5.5 Topography

The topography found at the property is very flat. See figures 5.38 and 5.39 below. Slight hollow and low points in the flat terrain are generally underlain by subsurface drainage on the west side of WW1&2.

Figure 5.38 Photograph of flat topography found at WW1&2.

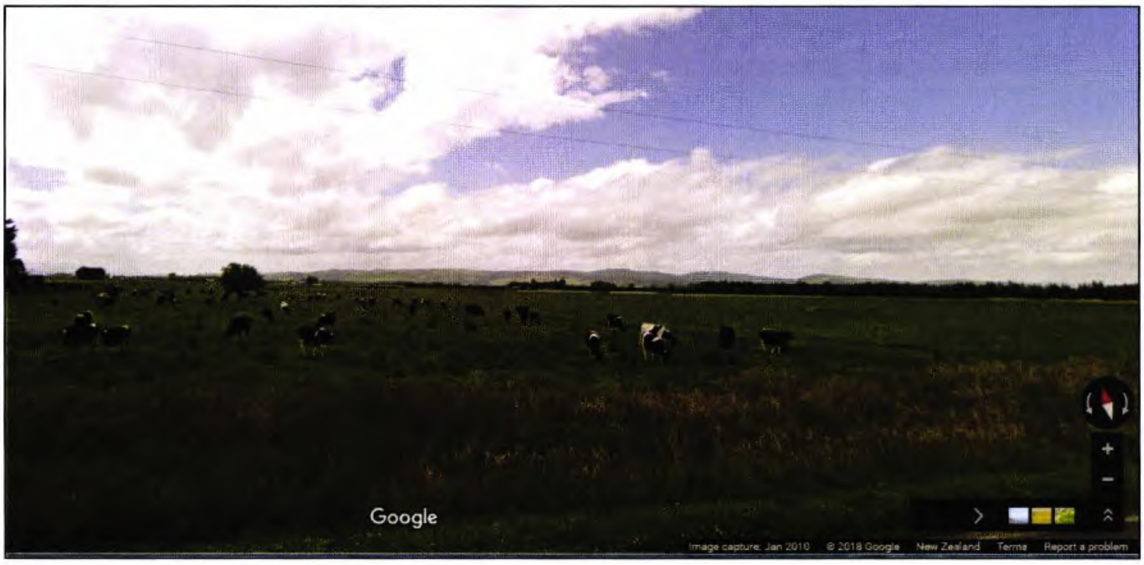

Figure 5.39 Photograph of flat topography found at WW1&2.

6. Proposal Details

6.1 Effluent Discharge

Overview of effluent discharge activity

Table 6.1

Effluent Discharge	
Replacement of consents	Replace 301663 and 20171278-01 with a single discharge permit for WW1&2
New consent	Grant consent for the discharge of agricultural effluent from WW1&2 at the Horner Block. The Horner Block is an effluent receiving area only; it has no effluent storage infrastructure or irrigation infrastructure. It is currently authorised to receive effluent on discharge consents 301663 and 20171278-01.
Duration of consent sought	15 years
Herd size	1,500 cows total: 800 cows at WW2 700 cows at WW1
Supplier number	WW2 unit = 32651 WW1 unit = 32650
Period of discharge	The cowsheds are generally operated from 1 August to 31 May each year, with a limited number of late calving cows milked until mid-June (15th). Effluent irrigation to the discharge areas will be carried out between August and May, and as ground conditions permit for June and July if deemed necessary.
Milking frequency	Twice per day
Winter milking	Not anticipated, seasonal supply only
Feed pad/wintering pad/stand-off pad	There are two wintering barns that will house a total of 1,250 cows.
Other sources of effluent collected in main effluent system	Concrete area at two vat stands Silage pad (WW2)

Feed Pad/Wintering Pad/Stand-off Pads

There are two wintering barns that will house a maximum of 1,250 cows. One barn is located on each dairy unit; each has capacity to house 640 cows but will house a maximum of 625 cows to minimise cow stress. The WW1 barn has recently been upgraded to go from 400 to 640 cow capacity as has its effluent storage infrastructure.

The wintering barns are mainly used in May, June, July, August and September but can be used as stand-off pads at other times during inclement weather. The use of wintering barns as a stand-off pads varies from year to year dependent on weather. Cows are removed from the wintering barn for calving.

The wintering barns have a sealed concrete floor. Effluent from the barns is scraped into a concrete collection channel from where it is pumped to respective storage ponds, which also store effluent from the dairy shed and silage pad (WW2 only) as required. The barns have a small uncovered area, which has been included in the Massey DESC reports.

A rainwater diversion is used on the concrete areas during the off season.

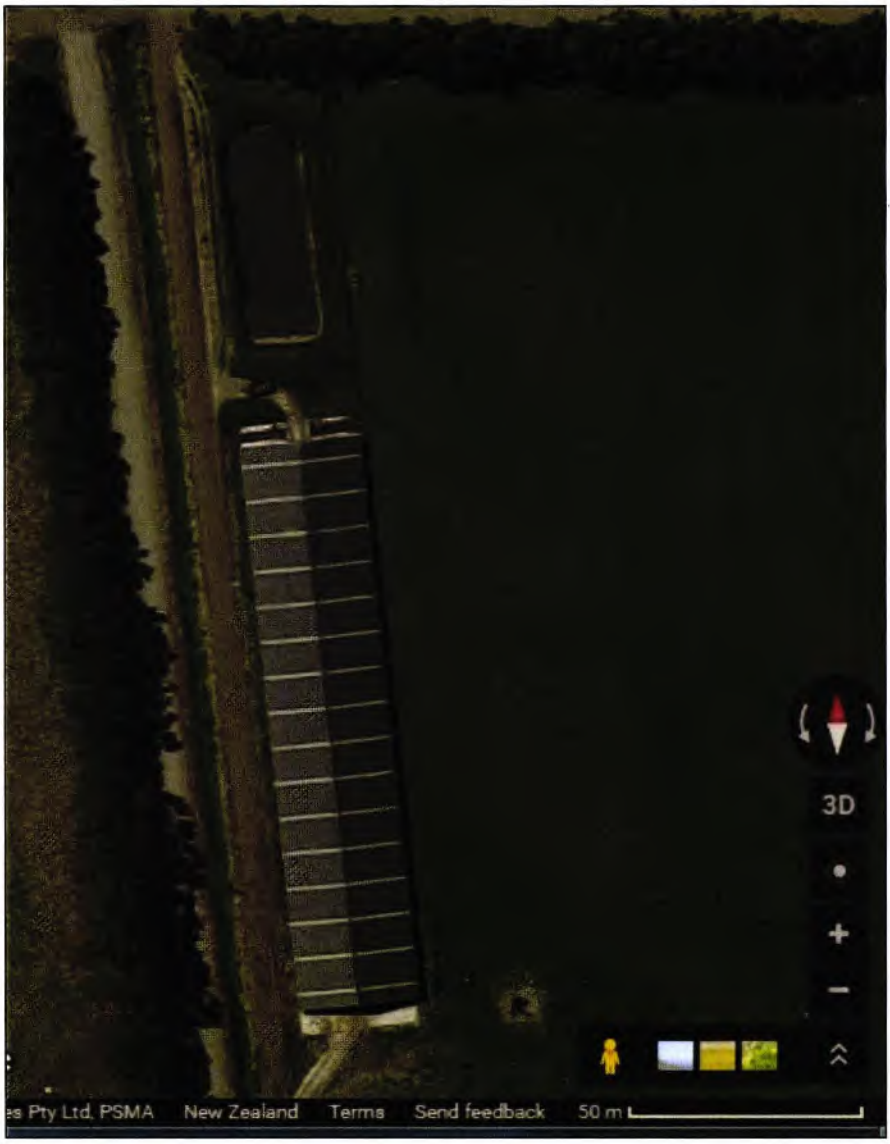

Figure 6.1 Wintering barn and effluent pond – WW1 dairy unit.

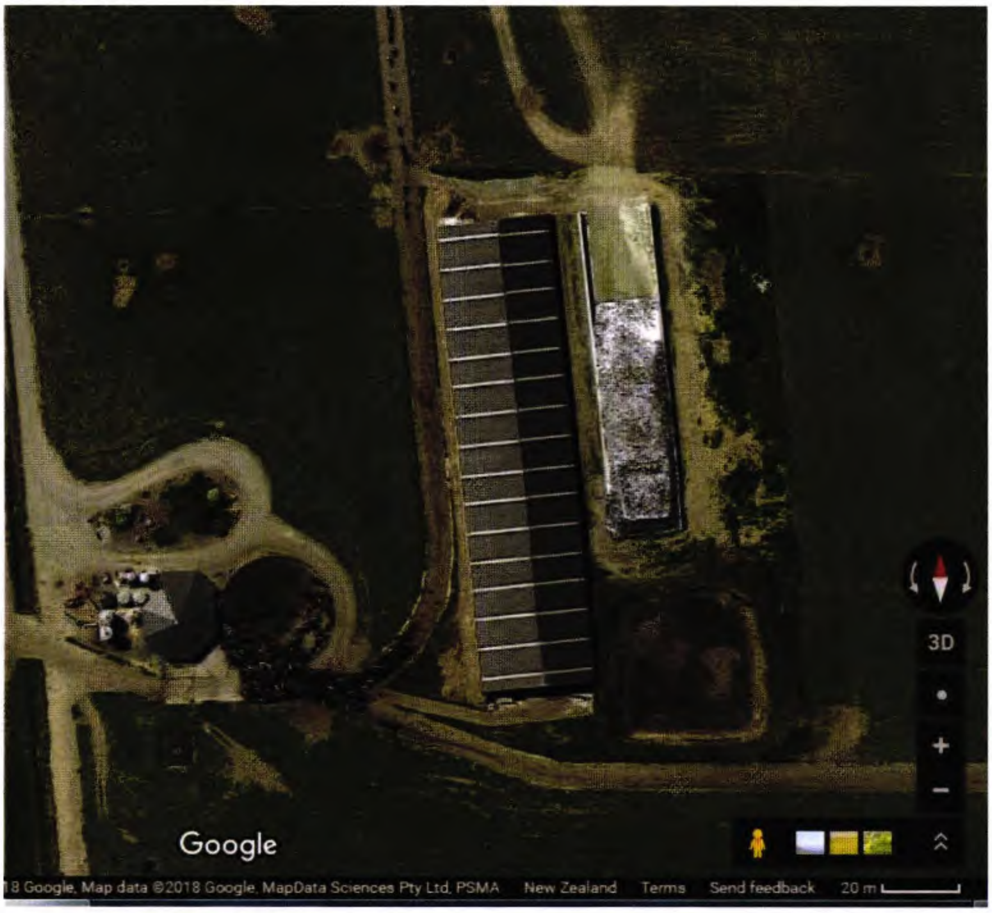

Figure 6.2 Wintering barn, silage pad, dairy shed and effluent pond – WW2 dairy unit

WW2 wintering barn – effluent volume

The total volume of effluent collected has been calculated based on approximately 50 litres per cow per 24-hour day. The volume has been calculated as follows:

May:

$$625\ cows\ x\ 12\ Hours/day\ x\ 50\ l\frac{effluent}{24}Hours\ \ x\ 31\ days = 484\ cubic\ metres$$

June and July:

$$625\ cows\ x\ \ 50\ l\frac{effluent}{day}\ x\ 61\ days = 1{,}906\ cubic\ metres$$

August:

$$370\ cows\ x\ 23\ Hours/day\ x\ 50\ l\frac{effluent}{24}Hours\ \ x\ 31\ days = 550\ cubic\ metres$$

September:

$$75\ cows\ x\ 23\ Hours/day\ x\ 45\ l\frac{effluent}{24}Hours\ \ x\ 30\ days =\ 108\ cubic\ metres$$

Total

$$484\ m3 + 1{,}906\ m3 + 550\ m3 + 108m3\ \ = 3{,}048\ cubic\ metres$$

WW1 wintering barn – effluent volume

The same calculation applies to WW1's wintering barn, which is estimated to be 3,048 m^3.

Wintering barns – total volume of effluent

The volume total of effluent collected from the wintering barns has been calculated as approximately 6,096 m^3/year.

Other sources of effluent

UNDERPASS

An underpass connects WW2 blocks north and south of Wreys Bush Highway, which has a catchment of 200 m^2. The underpass has a concrete sump, from where rainfall and effluent are pumped to a dedicated sprinkler. The underpass has not been included in the Massey DESC report.

Rainfall site used in Massey DESC: Drummond Marson Road = 1.061 m per year
200 m^2 catchment X 1.061 m rainfall = 212 m^3 volume to discharge.

Underpass effluent is very dilute as it is primarily composed of rainwater. It is irrigated using a dedicated low rate sprinkler (at an instantaneous rate of less than 10 mm/hour and less than 10 mm depth per application).

The discharge is to paddocks close to the underpass (low risk soils). Underpass effluent is not discharged to a surface waterway either directly or by overland flow. There is no discharge of underpass effluent when the soil moisture exceeds field capacity.

The discharge of underpass effluent is:

- not within 20 metres of a surface waterway;
- not within 200 metres of a neighbouring dwelling;
- not within 20 metres of a boundary with another landholding; and
- not within 100 metres of a bore.

The maximum loading of N from underpass effluent does not exceed 150 kg N/hectare/year; it is very dilute. Due to its very small volume and highly dilute nature, the nutrient loadings and losses from underpass effluent are negligible compared to that from effluent, slurry and the overall farming activity. The extremely small quantity of nutrients that fall on the underpass and are discharged are accounted for in Overseer, through cow numbers, feed inputs and system losses. Underpasses are not modelled separately in Overseer due to the negligible contribution they make.

Figure 6.3 Aerial photograph of underpass.

SILAGE PAD - WW2

A concrete silage pad is located adjacent to the wintering barn at WW2. Its area is 1,200 m^2. 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.

Only wilted silage is used to minimise the risk of creating leachate. The pad is empty for approximately 3-4 months per year. The silage pad catchment has been included in the Massey DESC report. Given the rainwater diversion in place when the pad is empty, and that rain landing on the cover does not mix with leachate so can be diverted to farm drainage, the silage pad leachate catchment is smaller than 1,200 m^2 for much of the year.

Good management practices for the concrete silage pad at WW2 are:

1. Only wilted silage is stored on the pad to minimise leachate generation;

2. The bunker is filled to the top of the walls with silage and the silage cover hangs over the walls so that rain landing on the silage cover does not mix with leachate.

3. The silage pad is flanked by 1.8 m high sealed concrete walls to prevent leachate escaping;

4. A dual drainage system is operated inside the wall on the low side; one for clean rainwater and one for silage leachate. Only leachate is collected, stored and discharged to land appropriately as follows:
    a. Drains at the front and underneath the stack are opened to the leachate channel. These drain leachate to a sump, from where it is pumped to WW2's effluent storage pond and irrigated appropriately. These areas capture no or minimal rainwater;
    b. The sumps in the rest of the pad are open to the farm drainage system so that clean rainwater can be diverted.

SILAGE PAD - WW1

The silage pad at WW1 meets permitted activity rules both for the use of land and for leachate management. See Section 2 for details. No effluent is collected and pumped to the storage system.

