of soil types following a site investigation, it is likely that the area of Oxidising soils is greater than is mapped by Beacon and that the Central Plains area is reduced. The main contaminant pathways for the Central Plains zoned land are artificial drainage and deep drainage. The main contaminant pathway for Oxidising zoned land is deep drainage.

Oxidising

For the Oxidising zone, nitrogen accumulation is expected, particularly during drier months, with excess nitrogen and other contaminants then leaching into underlying aquifers following periods of heavy rainfall over winter and spring. Oxidising soils (Drummond and Glenelg) at the property are free draining so do not have artificial drainage installed.

Central Plains

Central Plain's zoned land is prone to waterlogging, resulting in the installation of artificial drainage and the potential loss of contaminants (N, P, sediment and microbes) to streams and rivers. It is also believed to have risk of contaminant loss via deep drainage, which relates to swell/crack properties of Braxton type soils. Deep cracks can form in soils during dry summer periods. Subsequent rainfall can transport contaminants via bypass drainage to the underlying aquifer.

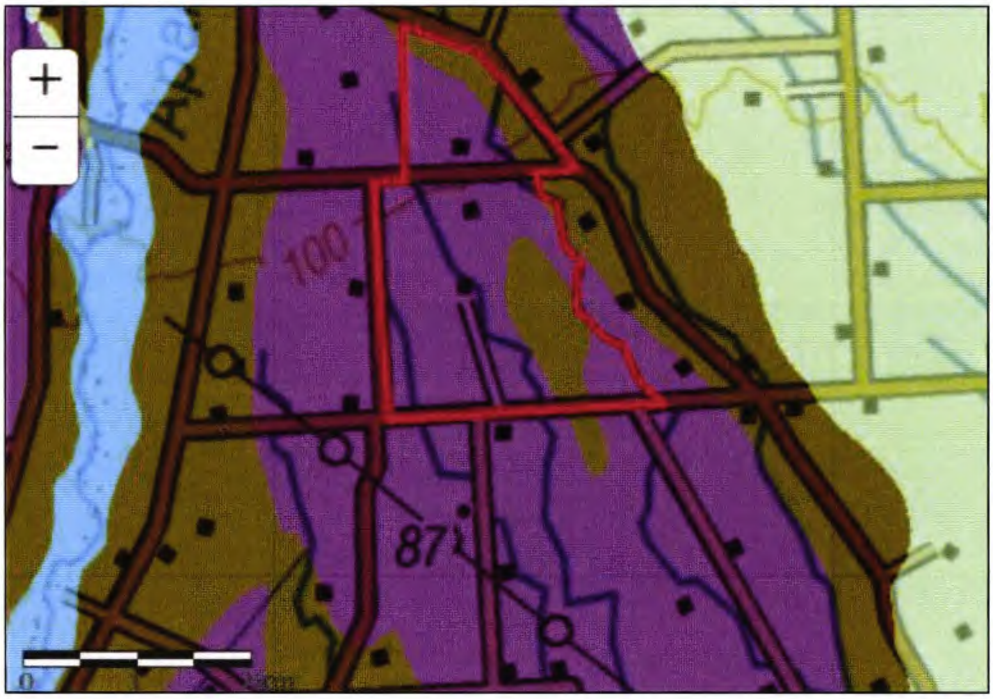

Figure 5.35 Physiographic zones (approximate WW1&2 boundary is outlined in red).

Figure 5.36 Physiographic zones in vicinity of Horner Block.

Figure 5.37 Key to physiographic zones