Figure 6.4 Silage pad at WW1

Figure 6.5 Silage pad at WW1

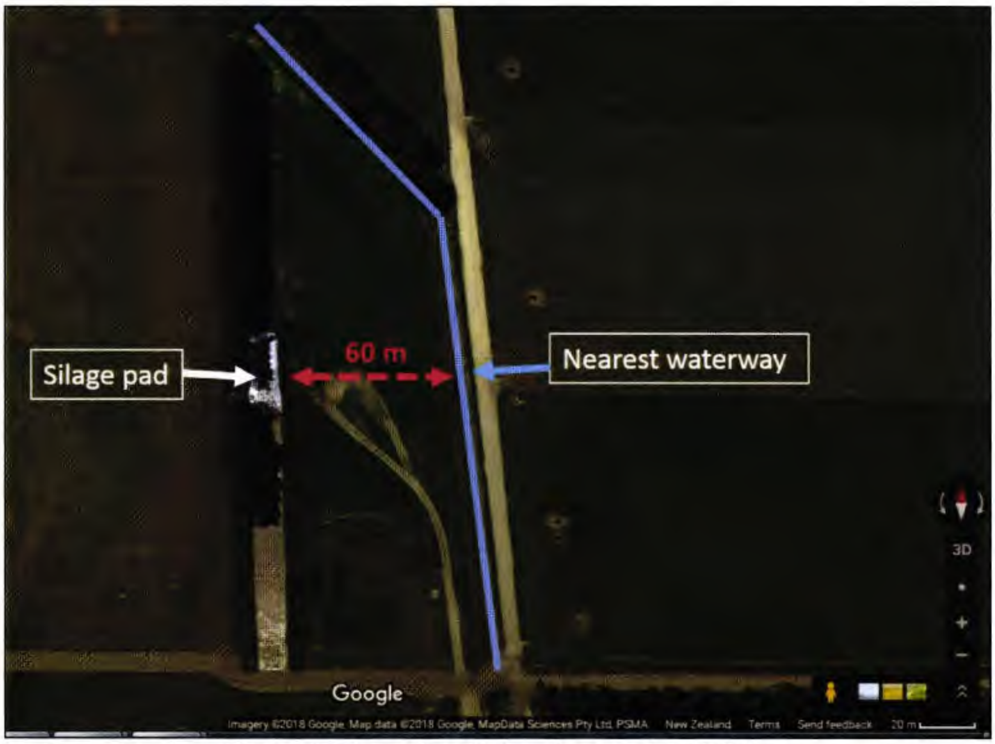

Figure 6.6 Location of the silage pad at WW1.

Effluent collection and storage system

WW1 - DAIRY SHED

The maximum daily dairy shed effluent volume comprises 35 cubic metres of effluent plus any rainfall.

I. Raw effluent from the dairy shed gravity feeds to a pump sump.
II. When soils are below field capacity and have sufficient soil moisture deficit, raw effluent is pumped to a travelling irrigator, from where it is applied to land at low depth.
III. When soils are near or at field capacity, raw effluent is pumped to the buffer storage pond and there is enough storage in the pond so that irrigation is not required.
IV. When soil moisture conditions are suitable for irrigation, raw effluent (slurry) from the pond is applied at low depth to land using a slurry tanker with a trailing shoe or using an umbilical system.
V. An off-season diversion is put in place at the dairy shed.

WW1 - WINTERING BARN

I. The effluent flows by gravity or is scraped to the concrete effluent collection sump, from where it is pumped to WW1 effluent 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 or umbilical system and irrigated at very low depth to land; and
IV. A rainwater diversion is used in the off season.

WW2 - DAIRY SHED

The maximum daily dairy shed effluent volume comprises 40 cubic metres of effluent plus any rainfall.

I. Raw effluent from the dairy shed gravity feeds to a pump sump.
II. When soils are below field capacity and have sufficient soil moisture deficit, raw effluent is pumped to a travelling irrigator, from where it is applied to land at low depth.
III. When soils are near or at field capacity, raw effluent is pumped to the buffer storage pond and there is enough storage in the pond so that irrigation is not required.
IV. When soil moisture conditions are suitable for irrigation, raw effluent from the pond is applied to land at very low depth using a slurry tanker with a trailing shoe or using an umbilical system.
V. An off-season diversion is put in place at the dairy shed.

WW2 - WINTERING BARN

I. The effluent flows by gravity or is scraped to the effluent 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.
III. The effluent is pumped from the pond to the slurry tanker or umbilical system and irrigated at very low depth to land; and
IV. A rainwater diversion is used in the off season.

WW2 – SILAGE PAD

I. Drains at the front and underneath the stack are opened to the leachate channel. These drain leachate to a sump, from where it is pumped to WW2's effluent storage pond and irrigated appropriately.

Storage capacity

WW1 – EFFLUENT STORAGE

The pond was upgraded in autumn 2018. As part of its upgrade the storage volume was increased and a synthetic liner (1.5 mm HDPE) was installed, overlying a leak detection system. The pond design was certified by a CPEng as meeting Practice Note 21 standards. The leak detection system terminates at a 400 mm diameter inspection well. The storage capacity of the pond is 4,281 metres cubed. The Massey Dairy Effluent Storage Calculator 90% storage probability volume for WW1 is 3,257 metres cubed, so has sufficient storage for 700 cows plus wintering barn effluent. See Appendix for the Massey DESC report.

WW1 - DESC PARAMETERS

- 700 cows milked at peak
- Milking season is 1 Aug – 15 June
- Yard is diverted from 16 June to 31 Aug
- Yard area – 553 m^2
- Milking shed roof area diverted.
- A maximum capacity of 640 cows wintered on a covered feedpad, which includes an uncovered area of 170 m^2 and is not diverted. The maximum capacity was used although 625 cows will be the maximum number housed in the barn.
- A winter/spring irrigation depth of 2 mm has been used. This reflects the predominant use of the trailing shoe slurry tanker to discharge slurry effluent from the storage pond, which can apply effluent to a depth of 1 mm if required. By applying effluent 20 m^3/hectare the slurry tanker applies slurry effluent to a depth of 2 mm. A low depth travelling irrigator is used to apply dairy shed effluent when there is sufficient soil moisture deficit.
- FDE area is split to reflect Drummond/Glenelg (low risk) and Braxton (high risk) soils at the milking platform and the Horner Block. Conservatively 50 hectares of low risk soils have been entered.

Note: if the dairy shed is upgraded/replaced in the future, additional storage is available in WW1's pond to allow for a larger yard catchment.

WW2 – EFFLUENT STORAGE

The storage capacity of the pond is 3,751 metres cubed. The Massey Dairy Effluent Storage Calculator 90% storage probability volume for WW1 is 3,203 metres cubed, so has sufficient storage for effluent from 800 cows, wintering barn effluent and silage pad leachate. See Appendix for the Massey DESC report.

WW2 - DESC PARAMETERS

- 800 cows milked at peak
- Milking season is 1 Aug – 15 June
- Yard is diverted from 16 June to 31 Aug
- Yard area – 1,126 m^2

- Milking shed roof diverted
- A maximum capacity of 640 cows wintered on a covered feedpad, which includes an uncovered area of 170 m^2 and is not diverted. The maximum capacity was used although 625 cows will be the maximum number housed in the barn.
- A silage pad catchment of 800 m^2 is entered under "Other catchments."
- A winter/spring irrigation depth of 2 mm has been used. This reflects the predominant use of the trailing shoe slurry tanker to discharge slurry effluent from the storage pond, which can apply effluent to a depth of 1 mm if required. By applying effluent 20 m^3/hectare the slurry tanker applies slurry effluent to a depth of 2 mm. A low depth travelling irrigator is used to apply dairy shed effluent when there is sufficient soil moisture deficit.
- FDE area is split to reflect Drummond/Glenelg (low risk) and Braxton (high risk) soils at the milking platform and the Horner Block. Conservatively 50 hectares of low risk soils have been entered.

WW1 and WW2 - Effluent irrigation

Primary irrigation methods – WW1&2 – low depth travelling irrigator

A low depth travelling irrigator system is used to apply dairy shed effluent to land at a depth of less than 10 mm per application. Two travelling irrigator systems are on farm, with one connected to each dairy shed. Both have been tested as per consent conditions and apply effluent at a depth of < 10 mm per application. See the Appendix for reports from testing each travelling irrigator.

The travelling irrigator systems have a safety system, which automatically switches the system off in the event of an effluent system failure, such as irrigator stoppage or breakdown.

Primary irrigation methods – WW1&2 and Horner Block – low depth slurry tanker with a trailing shoe

A low depth slurry tanker with a trailing shoe is used to apply pond slurry at a maximum depth of 2.5 mm per application. 2.5 mm is the maximum depth proposed as a consent condition.

It can apply slurry to depths as low as 1 mm depending on tractor speed. The applicants own a slurry tanker with a trailing shoe, which has a GPS system. The area and travel speed are monitored using the on-board GPS system. At a travel speed of 8-9 km/hour, the per hectare loading is 20 m^3, which gives a depth of 2 mm. By speeding up the tractor speed, the application depth of lowered further. The capacity of the slurry tanker is 24 metres cubed.

The trailing shoe part of the slurry tanker sits on the ground. It applies slurry at ground level and generates minimal aerosol and odour. It was invented in Europe to reduce adverse odours from the application of slurry/sludge to land, which is standard practice due to the housing of cows in barns over winter. It is regarded as an effective odour minimisation technology and is best practice for slurry/sludge application. Its use will help to avoid adverse odour effects on neighbouring properties.

Contingency method – WW1&2 and Horner Block – umbilical system

An umbilical system is used as a contingency irrigation method, with a maximum depth per application of pond slurry of 3.0 mm.

Future proof – WW1&2 – low rate irrigation

It is proposed to future proof the discharge activity by including low rate irrigation. The applicants may install a low rate system such as pods or a cannon/rain-gun system in the future. Both systems will apply dairy shed effluent at a maximum instantaneous rate of 10 mm/hour and a maximum depth of 10 mm per application.

By including both systems in the permit, the applicants will have flexibility when deciding which system is most suitable, while at the same time being able to assure Environment Southland via consent conditions that the new system will discharge effluent at low rate and low depth.

The system will only be plumbed to land authorised to receive liquid effluent (a.k.a. dairy shed effluent) on the discharge permit/Appendix 1 Discharge Map. If installed, the applicants intend to use a low rate system at times when the soil moisture deficit is too low to safely use the travelling irrigators. E.g. in the shoulders of the season, or in June and August if conditions are suitable and there is sufficient soil moisture deficit to irrigate at depths of 3 – 5 millimetres. The travelling irrigators would still be used over summer/early autumn when the soil moisture deficit is generally greater and irrigation of effluent at depths not exceeding 10 millimetres can be carried out without risk of drainage.

Note: The nutrient budgeting, proposal details and AEE used the high rate travelling irrigator as the primary irrigation system for dairy shed effluent. Low rate systems are regarded as best practice by Environment Southland, and as such will have similar or lesser effects as the high rate travelling irrigator system.

Other conditions – WW1&2

- A minimum return period of 28 days between applications;
- A maximum of 150 kg of N/hectare from agricultural effluent (dairy shed and pond slurry) is applied;
- No effluent is applied to soils showing evidence of cracking;
- A maximum combined depth of application of 25 mm per year for dairy shed effluent to any land area, and
- A minimum land area of 8 hectares/100 cows for the dairy shed effluent.

Other conditions – Horner Block

- A minimum return period of 28 days between applications;
- No effluent is applied to soils showing evidence of cracking; and
- A maximum of 250 kg of N/hectare from agricultural effluent (pond slurry) is applied.

WW1 and WW2 - Contingency measures

The aim is to operate the irrigation systems to always ensure there is buffer storage available. This allows a contingency for wet weather or pump failure.

The umbilical system may be used as a contingency irrigation method. The umbilical system will apply effluent at a maximum depth of application of 3 mm for each individual application.

Should the irrigation pump at either the WW1 or WW2 dairy sheds fail, a replacement pump is available within 12 hours. Alternately a petrol motor-driven or tractor driven pump could be hired. There is adequate storage to allow time for pump replacement.

Nutrient content of effluent

Dairy shed effluent

The nutrient content of dairy shed effluent has not been tested but is expected to be in line with typical dairy shed effluent[19]. An estimate for nutrient content of typical dairy shed effluent based on the above reference is as follows:

- 250 g/m^3 N
- 30 g/m^3 P
- 300 g/m^3 K
- 15 g/m^3 S

Discharging dairy shed effluent at a depth of 10 mm applies 25 kg of N/hectare, and 30 kg of K/hectare. Where the application depth is 9 mm, approximately 22.5 kg of N is applied per hectare.

Table 6.2 N loading from dairy shed effluent

	Dairy Shed
Number of cows	1,500
Nitrogen collected based on 50 L effluent per cow per day	0.013 kg N/cow/day
Daily nitrogen produced	19.5 kg N/day
Maximum days used per year	300
Annual nitrogen produced	5,850 kg N/year
Minimum annual size of discharge area (ha)	220 ha (WW1 + WW2)
Annual nitrogen loading rate	26.6 kg N/ha

Wintering barn effluent

The nutrient concentration of wintering barn effluent is higher than dairy shed effluent due to lack of dilution and the housing of cows in the barns for up 24 hours per day. Slurry effluent in the ponds is predominantly composed of wintering barn effluent, with minor dilution from rain falling on the pond, dairy shed effluent, which is diverted to the ponds when ground conditions are unsuitable for irrigation and silage leachate from WW2's pad.

[19] Longhurst, Rajendram, Miller and Dexter (2017). Nutrient content of liquid and solid effluents on NZ dairy cow farms. Science and Policy: nutrient management challenges for the next generation. Occasional Report No. 30.

The nutrient content of pond effluent (slurry) was tested as part of a 2011 AgResearch study[20]. The nutrient content of slurry at the applicant's pond was measured at:

- 3,200 g/m^3 N
- 800 g/m^3 P
- 4,400 g/m^3 K
- 400 g/m^3 S

Applying 15.2 m^3/hectare applies slurry effluent at a depth of 1.5 mm. Discharging slurry effluent at 15.2 m^3/hectare applies:

- 49 kg of N;
- 12 kg of P;
- 69 kg of K; and
- 6 kg of S.

Slurry effluent is applied at the Horner Block and at WW1&2.

Given the use of the Horner Block for grass harvesting, slurry effluent from WW1 and WW2 is applied at very low depth as fertiliser, and grass is harvested and fed to cows at WW1&2 and at other dairy farms. Cows are not grazed at the Horner Block, so a higher slurry loading can be applied without the potential risk of adverse animal health effects due to excessive K levels and without the risk of adverse environmental effects due as described in the AEE.

Nitrogen fertiliser is reduced accordingly at both the Horner Block and WW1&2 to account for the N loading from slurry. Adverse N-related environmental effects are further avoided through the application of pond slurry at very low depths (less than or equal to 2.5 mm per application and typically at 1.5 – 2.0 mm depth per application).

E.g. Slurry effluent applied at 1.5 mm depth by applying 15.2 m^3/hectare, will apply 49 kg of N/hectare. A total of five applications at 1.5 mm depth each will apply a total of 243 kg N/hectare, which is less than the 250 kg N/hectare proposed limit for the Horner Block.

One application of slurry effluent at a similar depth and rate per hectare is also applied at WW1&2 to land that does not receive dairy shed effluent.

Slurry volume

Slurry volume is estimated based on the volume of wintering barn effluent (6,096 m^3), rainwater on the ponds' surface (606 m^3 for WW1, 912 m^3 for WW2) and an allowance for dairy shed effluent diverted to the ponds (2,400 m^3) given the presence of low risk soils and use of very low depth application using the slurry tanker/trailing shoe, which results in a large number of irrigation days available. The area available at the Horner Block (97 ha) and dairy platform (> 180 ha) is sufficiently large to receive the volume of slurry.

[20] Houlbrooke, Longhurst, Orchiston & Muirhead (2011). Characterising dairy manures and slurries. AgReseacrh. Envirolink tools report AGRX0901.

Effluent discharge and receiving area

See table 1.1 for details of land areas within the discharge areas at WW1&2 and the Horner Block, which will be authorised on separate permits.

Effluent irrigation to the discharge areas is carried out between August and May, and if ground conditions permit in June and July as necessary. Overall, the effluent receiving area encompasses most of WW1&2 and the part of the Horner support block (c.97 hectares), less Council required buffers around waterways, bores, neighbouring dwellings, boundaries etc.:

- 20 metres from any surface watercourse;
- 100 metres from any potable water abstraction point;
- 20 metres from any property boundary (unless the adjoining landowner's consent is obtained to do otherwise);
- 200 metres from any residential dwelling other than residential dwellings on the property;
- Dairy shed effluent shall not be discharged onto any land area that has been grazed within the previous 5 – 10 days;
- Effluent shall not be discharged to leased land described as Lot 1 DP 451158, Lot 1 DP 13077 and Lot 1 DP 9925;
- Effluent shall not be discharged where the soil has cracked, and
- Effluent shall not be discharged over tiles or mole drains when the soil is at field capacity.

Allowing for the above buffers, a conservative estimate for the size of the effluent discharge area is c.350 hectares at WW1 and WW2, and c.97 hectares at the Horner Block, which gives a total FDE area of 447 hectares. Given the presence of Drummond/Glenelg soils, there are significant areas of low risk soils assuming the use of low depth irrigation.

At an operational level:

- Dairy shed effluent from WW1&2 will continue to be discharged via travelling irrigator at low depth; in the future a low rate irrigation system may be installed;
- Slurry effluent will be discharged at very low depth via slurry tanker (or umbilical system) at the WW1&2. This includes land referred to as the SH96/Marcel Block. A maximum of 150 kg N/ha/year from agricultural effluent will be applied at the dairy platform;
- Slurry effluent will be carted via slurry tanker and discharged at very low depth at the Horner Block. Approximately 97 hectares is available at the Horner Block for this purpose (see figure 6.7). A maximum of 250 kg N/ha/year from slurry will be applied at the Horner Block.
- The slurry effluent areas at the milking platform (WW1 and WW2) and at the Horner Block are sufficiently large to receive both the volume and N loading from the effluent ponds.

- Effluent will not be discharged at times where there is snow on the ground or when rainwater/irrigation water has ponded on the land surface.

- Effluent will also not be discharged when soil conditions are considered unsuitable i.e. when soil temperature is at or below 5 degrees Celsius or when the soil moisture deficit is insufficient. Environment Southland's Beacon website will be consulted as a guide to soil moisture levels.

Figure 6.7 Horner support block with slurry effluent area annotated in purple.

Horner Block – slurry receiving area

The discharge of slurry from WW1&2 at the Horner Block will be authorised on a separate discharge permit. The Horner Block has no effluent storage or permanent irrigation infrastructure. The slurry tanker with the trailing show will be used to discharge pond slurry at the Horner Block, with an umbilical system used as a contingency.

Land use

Land is used as for cut and carry, and to discharge slurry effluent from ponds at WW1&2 and from WW3. No stock is grazed at the block so there is no nutrient loss from urine patches. Cut and carry block are used to grow grass only, typically having 4 cuts per season. Relatively high N inputs are required to achieve this. In this case fertiliser and slurry provide N. Cut and carry blocks are efficient at utilising N and generally have low N loss to water despite relatively high N inputs.

The block (160 ha) will continue to be managed as it has been managed in recent years. A general description of how the block will be managed is as follows:

Cut and carry

- Pasture renewal - the pasture renewal programme is by grass to grass cultivation. Approximately 5% is re-grassed each year.
- Grass (approximately 17 t DM/ha) is harvested and is purchased by dairy farms in the Woldwide Farming Group (including WW1 and WW2 and other farms). Some grass harvested is fed fresh or is stored as silage and fed to cows at wintering barns at WW1 and WW2.

Slurry

Slurry (from WW1&2) receiving area: 97 hectares

N loading: 5 applications of slurry at 15.2 m^3 per hectare per application = 243 kg N/ha from slurry

Woldwide Three: 57.5 hectares (not part of this application)

General fertiliser use

For a detailed fertiliser programme, please see the nutrient budget inputs. N, P, K and S are applied as follows:

- N (207 kg/ha – split applications, little and often)
- P (10 kg/ha)
- K (0)

Fertiliser is applied outside high risk months (i.e. May – July). If ground conditions are suitable and there is minimal risk of drainage, fertiliser can be applied in August.

Downstream users of groundwater

- Farmland is found due south of the HB. Downstream users of groundwater are farms (sheep, dairy and cropping).
- Drummond Township is located ~ 9 km to the south east of the HB so has domestic users of groundwater including Drummond Primary School and Drummond Kindergarten. Both are located at the south of the township.

6.3 Water Take

Groundwater is abstracted from three bores for use at the dairy sheds and to supply stock drinking water. The bores are over 100 metres apart. Two bores supply groundwater to the WW2 unit, one bore supplies groundwater to the WW1 unit. **The maximum volume of groundwater abstracted for 1,500 cows will be 180 meters cubed per day.** This is abstracted as follows:

> **WW1** -The bore (well ID E45/0071) is located to the west of the dairy shed and supplies water via a submersible pump to three tanks (3 x 30,000 litres) at the dairy shed for stock drinking water and dairy shed use. The abstraction for WW1 is currently managed under Water Permit 301664. **It is proposed to increase the groundwater take to meet the needs of 700 cows milked through the WW1 dairy shed.** The proposed groundwater take at the WW1 unit is 84,000 litres per day.
>
> **WW2** - Two bores (well ID E45/0727 and E45/0083) supply groundwater for dairy use; one is adjacent to Wreys Bush Highway north of the dairy shed, and the other is on the west side of the dairy shed. The two bores supply water via submersible pumps to three tanks (3 x 30,000 litres) at the dairy shed for stock drinking water and dairy shed use. The abstraction for WW2 is currently managed under Water Permit 20171278-02. **The proposed groundwater take at WW2 is the same as the existing take to meet the needs of 800 cows milked through the dairy shed.** The proposed groundwater take at WW2 unit is remaining at 96,000 litres per day.

Groundwater use equates to 120 litres per cow per day and is in line with the Council's standard estimate for water usage (i.e. 70 litres per cow per day for drinking water and 50 litres per cow per day for dairy shed washdown).

Water requirements

Season

During the milking season (twice per day milking), requirements are 70 l/cow/day for drinking water and 50 l/cow/day for dairy shed wash down water:

1,500 cows x 120 l/day = 180,000 litres per day

180,000 litres per day is split between the WW1 (84,000 litres per day) and WW2 (96,000 litres per day) dairy units.

An average lactation length is 280 days.

280 days x 180,000 litres per day = 50,400,000 litres

Off season

Cows remain on-farm over winter when they are housed in two wintering barns. An average lactation length for cows is 280 days, which leaves an average of 85 days when cows are dry. A drinking water allowance for dry cows is 45 l/cow/day. On average 1,280 cows require drinking water in the off season for 85 days:

1,280 cows x 45 l/day x 85 days = 4,896,000 litres for the off season.

Total volume of groundwater required

55,296,000 litres or 55,296 metres cubed

Extraction

Groundwater is abstracted from three bores over 50 metres apart from each other, which ensures that the abstraction rate will be less than 2 L/sec.

Average daily rate of take (WW1)	0.97	litres per second
Average daily rate of take (WW2)	1.11	litres per second
Maximum daily rate of take	2.0	litres per second
Maximum daily volume	180	cubic metres per day
Maximum weekly volume	1,260	cubic metres per week
Maximum monthly volume	5,400	cubic metres per month (30-day month)
Maximum annual volume	55,296	cubic meters

The bores are over 50 metres apart from each other. The bores are not within 700 metres of a neighbouring bore or groundwater take.

The dairy supply bore map references (NZTM2000) are:

- E45/0083 E1225011 N4889693
- E45/0727 E1225014 N4890268
- E45/0071 E1225145 N4888768

Water storage

Three water storage tanks (3 x 30,000 L) are utilised at WW1's dairy shed to ensure that the rate of take is less than 2 L/sec.

Three water storage tanks (3 x 30,000 L) are utilised at WW2's dairy shed to ensure that the rate of take is less than 2 L/sec.

6.4 Proposed land-use – dairy farming

WW1&2 Land use activities

Land use

The land is used as a pasture based dairy farm. Calving officially starts on 1 August and cows are typically milked from 1 August to 31 May, with late calving cows milked until 15 June. Cows (Friesan) are milked twice per day.

Stock management

- Up to 1,500 cows (i.e. mixed age cows and replacements) are calved each year. The milking herd peaks in October/November at 1,500. It drops slightly over consecutive months depending on seasonal variation in pasture production; approximately 1,410 cows are milked in March. Cows are dried off in May and June. Approximately 375 cows (25%) are culled by May/June and replaced each year.

- Median calving date is 20 August with approximately 417 heifer calves kept as replacements. R1 calves are on farm for August, September and October. Replacement calf numbers will be reduced by 10% over the following 21 months through deaths/culling, leaving 375 R2 heifers to be wintered, calve and join the milking herd at WW1&2.

  Activities at WRO are explained in detail in the WRO section of the application:
  - In November, weaned R1 calves go to WRO where they remain for approximately 19-21 months. All R1 heifers are IWG at WRO in June/July.
  - Once grown out to R2s, heifers are mated.
  - In-calf R2 heifers are either wintered in barns at WW1&2 (up to 125) or IWG at WRO.
  - The long-term goal is to house all in-calf R2 heifers from WW1&2 in winter barns although that is not part of this proposal.

- Approximately 375 in-calf R2 heifer replacements return to WW1&2, calve in August, September and October when they join the milking herd.
- Approximately 15 bulls are grazed on farm and used as part of the mating programme each year.

Wintering, cropping, grazing and supplements – WW1&2

- Wintering – all MA cows are wintered on farm where they are housed in two wintering barns over June and July. Depending on the season, R2 heifers (c.125) are also wintered in barns. Cows are housed in barns during May, August and September as required also.
- Fodder crop – no fodder crops (brassica or beet) are sown. Animals are not IWG or grazed on fodder crop at any other time.
- Pasture renewal - the pasture renewal programme is by grass to grass cultivation. Approximately 5% of the farm is re-grassed each year.
- Grazing – cows are grazed on pasture throughout the season. The wintering barns are used to stand cows off paddocks during the shoulders of the season and during high risk inclement weather events throughout the season.
- Supplements made – If there is a surplus, silage may be harvested at the dairy farm. There is no dedicated silage block, however, and in general silage is imported.
- Supplements imported – barley, molasses, PKE and grass silage (see nutrient budget inputs)

General fertiliser use

For a detailed fertiliser programme, please see the nutrient budget inputs. N, P, K and S are applied as follows:

Effluent block:

- N (139 kg/ha – split applications, little and often)
- P (25 kg/ha)
- K (0)

Slurry receiving area:

- N (179 kg/ha – split applications, little and often)
- P (22 kg/ha)
- K (0)

Non-effluent blocks:

- N (209 kg/ha – split applications, little and often)
- P (34 kg/ha)
- K (28 kg K/ha)

Fertiliser is applied outside high risk months (i.e. May – July). If ground conditions are suitable and there is minimal risk of drainage, fertiliser is applied in split applications from August to April.

Good Management Practices

Good management practices (GMPs) implemented on farm are also described in the FEMP. A general strategy of good management practice is undertaken to minimise contaminant losses across the whole activity. Details are described in table 6.3 below. Key mitigation measures (distinct from GMPS) are described in table 7.1.

Evidence of sustainable soil and nutrient management is clear in trends in soil testing over many years. See the Appendix for reports from Ravendown supporting good practice management of farm soils and farm fertility.

Table 6.3 General Good Management Practices – WW1&2

Strategy Type	Summary of Management Practices
Operational	Utilising a nutrient management plan;
	Soil testing is carried out each year to inform on decision making regarding fertiliser application;
	Trends in soil testing are evaluated and used to inform on decision making regarding soil health, fertiliser and agronomy plans;
	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;
	All cows are wintered in barns over June and July;
	Tracks and lanes predominantly sited away from streams;
	Lane runoff diverted to land;
	Good management practice of the silage pad is implemented;
	Restricted grazing of draining pastures in autumn/spring;
	Specialist machinery is used to harvest grass to minimise the risk of soil compaction;
	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, taking into account the higher strength nature of slurry effluent;
	Effluent volumes are minimized at source through efficient water use;
	Appropriate application depths for liquid effluent (a maximum of 10 mm depth per application and less than 50% PAW on Category E soils) and slurry (a maximum of 2.5 mm depth per application across the WW1&2 and the Horner Block) are used;

Appropriate effluent storage volume to allow for deferred irrigation;

All data and maps are kept up to date and all staff are trained and informed of any changes;

Programmed maintenance is done in and around FDE, and piping infrastructure around the dairy shed, silage bunkers, cow yards etc.;

Good Management Practices for Key Transport Pathways – WW1&2

See table 6.4 below for a summary of physiographic zones and key transport pathways of contaminants.

Table 6.4 Physiographic zones and key transport pathways

Physiographic Zone	Variant	Key Transport Pathways
Central Plains	n/a	Artificial drainage, deep drainage
Oxidising	n/a	Deep drainage

WW1&2 is classed in the Oxidising and Central Plains physiographic zones. The Horner support 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) have risk of nitrate and contaminant (pathogen) loss to groundwater via deep 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 low 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 is 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 6.5 describes good management practices, which have been implemented on-farm through most recent annual cycle to mitigate the risk of contaminant loss to water (N, P, sediment and microbes).

Reference factsheets: Artificial drainage; Deep drainage; Overland flow

Table 6.5 Good management practices implemented on farm and further explanations.

Transport Pathway	Environmental outcome	Summary of Management Practices
Artificial drainage,	Protect soil structure	Match stock management to land use capability, e.g. avoid grazing cows on more vulnerable soils, especially when wet.

Overland flow	(especially near streams)	Fence off waterways. Stock will not graze riparian strips. Riparian strips are approximately 3 m and well are vegetated; All cows are wintered off paddocks in wintering barns; When appropriate use minimum or no-till cultivation practices such as direct drilling; Re-sow areas of bare or damaged soil as soon as is practical;
Artificial drainage, Overland flow	Reduce P use or loss	Prepare a nutrient budget; Soil test regularly; Maintain Olsen P values at agronomic optimum and no higher; Apply P fertiliser outside of high-risk months in autumn and winter; Manage CSAs close to surface drains appropriately. During and following inclement weather, CSAs close to surface drains will be temporarily fenced off to prevent stock from damaging soils and from adding nutrients to high drainage locations. No effluent will be discharged to the same areas;
Artificial drainage, Deep drainage	Reduce accumulation of surplus N in the soil, particularly during autumn and winter	Maintain sustainable stocking rate (3.1 cows/ha at WW1&2); Reduce inputs of N where possible through optimal fertilizer application on farm, use little and often approach; All MA cows are wintered off paddocks in wintering barns; Optimize timing and amounts of effluent irrigation input applications, accounting for higher strength nature of slurry effluent; Substitute autumn diets with low-N feed when practical; Time N application to meet pasture demand using split applications and when pastures are actively growing (>6 degrees Celsius); Control the duration of grazing pastures; Cut and carry feed where practical;
Artificial Drainage Deep drainage	Avoid preferential flow of effluent through drains or soil cracks	Defer irrigation to effluent storage ponds when soil conditions are unsuitable; Very low depth slurry application is implemented; Low depth dairy shed effluent application is implemented;

		Avoid applying slurry or dairy shed effluent where soils are cracked; A sufficiently large FDE area is available for effluent; Observe buffer zones and placement guidelines; Observe discharge consent conditions;
Overland flow	Manage CSAs; low areas overlying tiles close to outfalls at surface drains	Restrict grazing of pasture CSAs when soils are near saturation; Avoid working pasture CSAs and their margins; Move troughs and gateways away from water flow paths; Reduce runoff from tracks and races;
Deep drainage	Avoid loss of contaminants (nitrate and faecal microbes) to groundwater via deep 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; Avoid deep crack formation by maintaining good soil structure and good pasture cover;

Specific Mitigation Measures – Expansion

The change to the 1,500-cow system brings in an additional 160 cows. This will occur in conjunction with key mitigation measures to off-set nutrient and contaminant losses potentially generated by additional cows. Overseer predicts that the average annual N loss for WW1&2 will decrease slightly per hectare and that P loss will remain stable per hectare. Some key mitigation measures not recognised by Overseer will further reduce contaminant loss, although these are not recognised by Overseer. P loss can generally be used as a proxy for sediment and microbial loss.

Key mitigation measures are described in table 7.1, along with an assessment of their effectiveness and level of effectiveness.

FURTHER INFORMATION REGARDING MITIGATION MEASURE #6 (FROM TABLE 7.1)

Two lanes lie adjacent to a stream close to the WW1 wintering barn (see figure 6.8). Only one of these lanes (i.e. the east side lane), however, is used for cow traffic to the milking shed. The west side lane is solely used to truck silage in and for truck access to the cattle yards to load and unload stock. Cows do not use the west lane, so it only collects rainwater. Since there is no cow traffic on the west side lane, there is no risk of runoff of contaminants (containing phosphorous or microbes) from dung or urine to the stream.

Figure 6.8 Aerial photo of stream flanked by two lanes at WW1, close to wintering barn and north of milking shed.

The east lane has cow traffic, as seen the below figures. The stream is protected by a wide buffer (>3 m) that has a slope of approximately 30 degrees and is vegetated with long grass. In view of an additional 160 cows using the lane, work has recently been carried out to contour the lane to ensure rain falling on the lane drains away from the adjacent stream. This measure will be effective at preventing runoff to the stream, which otherwise could be a greater risk with additional cows. Good grass cover will always be maintained on the stream bank to further protect the stream.

In the below photo, water flowing in the stream appears clear, which is noteworthy as the photos were taken after 40 mm of rainfall in the previous week.

Figure 6.9 Stream flanked by two lanes. Note that photo was taken from the north/facing south.

Figure 6.10 Cows crossing waterway over culvert to walk to the dairy shed on the east lane.

Overseer summary

N LOSS

The key drivers of the small decrease in N loss (kg/ha) despite an additional 160 cows are as summarised follows:

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

N losses from crop blocks are driven by fertiliser and effluent application, as well as mineralization processes and accumulation of cow excreta associated. The proposed system has no fodder crops/IWG annually. The effect of this is to reduce the average N loss slightly, despite increasing cow numbers by 160.

P LOSS

The key drivers of a stable P loss (kg/ha) despite an additional 160 cows are summarised as follows:

- Decrease in winter crop area;
- Maintaining Olsen P at target level of 30;
- Expansion of size and use of wintering barn facilities.

The key measures that will mitigate P loss also will help to mitigate the loss of sediment and microbial contaminants to water, as they are generally transported to water via artificial drainage and overland flow also.

OTHER MITIGATION MEASURES FOR P LOSS

Other measures that mitigate P, sediment and microbial contaminant loss that are not modelled by Overseer prevent overland flow from critical infrastructure to surface waterways following periods of heavy rainfall. This greatly reduces the propensity of a pathway that transports P (and sediment and microbes) directly to surface waterways. P remains on lanes and/or is returned to adjacent paddocks where it is filtered, attenuated and can be taken up by plants.

These measures include:

- Only a small proportion of lanes run parallel to or close to waterways. This greatly reduces the risk of runoff from tracks and lanes into waterways. Overseer does not recognise the layout of individual farms;
- Herd movement is managed to minimise the time cows spend on lanes and other tracks, especially where there is a risk of runoff to waterways;
- Minimise the number of culvert/bridge crossings of waterways, where run-off from tracks and lanes can reach surface waterways. Any locations where run-off could potentially occur are identified as CSAs and managed to minimise the risk of runoff occurring. Track shaping and cutting is carried out to direct surface drainage at such locations to paddocks and away from waterways. If necessary, nib boarding is put in place. Runoff is filtered through pasture before draining to waterways.

Review

A review of good management practices and mitigation measures will be carried out annually. Practices undertaken in the previous 1 June to 31 May period will be reviewed and practices will be implemented over the following 1 June to 31 May as appropriate.

Nutrient budgets

Seven nutrient budgets (NBs) have been prepared:

- Four pre-expansion nutrient budgets have been prepared based on actual figures for 2013/14, 2014/15, 2015/16 and 2016/17 years. A high level of evidence has been provided to support inputs used for all year end nutrient budgets.
- One nutrient budget has been prepared to for the proposed 1,500 cow system at WW1&2.
- Two nutrient budgets for the Horner Block (one current and one proposed).
    - Environment Southland have since been advised via a legal opinion that the Horner Block is not required to be on the land use consent for farming; as such nutrient budgets are not needed. Since nutrient budgets were already prepared for the Horner Block, they will be used as a useful information source.
- One nutrient budget has been prepared for WRO based on the 2017/18 year.

Cain Duncan (CNMA) from Farm Source Sustainable Dairying carried out all Overseer work. Soil nutrient test data, the latest version of the Overseer model (ver. 6.3.1) and Overseer Best Practice Data Input Standards were used. Associated XML files have been submitted electronically.

Table 6.6 Overseer files

Number	Year	XML file name
1	2013/2014	Ovr-Woldwide 1,2 & 96 13_14 (2).xml
2	2014/2015	Ovr-Woldwide 1,2 & 96 14_15 (2).xml
3	2015/2016	Ovr-Woldwide 1,2 & 96 15_16 (2).xml
4	2016/2017	Ovr-Woldwide 1,2 & 96 16_17 (2).xml
5	Proposed WW1&2	Ovr-Woldwide 1&2 Proposed (Mitigations & Slurry) (2).xml
6	Current use - Horner Block	Ovr-Horner Block -Current (3).xml
7	Proposed use - Horner Block	Ovr-Horner Block - Proposed (3).xml
8	2017/18 – WRO	Ovr-Woldwide Runoff (Merrivale & Merriburn).xml

Mr. Duncan also prepared an in-depth nutrient budget analysis report for WW1&2 and the Horner Block, which is submitted with this application. Rather than duplicate material, please refer to the appended nutrient budget analysis report for assumptions and a summary of inputs for each nutrient budget:

- Assumptions: Sections 5, 6 and 7
- Inputs: Section 9, 12

Nutrient budgets 1 – 5 from the above table contain the same land areas: former WW1 milking platform, former WW2 milking platform, Marcel Block and SH96 block.

Where the nutrient budget report by Mr. Duncan states that the land area is being increased by bringing in support land, this refers to the SH96 and Marcel Blocks, which were consented for dairy farming as part of WW2's land use consent for farming granted in 2017. Mr. Duncan has also prepared detailed maps and a summary for each individual nutrient budget as part of the report.

The WRO nutrient budget is described in a separate report prepared by Mr. Duncan. Outputs from the WRO nutrient budget are detailed in the WRO section of the application.

Nutrient Losses as Modelled by Overseer – WW1&2

PRE-EXPANSION

Table 6.7 Modelled nutrient losses for pre-expansion year end nutrient budgets (source: Nutrient Budget Analysis Report).

	13/14	14/15	15/16	16/17	Average
Total N Loss (kg)	19055	23016	19112	20723	20477
N Loss/ha (kg)	40 (15)	46	38	41	41
N Concentration in Drainage (ppm)	7.3 - 12.9 (Pastoral) 16.4 - 27.1 (Crops) 5.9 – 12.5 (Silage/WGYS)	9.9 – 15.7 (Pastoral) 13.5 - 17.6 (Crops) 5.9 – 9.5 (Silage/WGYS)	7.3 – 14.3 (Pastoral) 13.1 - 18.8 (Crops) 4.0 – 9.8 (Silage/WGYS)	8.5 – 15.3 (Pastoral) 18.0 - 23.8 (Crops) 2.9 – 7.5 (Silage)	
Total P Loss (kg)	345	374	362	357	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)	15,003	15,483	15,089	15,909	15,371

PROPOSED

Table 6.8 Modelled nutrient losses for post-expansion nutrient budget (Source: nutrient budget analysis report).

	Proposed Dairy Unit
Total N Loss (kg)	20,262
N Loss/ha (kg)	40
N Concentration in Drainage (ppm)	Pastoral – 7.8 to 17.2 ppm

Total P Loss (kg)	357
P loss/ha (kg)	0.7
Pasture Grown Kg/DM/ha/yr	15,544

Discussion – nutrient losses at WW1&2

N LOSS

The pre-expansion average annual N loss based on four years of supported data and analysis is 20,477 kg/year. The proposed 1,500 cow dairy farm is predicted by Overseer to have an average N loss of 20,262 kg/year. Overseer predicts an average reduction in N loss of 215 kg/year with the change to the proposed system. The N loss per hectare value for the proposed 1,500 cow farm (40 kg/year) is predicted to reduce slightly relative to the pre-expansion land use (41 kg/year).

This decrease is mainly driven by the removal of forage brassica and beet winter and summer crops, and their associated IWG or summer grazing, the removal of pasture grazing in winter, greater use of the wintering barns and more efficient fertiliser use. Soil aggregates are broken up and mixed when cultivated for cropping. This results in a high rate of N mineralisation through accelerated microbial decomposition of soil organic matter and subsequent rapid nitrification, which produces large quantities of nitrate. Dung and urine are deposited in relatively high volumes on winter crop ground, further driving losses of N. This is especially seen during late winter and early spring, when the ground lies fallow. Greater use of the wintering barn facilities allows the collection and storage of nutrients in dung and urine, some of which were previously deposited on winter crop and grass paddocks as they were grazed. Because of significant changes in management practices, the proposed 1,500 cow system is predicted to have slightly less average annual N loss than the pre-expansion system despite an increase of 160 cows.

Pasture production is similar for both the pre-expansion system (15,371 kg DM/ha/year) and the proposed 1,500 cow farm (15,544 kg DM/ha/year).

P LOSS

The pre-expansion average annual P loss is based on four years of supported data and analysis is 360 kg/year. The proposed 1,500 cow dairy farm is predicted to have an average P loss of 357 kg/year, which is essentially no change. The per hectare P loss value for the proposed 1,500 cow farm (0.7 kg/year) is predicted to remain as for the pre-expansion land use (0.7 kg/year). For both the pre-expansion and proposed system, the risk of P loss from effluent is classed by Overseer as low for all blocks. The risk of P loss from soil and fertiliser is classed as low for all soil type blocks.

The key drivers of the stable predicted P loss are the removal of forage brassica and beet winter and summer crops, and their associated grazing, the maintenance of Olsen P at a target of 30, and the expansion in size and use of the wintering barns.

As already explained, effective measures to mitigate P loss that are not detected by Overseer will also be implemented on farm.

Nutrient loss – Horner Block

The current nutrient budget represents a conservative approach to modelling the existing nitrogen and phosphorus losses on the HB.

Under both current and proposed land use, the Horner Block has very low nutrient losses. The current use is predicted to have an annual average N loss of 20 kg/hectare; the proposed has N loss of 19 kg/hectare. The current use is predicted to have an average P loss of 0.1 kg/hectare; the proposed has P loss of 0.1 kg/hectare.

Discussion – effects of losses

Please see Section 7 (AEE) for a discussion on the effects of predicted nutrient losses.

7. Assessment of Environmental Effects/Mitigations

An assessment of effects in accordance with Schedule 4 of the RMA is provided in this section. The assessment has been prepared in three sections covering the discharge activity, water take and land use/farming activity respectively, since each will be authorised on its own consent; discharge permits, water permit and land use consent for farming respectively.

The discharge activity will be authorised on two permits, one each for WW1&2 and the Horner Block respectively.

The discharge activity is part of the overall farming activity, so information provided in section 7.1 is also relevant to the AEE for the farming activity (section 7.3).

7.1 Effluent discharge activity

Odour

Adverse effects from odour can occur due to the discharge of agricultural effluent (liquid and slurry) where it may be encountered beyond the boundary of the site. The applicants have proposed the continued use of very low depth and low depth application technology, which coupled with the proposed effluent discharge buffers means there is little risk of adverse effects from odour and spray drift on surrounding land owners and occupiers. They irrigate according to wind direction and risk, which helps to avoid adverse odour effects.

Slurry is applied a very low depth using the slurry tanker with the trailing shoe. The trailing shoe part of the slurry tanker sits on the ground. It applies sludge at ground level and generates minimal aerosol and odour. It was invented in Europe to reduce adverse odours from the application of slurry/sludge to land, which is standard practice due to the housing of cows in barns over winter. It is regarded to be an effective odour minimisation technology and is best practice for slurry application. Its use will help to avoid adverse odour effects on neighbouring properties.

Risks to surfacewaters from effluent discharge

Adverse effects on surface water can occur from the discharge of farm dairy effluent where contaminants present in effluent such as nutrients N and P, organic matter and microbes reach receiving surface waters such as streams, rivers and estuaries. Effects such as nutrient enrichment of surface waters *are cumulative*, and can lead to algal blooms including slime, and promote nuisance aquatic plant growth. The collection of plants and animals that inhabit receiving waters are adversely affected by nuisance plant growth, as well as in-stream values such as biodiversity and ecosystem services. Values associated with surfacewater streams and coastal waters are many and relate to the landscape, biodiversity, history and people living in the catchment. These values include maintaining the health of water bodies both in-stream and coastal, protecting biodiversity and ecosystems, protecting recreational activities such as fishing, walking and boating; protecting human and animal health, maintaining sustainable farming practices and the socioeconomic well-being of people through preserving values that relate to inshore fishing, farming and tourism. Iwi/cultural values include the principles of protection or kaitiakitanga of the mauri of the water and mana of the land, while minimising adverse effects on taonga and mahinga kai.

WW1&2 receiving surface waters predominantly lie in the Waimatuku Stream catchment, Waimatuku Estuary and coastal waters, as well as New River Estuary catchment. Horner Block receiving waters also lie in the Waimatuku Stream and Waimatuku Estuary, as well as in the Aparima River, Jacobs River Estuary and coastal waters. These are considered sensitive environments due to the accumulation of nutrients, sediment and microbes. Receiving waters show evidence of land use impacts, with elevated levels of nutrients, sediment and algal blooms at times. The Waimatuku Stream catchment shows higher levels of nutrients than the Aparima River or Oreti River catchments.

Artificial drainage is a contaminant pathway, particularly subsurface drainage channels installed in silty clay Braxton soil types. Artificial drainage transports contaminants via bypass drainage to receiving surfacewaters during and following periods of heavy rainfall. Parts of the discharge area with Braxton soils types at both WW1&2 and the Horner Block are high risk for effluent discharge and require appropriate management of effluent discharge to mitigate the risk of contaminant loss to surfacewaters. Braxton soils are found in the Waimatuku catchment. Shallow groundwater in the Waimatuku catchment is understood to discharge to the local stream network and can potentially contribute cumulatively to adverse effects on surfacewaters.

Risks to Drummond Peat Swamp and Bayswater Bog are described and effects are assessed in section 5.

Risks to groundwater from effluent discharge

Adverse effects on groundwater can occur from the discharge of agricultural effluent where contaminants present in effluent such as nutrients N (nitrate) and microbes (pathogens such as campylobacter) reach receiving groundwaters 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 camplyobacteriosis. Adverse effects on other users of groundwater such as other farms, small industries, schools or settlements/domestic users are possible and need to be avoided. Particularly, any risk from the discharge activity to the drinking water supply at Heddon Bush School 2.3 km south of the property needs to be avoided. *E.coli* is widely used as an indicator of faecal microbial contamination of water, including groundwater.

WW1&2 predominantly overlies the Waimatuku Groundwater Zone. The eastern part of WW1&2 overlies the Central Plains Groundwater Zone. The eastern part of the Horner Block overlies the Waimatuku Groundwater Zone and the western part overlies the Upper Aparima Groundwater Zone. Heddon Bush School also overlies the Waimatuku Groundwater Zone. Although Drummond and Glenlg soil types have risk of contaminant loss via deep drainage to underlying aquifers, they are low risk for effluent discharge due to their physical properties (and drainage properties), and due to the nature of the discharge activity (low depth and very low depth).

Braxton soil types have swell/crack characteristics that can allow contaminants in effluent to be washed down to the underlying groundwater resource via deep cracks that can form during prolonged dry summer conditions. Parts of the discharge area with Braxton soils types at both WW1&2 and the Horner Block are high risk for effluent discharge and require appropriate management of effluent discharge to mitigate the risk of contaminant loss to groundwater if and where deep cracks are formed. A site investigation by Environment Southland in January 2018 did not find evidence of deep cracks on Braxton type soils, however, leading to a conclusion Braxton soil types may not form deep cracks and are therefore less likely to provide a pathway for contaminants in effluent to reach groundwater.

Mitigation of adverse effects due to effluent discharge

Adverse effects, *including cumulative effects*, due to the discharge of agricultural effluent (liquid effluent and slurry) are either avoided, remedied or mitigated at WW1&2 and Horner Block through the implementation of good effluent management practice and mitigation measures. Contaminants present is effluent (N, P, microbes) are held in the root zone, adsorbed by plants or are filtered/adsorbed by soil particles. The below section refers to the mitigation of adverse effects due to effluent discharge at both WW1&2 and the Horner Block.

Due to its nature and scale, there will be little or no effect on receiving ground and surface waters *including cumulatively*, from the effluent discharge activity in this instance. The discharge system meets industry best practice standards for farm dairy effluent discharge by using buffer storage and low depth application. The use of best practice effluent application should avoid adverse effects on the environment. This principle is well documented in various scientific reports prepared for Environment Southland during the process of setting policies and rules around effluent discharge to land. A 2009 report[21] provides context and background to the principle that best practice effluent application should not cause adverse effects on water quality. The graph below is taken from the report to illustrate that nutrient loss from FDE application is minor if undertaken using best practice. In this example, less than 1% of nutrients applied in effluent reached drainage water on tile and mole drained soil. These soils are considered high risk relative to some of the soils available for effluent discharge at WW1&2 and Horner Block, that drain via matrix flow.

[21] Houlbrooke & Monaghan (2009). The influence of soil drainage characteristics on contaminant leakage risk associated with the land application of farm dairy effluent. Report prepared for Environment Southland.

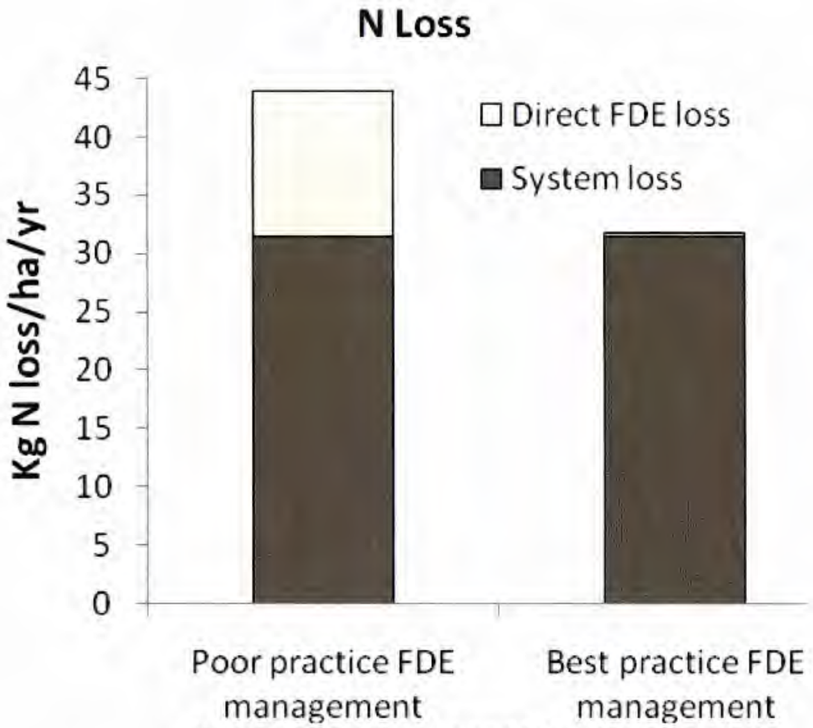

Figure 7.1. Houlbrooke and Monaghan (2009)

The applicants intend to apply effluent in accordance with best practice at all times to avoid adverse or *cumulative effects* on the receiving environment. The authors explain that if effluent is applied to soil when a soil moisture deficit exists then the effluent preferentially remains in the soil's root zone as plant available water or is adsorbed onto soil particles. The soluble nutrients in the effluent can then be taken up by the plant and used in nutrient cycling. Microbes can be filtered and held by soil particles until they are no longer viable. The applicants use the closest Environment Southland soil moisture monitoring site, which is available on the ES website, to determine whether a suitable soil moisture deficit exists for each of the irrigation systems. Effluent application, including both liquid effluent and slurry, is deferred if soil moisture levels are too high to safely and correctly apply effluent. Effluent is only applied when there is a ground moisture deficit and when effluent application will not induce drainage.

Deferred irrigation

The dairy platform currently has a total storage capacity of 8,032 m^3 in two effluent storage ponds, which provides for deferred irrigation for effluent from the dairy sheds, wintering barns and silage leachate according to the Massey Dairy Effluent Storage Calculator. 6,460 m^3 is the 90% probability volume according to the Massey DESC. The ability to defer irrigation during marginal times means that effluent will only be applied when a soil moisture deficit occurs. By deferring irrigation when ground conditions are unsuitable, losses to drainage water should be considerably less than the 1.1% of the total nutrients applied in the effluent experienced in the above-mentioned trial. When soils are near or at field capacity and there is risk of contaminant loss via artificial drainage (or overland flow when soils are saturated) to receiving surfacewaters, or risk of contaminant loss via cracks in Braxton soil types to groundwater, irrigation is deferred by storing effluent in the two storage ponds. The risk of contaminant loss from effluent discharge via artificial drainage, overland flow or deep drainage is in this way mitigated.

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.

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[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).

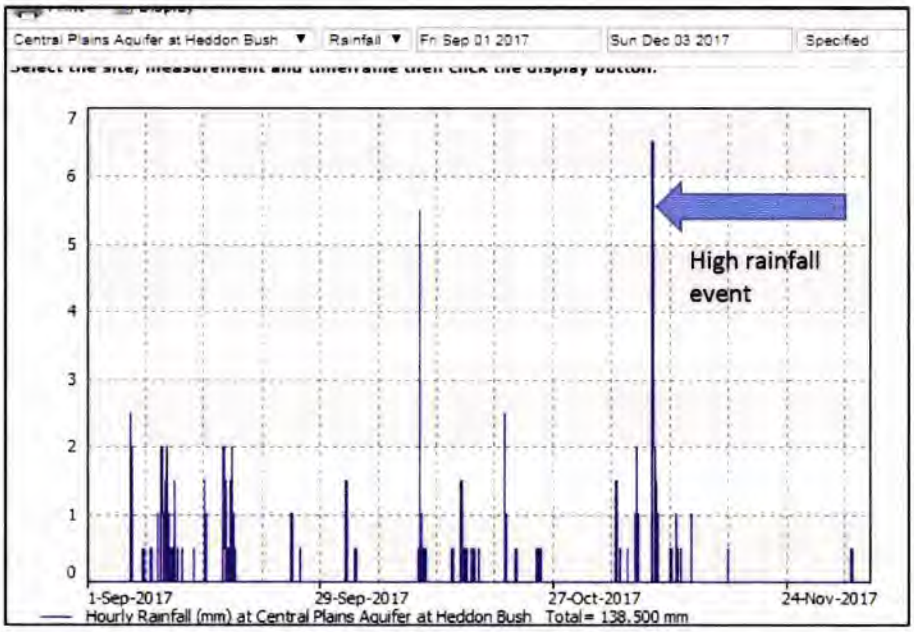

Figure 7.2. Rainfall at Central Plains Aquifer at Heddon Bush.

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.

[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

[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

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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

[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.

WW1&2 consent application 2019

Appendices

A

- Certificates of Incorporation
- Reports: Massey DESC
- Reports: Travelling irrigator application depths
- Report: WW2 pond drop test – 2017
- Report: WW1&2 – visual inspection of effluent storage and treatment structures
- Report: Compliance monitoring – 2018

B

- Report: Soil type assessment report at WW1&2 by Mr. J Scandrett – 2017
- Report: Investigation of cracking soils by Mr. M Killick – 2018
- Findings regarding soil cracking – Mr. J Scandrett – 2018
- Reports: Ravensdown fertility trends at WW1, WW2
- Report: Ravensdown agronomy plan and trends at the Horner Block

C

- Bore map and data
- Reports: Heddon Bush School bore – bacteriological water quality testing (ICC Water Testing Lab)
- Reports: Heddon Bush School bore – nitrate-N, *E. coli* water quality testing (Watercare)

D

- Wynn Williams Legal Opinion & Addendum – 2018

E

- Fonterra data - N loss for farms within a 20 km radius of WW1&2
- Fonterra data - cow number by month within a 20 km radius of WW1&2
- Report: Drummond Swamp by Mr. B Rance - 2008

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide 1&2 dairy farm

WW1 Unit

Farm Environmental Management Plan – Appendix N

Version 1.3

1 June 2019 – 31 May 2020

Table of Contents

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1 Property Details

Entity Name	Woldwide One Limited (WW1)
Physical address	Hundred Line Road East, Heddon Bush, Southland
Description of landholding ownership	Woldwide One Limited owns the land at the WW1 dairy platform. It is owned by Woldwide Trust (98%), (1%) A de WW1de, (1%) JJ e WW1de; Woldwide Farming 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:	Jacques Jooste - 027-4554550
Legal Description:	Lot 4 DP 399915 Parts Lot 18 DP 942 Lot 1 DP 10885 Part Lot 1 DP 4092 Section 420 Taringatura Survey District Horner Block - Lot 4 DP 399915
Land Area:	Milking platform – 240 hectares (effective) Horner block 97 ha – slurry discharge only
Resource Consents:	Existing discharge consent **301663** – expiry date 9/11/27 Existing water permit **301664** – expiry date 9/11/27 *Note: the consent holder in future consents will be "Woldwide One Limited and Woldwide Two Limited."*

This document is designed to be a living document.

The plan should be updated at least yearly – at the end of the season is advisable.

2 Maps

2.1 Accompanying notes to maps

- The dairy platform lies north of Hundred Line Road East Road.
- The Horner Block, which receives slurry effluent from the dairy platform, lies to the south west of the platform.
- The topography is flat and soils are well developed. There are minimal critical source areas. Two are indicated on figure 4 at the south of the dairy platform, close to where tiles have outfall to waterways.
- 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.
- The location, position and outfall of subsurface drainage is indicated on figure 4. The relative depth of subsurface drainage is drainage is c.800 mm.
- Infrastructure includes a dairy shed & yard, wintering barn and effluent storage pond.
- Culverts are identified on an aerial photo in the Appendix.

2.1 Boundaries

Figure 1: WW1 milking platform (outlined in purple), Horner Block (outlined in red)

2.2 Infrastructure

Figure 2a: WW1 – Location of dairy shed, storage and farm houses

Figure 3: Woldwide One – Effluent discharge areas (dairy platform - top and Horner Block - bottom)

2.3 Waterways, Stock Crossings and Critical Source Areas

Figure 4: WW1 and Horner Block – Waterways, tiles and critical source areas

Key	
Open Drain	(yellow line)
Tile Drain	(red line)
Critical Source Area	(blue line)

2.4 Physiographic Zones

The WW1 and the Horner Block overlie Oxidising and Central Plains Physiographic Zones as shown in figure 5.

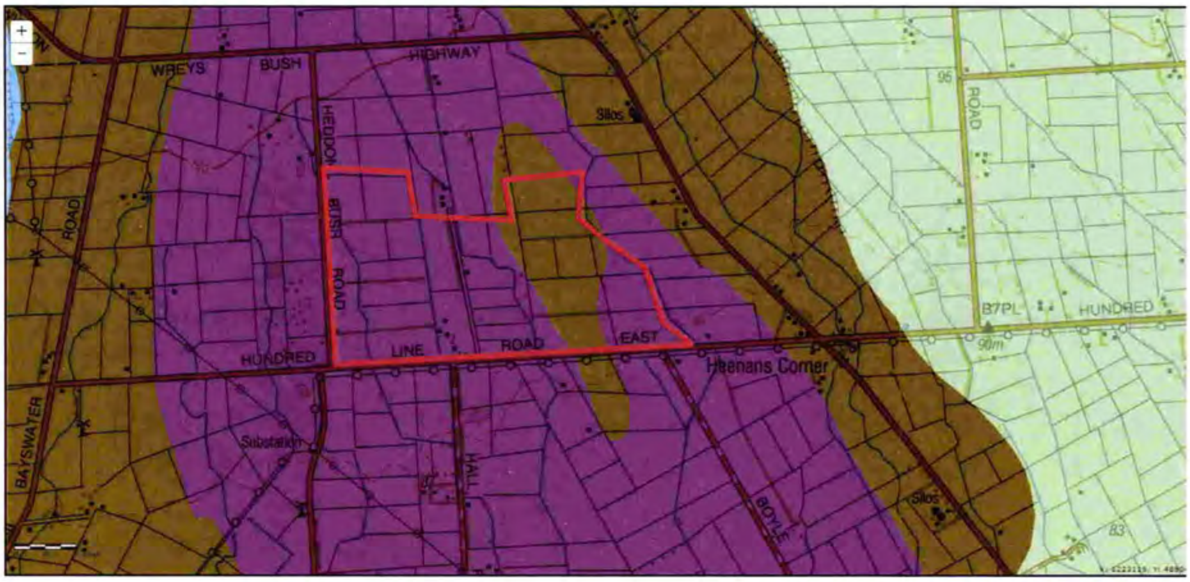


Figure 5: Map of physiographic zones at the WW1 and Horner block.

2.5 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. Riparian buffers are wide and have good grass cover.

2.6 Heritage

There are no known or recorded heritage sites on the property.

2.7 Significant Indigenous Biodiversity

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

2.8 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 6. Note that the map used in figure 6 was the farm map at the time that soil investigation was carried out by Mr. Scandrett.

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 7.

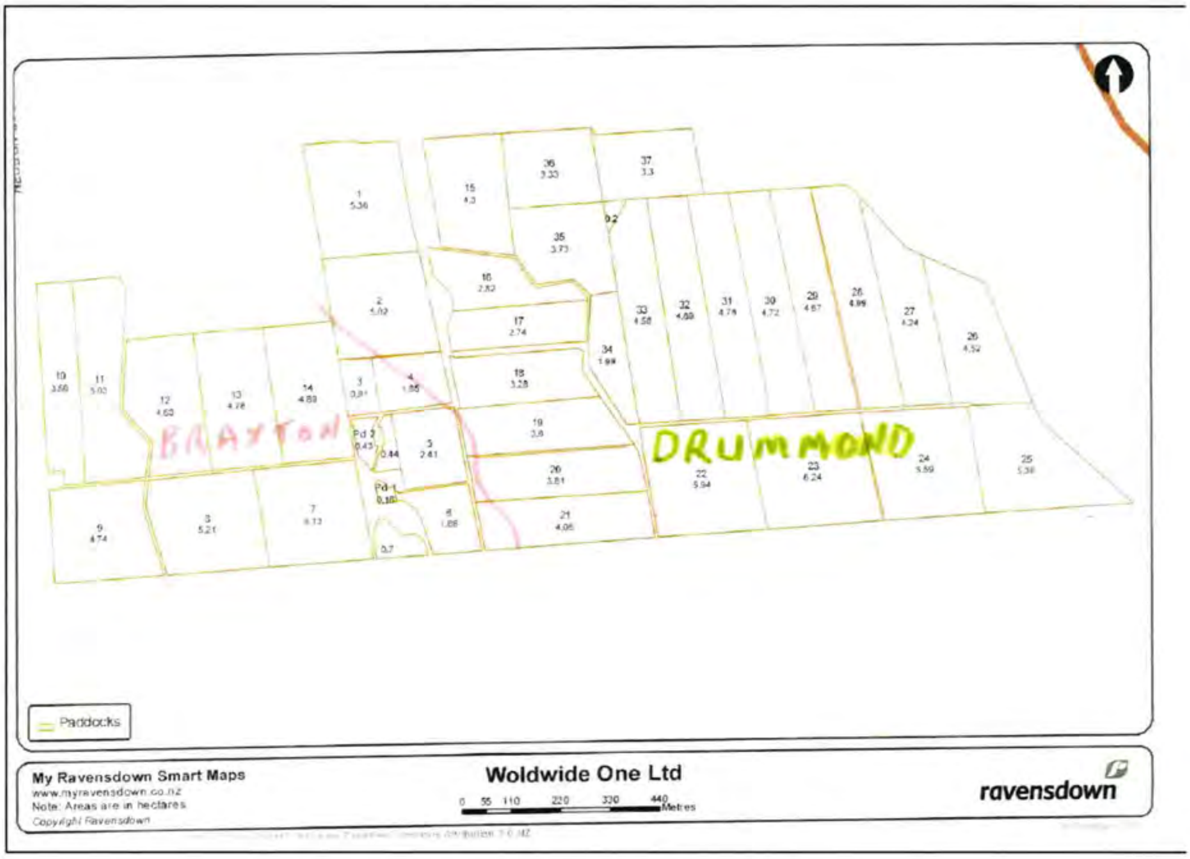


Figure 6: Map of soil types at the WW1.

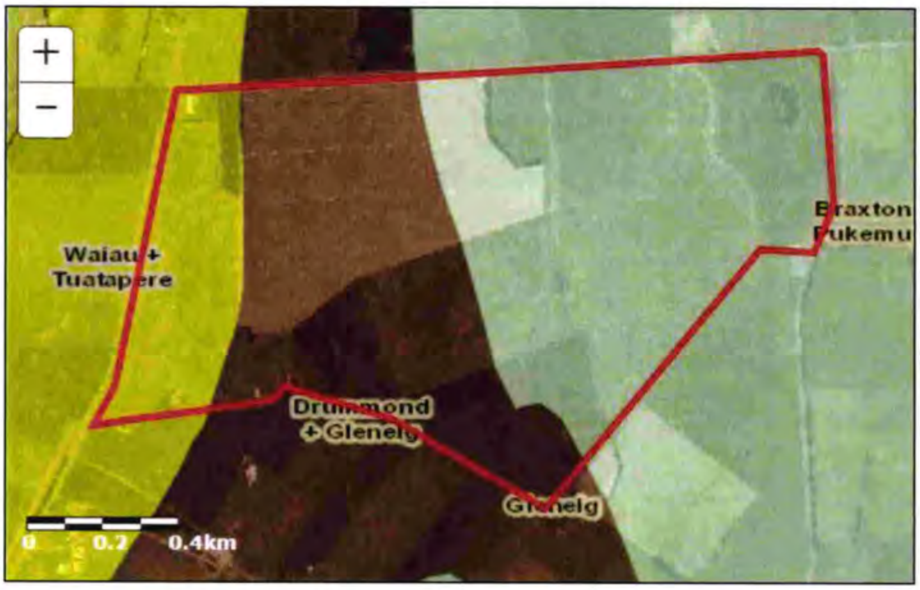


Figure 7: Map of soil types at the Horner Block

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

Table 1: Vulnerability of soils at the WW1dwide One and Horner block properties

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 soils at the WW1 are shown in Figures 6 and 7. 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.

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 6. 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 7. Braxton soil profile.

Plant Available Water (PAW)

The PAW in the top 30 cm of the soil profile values for the soils at WW1 have been obtained from the Landcare SMap database and are provided in Table 2.

Table 2: PAW values

Soil Type	PAW_{30}
Braxton	85 mm
Drummond	48 mm
Glenelg	53 mm
Waiau	50 mm

3.2 Environmental Management Actions Recommended

To mitigate the potential loss of nutrients the following actions will be adopted as far as practical:

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 initially be annually until an understanding and trends have been established. See Appendix for latest soil mapping based on soil tests;

ii. Fertiliser and lime management plan prepared annually with guidance from Overseer output reports. See Appendix for the latest Agronomy Plan;

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 to divert run off away from potential waterway ingress. Water tables will be designed to shed water to pasture for riparian treatment where practical;

vi. Effluent concentration measured and effluent application depth 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.

3.3 Fertiliser Application Best Management Practices

The following practices are recognised as being most desirable and will be followed as much as is practical.

i. The spreaders used to apply fertiliser are 'Spread Mark' accredited and ideally 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. Best practice is to have a 20 m buffer between fertiliser placement and waterways;

iv. Fertiliser is not applied to saturated soils;

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

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

vii. The need for large fertiliser dressings should be achieved through split dressings rather than a single application.

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 adopted as far as practical:

i. Test effluent nutrient concentrations 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. At all times the management of the effluent system will comply with the discharge consent conditions, including annual N loadings per hectare at WW1 dairy platform and the Horner Block;

iv. 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;

v. 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;

vi. Buffer distances as required in the discharge consent will be followed;

vii. 7 -10 days post grazing before effluent application;

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

ix. Apply maintenance rates of nutrient to as much of the farm as possible rather than load up a smaller area with all the effluent/nutrient;

x. 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.

3.5 Potential Nutrient Loss Effects of Dairying

See the appended Overseer® summary report and related Overseer® input parameter report. The nutrient budget was prepared in Overseer® Version 6.3.1 by Mr. Cain Duncan, Certified Nutrient Advisor, in accordance with the latest version of the OVERSEER Best Practice Data Input Standards (March 2018).

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.

The nutrient budget prepared for a dairy platform includes both the WW1 and WW2 dairy platforms and includes the wintering activity (i.e. 1,250 cows wintered in barns on site).

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

Table 3: Nutrient loss summary for both WW1 and WW2 dairy farms.

Indices	WW1 & WW2	Average NZ Dairy Farm
N/loss to water, kg N/ha/yr	40	24-42
N conversion efficiency, %	44 %	27-35

Indices	WW1 & WW2	Average NZ Dairy Farm
P loss to water, kg/ha/yr	0.7	0.5-1.6

3.6 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. There are approximately 300 hectares available for effluent and slurry at WW1 and Horner Block.

4 Good Management Practices

4.1 Land

Key strategies to achieve this objective:

i. Fence off all waterways;

ii. Maintain riparian vegetation;

iii. 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;

vi. Ensure adequate buffer zones from waterways during tillage;

vii. Maintain sustainable stocking rate; and

viii. Stock management to avoid excessive pugging, e.g. winter cows in barn, stand cows off pastures during inclement weather, especially 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. Subject to soil moisture and weather conditions, irrigate effluent at every practical opportunity to keep the storage pond as empty as possible;

iv. 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 handling system and the farm's drainage networks and the potential for Braxton soil types to develop cracks;

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

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

vii. 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;

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

ix. 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; and

x. Use monitoring bore data to inform on decisions regarding effluent and land management.

4.3 Physiographic Zones and Transport Pathways

The physiographic zones for the property are shown on a map in Figure 5. 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 for WW1.

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 at 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 <u>not</u> 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 over winter.

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 2019

Table 5. General good management practices (June 1 2018 – 31 May 2018).

Strategy Type	Summary of Management Practices
Capital	Fencing and enhancing riparian areas according to an agreed riparian enhancement plan where practical;
	Upgrading FDE handling equipment as new technology improves the utility and reduces risks of these systems.
	Upgrade/install culverts or bridges at stock crossings;
	Increase capacity of wintering barn facilities;

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 the silage pad is implemented;
	Restricted grazing of draining pastures in autumn/spring;
	Wintering barns are used as stand-off pads during inclement 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 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) have particular 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 low 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 is 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
Accumulation of surplus N in the soil, particularly during autumn and winter	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 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 where practical	
	Time N application to meet pasture demand using split applications	
	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 as soon as possible	
Protect soil structure, particularly in swales and near stream areas.	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 as soon as possible	
	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 or loss	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 appropriately. Fence off if required to prevent compaction and runoff.	

Mitigation	Good Management Practise	Key transport pathway
Avoid preferential flow of effluent through drains or soil cracks	Defer effluent application when soil moisture levels are high 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)	Artificial subsurface drainage Deep drainage
Manage CSAs; low areas overlying tiles close to outfalls at surface drains	Restrict grazing of pasture critical source areas when soils are near saturation 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)	Overland flow
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.

The nutrient budget analysis predicts an average annual N loss of 40 kg/hectare and an average annual P loss of 0.7 kg/hectare. Key drivers of controlling nutrient losses are regarded as key mitigation measures. These are as follows:

N loss – key changes/mitigations

i. Removal of summer and winter crop;
ii. Removal of cows & young stock wintered outside on crop (IWG);
iii. Expansion of size and use of wintering barn facilities;
iv. More efficient use of N fertiliser.

P loss – key mitigations

v. Decrease in winter crop area;

vi. Maintaining Olsen P at target level of 30;
vii. Expansion of size and use of wintering barn facilities.

Pending the granting of a consent for expansion of dairy farming, these key mitigation measures (i to vii inclusive) will be implemented in the 2019/2020 season. In the future any material change to the farming system will be modelling 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 are to be completed and any damaged sections or breakages/breaches are to be repaired immediately;

iii. Calves or other stock that are found in the riparian areas are to 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.

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 Area of Cultivation

For winter 2019, no areas of cultivation into fodder crops (brassica or beet) have been sown and no cropping is anticipated in the future.

Note: The move to grass to grass re-grassing is dependent on the farming system changing; 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 although there will be no IWG in June/July 2019.

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 - 10% of the farm's effective area will undergo cultivation into new grass each year. Where grass to grass re-grassing occurs, paddocks are sprayed off and direct drilled with grass seed or undergo full cultivation if necessary.

Forage brassica or beet crop – not anticipated 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 October/November;

Surplus grass is harvested as baleage when possible. 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 possible;

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

iv. Plough lines will be kept 3 metres back from the top of drain banks. This ensures at least a 3 m buffer along waterways.

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 off the milking platform (in wintering barns) during June and July, as well during May, August and September as required. No IWG of any fodder crop is WW1 is anticipated in the future, starting June 2019.

In the case of all grazing within the Environment Southland defined winter period, the following management will be employed. These procedures are also applicable to returning stock in early spring.

7.2 Pasture

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. The proposed stand-offs will reduce pugging damage through less time on pasture and more settled stock.

Back fencing

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

- If break fencing is to be used, the breaks, once eaten off, will be back fenced;
- Breaks should be sequenced to insure grazing is towards the watercourse; and
- If baleage is used, place baleage in the paddock before soil becomes too wet thereby preventing heavy vehicles from damaging the ground.

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 the fenced buffer zones along the water ways, but higher risk areas over tiles, drainage depressions (swales) or cracked soils will be temporarily fenced off and not grazed in the critical source areas. Temporary fencing is erected if a larger buffer is needed than provided by the permanent fence.

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 Collected Agricultural Effluent

8.1 Overview of the Proposed Effluent Collection, Storage and Irrigation System

Dairy Shed Effluent System

i. During adequate soil moisture conditions effluent is discharged from the dairy shed directly to the travelling irrigator;

ii. When soil moisture conditions do not allow for direct effluent discharge from the dairy shed, effluent from the dairy shed is pumped to the storage pond adjacent to the wintering barn;

iii. Effluent is stored in the pond until soil moisture conditions allow for irrigation to occur;

iv. Slurry effluent from the storage pond is discharged to land via slurry tanker at very low depth or by umbilical system; and

v. A rainwater diversion is used in the off season.

Wintering Barn Effluent System

i. Effluent flows by gravity or is scraped automatically 8 times per day to a concrete collection channel, from where it is pumped to the storage pond where it forms a slurry;

ii. Slurry effluent is stored in the pond until soil moisture conditions allow for irrigation to occur;

iii. Slurry effluent is pumped from the pond to the slurry tanker with a trailing shoe, for discharge to the land at very low depth; and

iv. A rainwater diversion is used in the off season.

8.2 Effluent System Volumes

Effluent Sources

i. Cowshed

ii. Rainwater captured on the yard area and milk vat stand area.

iii. The wintering barn will enable 625 cows to be wintered at WW1, with the effluent collected in the effluent storage pond adjacent to the wintering barn.

Effluent Volume

The total average effluent generated per day at the dairy shed should be approximately 35 m^3.

The total volume of effluent generated by wintering cows in the barn over some of May, all of June and July, some of August and some of September is 3,048 m^3.

Effluent Storage Volume

The existing storage pond has a pumpable volume of approximately 4,281 m^3. The Massey Dairy Effluent Storage Calculator 90% storage probability volume for is 3,257 metres cubed, so the pond has sufficient storage for 700 cows plus wintering barn effluent effluent.

8.3 Effluent Application Rate and Depth

The irrigator system's application rates, application depths and uniformities are to be checked annually in accordance with section 4: Land Application "A Farmer's Guide to Managing Farm Dairy Effluent – A Good Practice Guide for Land Application Systems" (2015).

Application Depth

Travelling irrigator:

The minimum application depth of the travelling irrigator is 8-9 mm per application, this is achieved when the travelling irrigator is set at an appropriate speed. When soil conditions allow a higher application depth can be obtained by reducing the speed of the travelling irrigator. The specified pump will deliver 16 – 18 m^3 per hour. The travelling irrigator system has a safety system, which automatically switches the system off in the event of an effluent system failure, such as irrigator stoppage or breakdown.

Slurry tanker with a trailing shoe:

The slurry tanker's application depth is set by tractor speed. It has an on-board GPS system, allowing the area and travel speed to be monitored. At a travel speed of 8-9 km/hour, the application depth is 2 mm. By speeding up the tractor speed, the application depth is lowered further. The application depth for the slurry tanker will not exceed 2.5 mm per application.

Umbilical system

The umbilical system may be used as a contingency irrigation method. The umbilical system will apply effluent at a maximum depth of application of 3 mm for each individual application. Its application depth can be lowered by speeding up travel speed.

Dairy shed effluent

Where the composition of the effluent is not known, use the following conservative figures as a guide.

1 mm of irrigated dairy shed effluent depth equals:

2.5 kg per hectare of N

3.0 kg per hectare of K

0.3 kg per hectare of P

So if 10 mm depth of effluent is irrigated over 1 ha, the nutrient application will be:

25.0 kg per hectare of N, 30.0 kg per hectare of K and 3.0 kg per hectare of P

Note: Due potential to animal health issues, it is advised that not more than half the annual potassium requirement be applied per application of effluent i.e. the annual requirement of potassium (is 60 - 80 kg per hectare per annum).

Wintering barn effluent

The nutrient concentration of wintering barn effluent is much higher due to lack of dilution. The slurry effluent in the ponds is predominantly composed of wintering barn effluent, with minor dilution from rain falling on the pond and dairy shed effluent, which is diverted to the ponds when ground conditions are unsuitable for irrigation.

The nutrient content of pond effluent (slurry) has been tested as part of a 2011 AgResearch study "Characterising dairy manures and slurries – Case study 15." The nutrient content of slurry at the applicant's pond was measured at:

N	3,200 g/m^3
P	800 g/m^3
K	4,400 g/m^3
S	400 g/m^3

Applying 15.2 m^3/hectare applies slurry effluent at a depth of 1.5 mm. Discharging slurry effluent at 15.2 m^3/hectare applies:

N	49 kg
P	12 kg
K	67 kg
S	6 kg

8.4 Effluent Irrigation Records

As each paddock is irrigated the daily pumping time will be recorded. This will also provide an annual record of the total depth of effluent applied.

Application Log book

As each paddock is irrigated the irrigator placement location and date is recorded in a farm diary and on a map. These provide an annual record of when and where effluent and slurry have been applied.

The following good management practice measures are consistently used:

- The travelling irrigator system is always operated at high speed system. This results in an application depth of 8-9 mm per application;
- The slurry tanker with the trailing shoe is operated with the aid on an on-board GPS system. The volume of effluent applied per hectare is controlled. This ensures a low application depth is achieved (< 2.5 mm).
- A visual assessment of uniformity and intensity of effluent application is carried out daily to ensure each system is operating properly;
- Care is taken to monitor drainage to ensure there are no adverse effects from effluent application;
- Irrigation records can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

Records can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

Maintenance Log Book

Exercise book with a page for each of the following recording the relevant date, time, person responsible and action taken.

i. Pond levels

ii. Pump servicing and maintenance

iii. Fail safe/controller maintenance

8.5 Effluent irrigation decisions

Drainage monitoring and crack formation monitoring is carried out on an ongoing basis, which helps to inform decision making on effluent discharge.

The following effluent decisions are made on farm prior to the discharge of effluent:

Slurry

- Check Heddon Bush soil moisture site to determine if the current soil moisture is suitable for irrigation;
- Ensure ground is dry enough (cannot use tractor with slurry tanker and trailing shoe machine if ground conditions are unsuitable as the slurry tanker weighs over 50 T when full of slurry);
- Check for any cracks in the discharge area – if any cracks present do not discharge slurry where the cracks are, either move to an area with no cracks or do not discharge;
- Check wind direction to ensure the wind direction is not towards neighbouring houses;
- Use GPS system to control the volume applied per hectare. Increase speed of tractor if a smaller application depth is required.

Dairy shed effluent

- Check Heddon Bush soil moisture site to determine if the current soil moisture is suitable for irrigation;
- Check for any cracks in the discharge area – if any cracks present do not discharge slurry where the cracks are, either move to an area with no cracks or do not discharge;
- Check wind direction to ensure the wind direction is towards neighbouring houses;
- Ensure travelling irrigator is operating on a high speed setting, which will apply effluent to a depth less than the soil moisture deficit.

8.6 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:

- Keeping a higher pasture cover;
- Discharging effluent little and often to ensure the soil moisture is kept as high as possible, preventing the soil from drying out and cracking.

Before each effluent application 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.

9 Effluent System Management

9.1 Person in Charge

The person in charge of the effluent management system will be the farm manager; Jacques Jooste.

9.2 Effluent System training

Training

All new staff will be trained in the operation of the effluent system as and when employed. Details are to be recorded in the staff training log.

Resources – Shed Operations Manual.

i. Effluent system operational guidelines - also displayed in the pump house;

ii. Irrigation map marked up with drainage outfalls, irrigation areas etc; and

iii. Copies of Environment Southland consents.

9.3 Effluent Minimisation

There are management practices and operational methodologies that can be used to minimise effluent voided on lanes, tracks and hardstands and around gateways. These include:

i. Allowing the herd to walk in rather than be driven;

ii. Splitting the herd into small herds for faster movement;

iii. Not using tracks and lanes as standoffs;

iv. Do not supplement feed cows on or along the edges of lanes;

v. Wet the yard before the cows arrive;

vi. Minimisation of freshwater shed water use in yard hose down; and

vii. Ensure there are no excessive volumes lost through the D gate platform washer.

9.4 Effluent Pumping

The specified travelling irrigator pump will deliver 16 – 18 m^3/hr approximately depending on the distance of the irrigator from there pump and the height above the pump (i.e. static head).

9.5 Discharge Area

The proposed effluent discharge area is shown in figure 1, less buffers from dwellings, bores, waterways and boundaries. The maximum area is approximately 297 hectares less buffers.

9.6 Paddock Selection

Paddocks will be selected according to their moisture status and grazing management history. A sequence of paddocks can be pre-planned for effluent irrigation. As each area is grazed and then spelled for the required period it can then be irrigated.

Prior to irrigation occurring a visual assessment of the soil will be made along with data from Environment Southland's soils moisture irrigation site at www.es.govt.nz. If paddocks are pugged or are likely to have very low infiltration rates the effluent irrigation depth will be reduced or the paddock rescheduled for irrigation after the soil conditions have improved.

The critical factor is that paddocks should not be irrigated with effluent when, or where, irrigation will result in the soils reaching field capacity. Field capacity is the point at which drainage starts either by passing down through the soil profile or flowing over the surface (overland flow).

Effluent irrigation is to be avoided when the soil temperature is less than 5º C.

The following will be marked up on the dairy shed map. These will be updated each year as crop/re-grassing rotations, drainage, fencing changes etc. affect the relative risks.

High and low risk

At least 50 hectares is considered to be in the low risk soil category for dairy effluent discharge with the remaining area considered to be in the high-risk soil category for dairy effluent discharge. The low risk area is found at the east.

There are low risk soils at the Horner support block also. These are found at the mid-west of the block.

Therefore the discharge of dairy effluent needs to be carefully managed with differed irrigation used when necessary.

Tile lines

These, where known, are marked on Figure 4, and irrigation should not be carried out directly over them if there is any risk of irrigation creating drainage.

Wind

Consideration needs to be given when high winds are predicted for example in the equinox seasons to ensure that spray drift does not end up in unintended places such as within minimum distances from waterways or outside the farm boundary.

9.7 Coverage Area

There shall not be any discharge of dairy shed effluent onto land within:

i. 20 metres of any surface watercourse;

ii. 100 metres of any potable water abstraction point;

iii. 20 metres of any property boundary, (unless the adjoining landowner's consent is obtained to do otherwise);

iv. 200 metres of any residential dwelling other than residential dwellings on the property;

v. Effluent shall not be discharged onto any land area that has been grazed within the previous 7 – 10 days; and

vi. Effluent shall not be discharged over tiles/mole drains where the soil is at or near field capacity.

9.8 Effluent Irrigation - Conditions

Field Moisture Conditions

Paddocks to which effluent is to be applied should be visually inspected, prior to irrigation to gain an understanding of an any high traffic areas to be avoided, location of water troughs, tiles, drains etc.

Near Field Capacity

When soils are near field capacity, the depth of application is to be limited to less than the soil moisture deficit. During operation of the system the irrigated area will be checked to ensure there is no ponding. If necessary, irrigation is to be deferred to the storage pond. The slurry tanker can achieve very low application depths, so can be used when soils are closer to field capacity.

Drier Ground

As the soil moisture deficit increases, the speed of the travelling irrigator can be reduced to increase the application depth of effluent.

9.9 Drainage Monitoring

Map

i. There will be a map in the cowshed that shows all known tile lines on the property along with their outfalls (and any open inlets);

ii. This is to be updated as the tile network is expanded or unknown installations are located; and

iii. It is to be updated when paddocks are re-moled.

Tile End Marks

i. All tile outfalls are marked on the watercourse banks with a yellow painted stake; and

ii. Each has a unique identifier.

Monitoring

i. Tile outfalls should be regularly monitored when effluent irrigation is occurring in their vicinity or when it is possible that there may be moles that run to the tiles when ground moisture conditions plus the proposed irrigation volumes are approaching field capacity; and

ii. If there is any discolouration of drainage water irrigation should stop immediately;

iii. Data from a proposed monitoring bore should be used to inform on effluent related decision making.

9.10 Solids' Removal

Timing

i. De-sludging the storage pond is best done when there are paddocks to be cultivated or lea awaiting cultivation; and

ii. Emptying will only be done when ground conditions are suitable.

Discharge of solids

Solids can either be spread thinly, less than 10 mm thick on short pasture or on crop ground where they can be worked in.

9.11 Off Season Water Diversion

All the sources of effluent are fitted with "not in use" clean water/rainwater diversion systems. These are separate from the roof water systems. The areas from which the rainwater is to be diverted should be well washed with clean water and inspected for any effluent residues prior to the diversion being enacted. The location of these diversion points is on the dairy shed plan in the shed office.

10. Monitoring, Maintenance and Operating Procedures

10.1 Daily

i. Minimise water use at the cow shed;

ii. Check the storage and irrigation system for operating faults during and following use;

iii. Evaluate the soil moisture situation and calculate the optimum settings for the next effluent application;

iv. Check and record in the log any tile outfalls draining from the irrigation area after effluent irrigation;

v. Update the effluent irrigation log with settings, location, depth and method of application;

vi. Check lane/track edge cutouts to ensure they are not blocked and there is no risk of large single point discharges. (especially after heavy rainfall events); and

vii. Check the trough in the paddock the cows are leaving to ensure it has not been leaking due to animal activity.

10.2 Weekly

Storage Facilities

i. Check inlet and outlet pipes are clear of blockages;

ii. Check and clean grates and sumps in dairy shed and yard as required; and

iii. Check galleries/floor drainage around storage structures.

Effluent Pump, Motor and Controls

i. Check pump and motor, grease if required;

ii. Check mechanical switch gear is operating efficiently;

iii. Note and follow up any unusual noises when the pump is operating;

iv. Check anti siphon devices for blockages; and

v. Note operating pressure during irrigation and confirm it is in the 'normal' range.

Pipelines

i. Check for leaks and blockages in pipes and joiners; and

ii. Check for hydrant leaks.

Safety

i. Check guards and fittings;

ii. Signage; and

iii. Equipment.

10.3 Annual Maintenance

i. Check pumps and motors and have them serviced by a qualified technician;

ii. Service slurry tanker system as required;

iii. Assess condition of pipeline, repair and replace parts as necessary;

iv. Update irrigation maps for new fences, tiling, moling etc;

v. Training of new staff in system operation; and

vi. Refresher and training of all staff on the property in the, purpose and use of safety equipment and fittings.

10.4 End of Season

i. Ensure the storage pond is pumped down as far as is practical;

ii. Turn on rainwater diversion for dairy shed;

iii. Drain pumps and/or set frost lamps;

iv. Check pumps and pipes for wear and tear and perform any maintenance required; and

v. Check the lining of the pond is still intact i.e. not damaged.

10.5 Beginning of Season

i. Turn off rainwater diversion; and

ii. Prime pumps and check their operation.

10.6 Breakdowns

i. In the event of power failure, pump or motor breakdown:

- Contact repairer immediately to assess problem;
- Limit or cease water use in the dairy yard and scrape effluent where possible; and
- Complete repairs or install the back-up pump before the next milking, depending on the storage available. Where necessary arrange for a backup petrol, diesel or PTO driven pump.

ii. In the event of pipe blockages:

- For underground pipes: Clear if possible or if too difficult, contact blocked drain repairer to water blast;
- For drag hoses: open camlock joiners to locate and clear blocks in pipe sections; and
- If not able to clear blockages, replace the blocked section.

10.7 General:

i. Under no circumstances are storage facilities to be allowed to overflow;

ii. There shall be no ponding of effluent in the discharge area;

iii. Make full use of the discharge area;

iv. There shall be no discharge of effluent to frozen or snow covered ground;

v. The discharge will be managed to ensure aerosols, spray drift and odour do not travel past the property boundary; and

vi. The general state of WW1 is to be monitored, particularly areas where environmental contamination with effluent could be a problem. This includes races, silage storage and feeding areas. Preventative action should be taken before problems arise.

11 Other Environmental Issues

11.1 Lanes and Races

Run-off from races can in some situations constitute an illegal discharge to land. These can 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. 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
v. 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 divot/cutouts not being restored. All lane edges and culverts should be checked after lane maintenance.

11.2 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.

11.3 Animal Pests

i. Rabbits, hares, possums – regular culls using night shooting, poisoning etc.
ii. Magpies – trap, shoot etc.

12 Emergency Response

12.1 Storage Overflow

Where the storage pond is approaching full and rain events plus continued use could risk overflow, it is recommended that very low application depth effluent irrigation be carried out on the driest part of the farm available. Spreading slurry effluent very thinly (< 2 mm depth) over a larger area over a period is preferable to a point source discharge from the pond. The umbilical system can be contracted to achieve this.

12.2 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.

12.3 Drainage

Overland Flow

See Ponding Section 12.2.

Discharge Ex-Tile

See Effluent in Open Drains Section 12.3.3

Effluent in Open Drains

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

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

iii. If possible pump out and disburse with the vacuum tanker.

12.4 General Procedures

i. Follow consent conditions/notes, mitigate where possible;

ii. Advise Regional Council where the consent requires this;

iii. Seek help; and

iv. Advise authorities.

12.5 Emergency Contacts

Manager – Mr. Jaques Jooste

Environment Southland – 0800 768 845 or 03 2115115

13 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. Cultivation Areas

v. Intensive Winter Grazing, if applicable

vi. 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.

vii. Emergency Contacts

Version	Date	Reviewed	Distribution List
1.0	22 August 2017	JS	A & JJ de WW1de
1.2	15 July 2018	Nessa Legg, Dairy Green Limited	A & JJ de WW1de
1.3	25 Feb 2019	Nessa Legg, Dairy Green Limited	A & JJ de WW1de
2.			
3.			

Appendix

WW1&2 FEMP

Appendix

Culverts - south part of dairy platform

Culverts - north part of dairy platform.

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide 1&2 dairy farm

WW2 Unit

Farm Environmental Management Plan – Appendix N

Version 1.3

1 June 2019 – 31 May 2020

Table of Contents

1 Property Details

Entity Name:	Woldwide Two Limited (WW2)
Physical Address	State Highway 99, Winton
Description of landholding ownership	Woldwide Two Limited owns the land at the WTL dairy platform. It is owned by Woldwide Trust (98%), (1%) A de Wolde, (1%) JJ e Wolde; Woldwide Farming 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:	Hamish (Dusty) Wright: 021-440006
Legal Description:	Lot 1 DP 14660, Lot 1 DP 9925, Lot 1 DP 10885, Pt Lots 1 and 2 DP 4092, Pt Lot 18 DP 942, Lots 1 and 3 DP 5610, Pt Section 417 Taringatura SD, Section 418 Taringatura SD, Section 419 Taringatura SD, Lot 1 DP 14661, Lot 1 DP 451158, Lot 1 DP 13077 Horner Block - Lot 4 DP399915
Land Area:	Milking platform – 240 hectares (effective) Horner block - 97 hectares – slurry discharge only
Resource Consents:	Existing discharge consent (20171278-01) Existing water permit (20171278-02) Existing 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."*

This document is designed to be a living document.

The plan should be updated at least yearly – at the end of the season is advisable.

2 Maps

2.1 Accompanying notes to maps

- The WW2 dairy platform lies north and south of Wrey's Bush Highway and is connected via an underpass.
- The Horner Block, which receives effluent from WW2, lies to the south west of Hundred Line Road East.
- Topography is flat and soils are well developed. There are minimal critical source areas at the property. One is indicated on figure 4a at the north of the dairy platform.
- Waterways are best described as surface drains, are fully fenced off 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.
- The location, position and outfall of subsurface drainage is indicated on figure 4. The relative depth of subsurface drainage is drainage is c.800 mm.
- Infrastructure includes a dairy shed, wintering barn, effluent storage pond, silage pad and underpass.
- Culverts at WW2 are identified on aerial photos in the Appendix.

2.1 Boundaries

Figure 1a. Boundary of dairy platform at WW2

Figure 1b: Horner block property boundary (outlined in red)

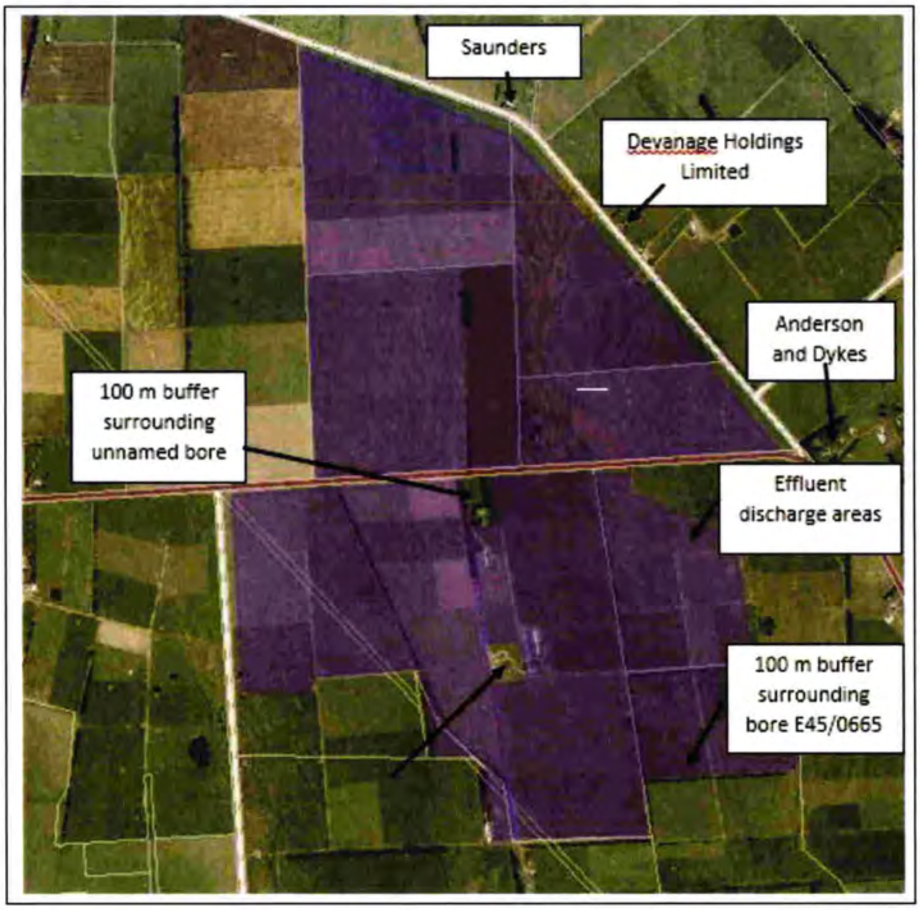


Figure 2a. Effluent discharge area at WW2 and neighbours.

Figure 2b. Effluent discharge area at Horner Block.

2.3 Infrastructure

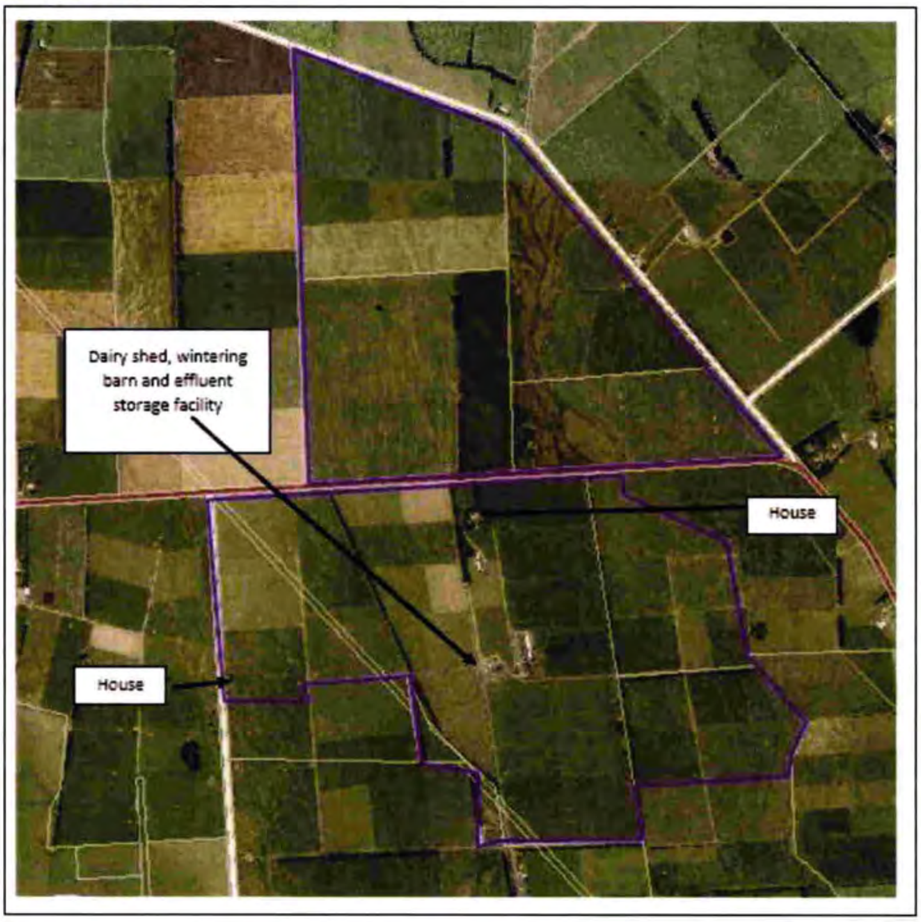


Figure 3. Infrastructure at WW2.

2.4 Surface waterways, crossings and critical source areas

Figure 4a. Surfacewaterways, tiles and CSAs at WW2.

Figure 4b. Surfacewaterways, tiles and CSAs at the Horner Block.

Key	
Open Drain	
Tile Drain	
Critical Source Area	

2.5 Physiographic zones

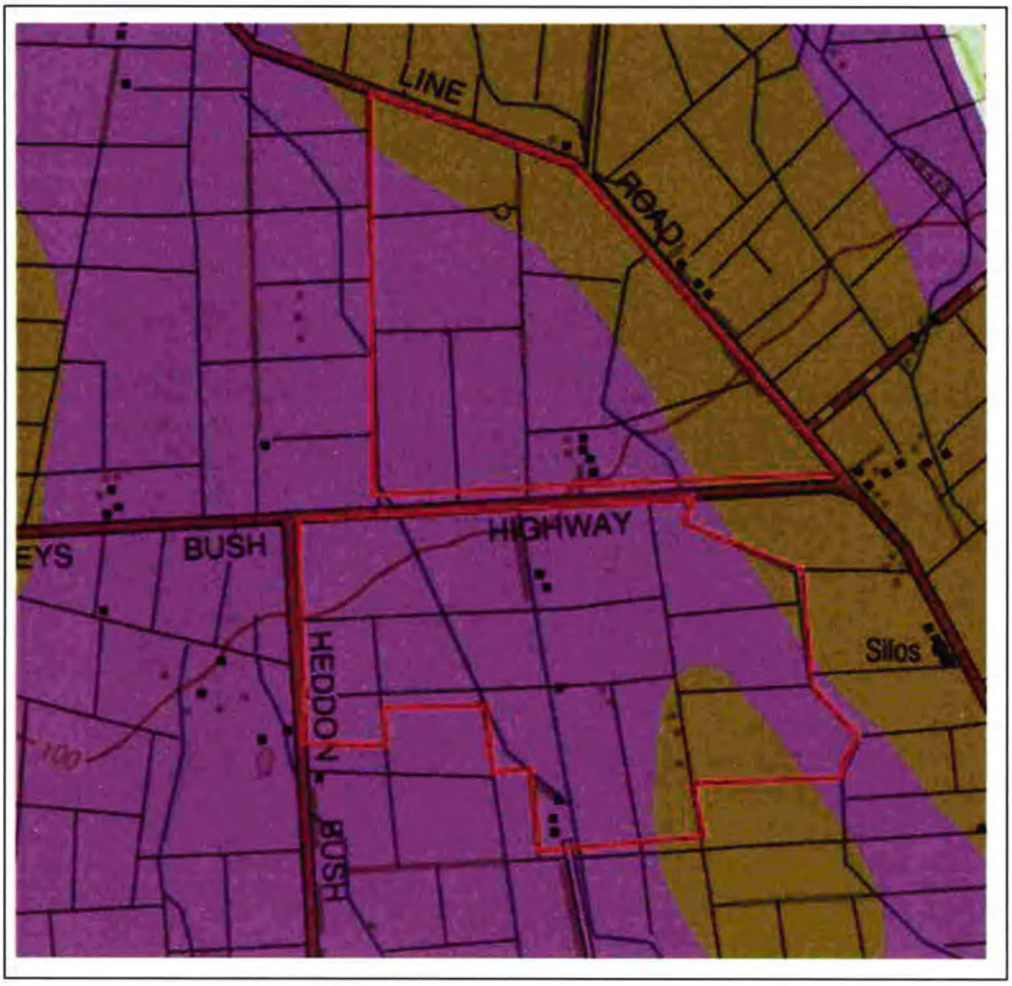


Figure 5a. Physiographic zones at WW2.

Figure 5b. Physiographic zones at Horner Block.

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 Riparian Vegetation and Fencing

Waterways flow in a north to south/south east direction. All streams and drains are fenced off to ensure cows cannot enter the waterways. Riparian buffer are wide and have good grass cover.

2.7 Heritage

There are no known or recorded heritage sites on the property.

2.8 Significant Indigenous Biodiversity

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

2.9 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 boundaries as shown in figures 6a and 6b. Note that the map used in figure 6 was the farm map at the time that soil investigation was carried out by Mr. Scandrett. The soils for the Horner block have been obtained from the Topoclimate layer in Environment Southland's Beacon mapping service.

As is shown in figure 7, the Horner block is overlying by Braxton soils, with intergrades of Pukemutu soils in places; Drummond soils with intergrades of Glenelg soils in places, and Waiau soils with intergrades of Tuatapere soils in places.

Figure 6a. Soils at WW2 (south of Wrey's Bush Highway)

Figure 6b. Soils at WW2 (north of Wrey's Bush Highway)

Figure 6c. Soils at Horner Block.

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

Table 1: Vulnerability of soils at the WW2 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

Profiles of dominant soils are shown in figures 6, 7 and 8. The dominant soil types are Braxton (found in a small area at the south west of WW2 and at the east of Horner Block), Drummond types (mid to east at WW2 and mid-west the Horner Block) and Glenelg soils at the north east WW2. Drummond soils may have intergrades to Glenelg soils in places.

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 6. 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.

Figure 7. 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 8. 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.

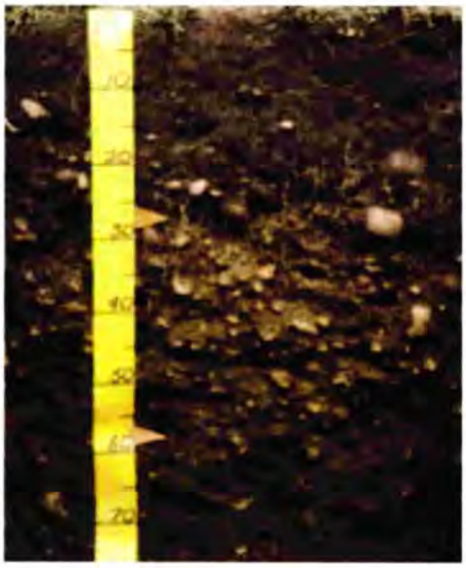


Figure 9. Waiau soil profile.

Plant Available Water (PAW)

The PAW in the top 30 cm of the soil profile values for the soils at the property 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 Recommended

To mitigate the potential loss of nutrients the following actions will be adopted as far as practical:

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 initially be annually until an understanding and trends have been established. See Appendix for latest soil mapping based on soil tests;

ii. Fertiliser and lime management plan prepared annually with guidance from Overseer output reports. See Appendix for the latest Agronomy Plan;

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 until cracks disappear;

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

vi. Effluent concentration measured and effluent application depth 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.

3.3 Fertiliser Application Best Management Practices

The following practices are recognised as being most desirable and will be followed as much as is practical.

i. The spreaders used to apply fertiliser are 'Spread Mark' accredited and ideally 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. Best practice is to have a 20 m buffer between fertiliser placement and waterways;

iv. Fertiliser is not applied to saturated soils;

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

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

vii. The need for large fertiliser dressings should be achieved through split dressings rather than a single application.

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 adopted as far as practical:

i. Test effluent nutrient concentrations 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. At all times the management of the effluent system will comply with the discharge consent conditions, including annual N loadings per hectare;

iv. 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;

v. Do not apply effluent to areas prone to cracking in dry summer periods. Braxton soils, with swell crack characteristics, are found in a small area at the south western-most part of WW2 and at the Horner Block;

vi. Buffer distances as required in the discharge consent will be followed;

vii. 7 -10 days post grazing before effluent application;

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

ix. Apply maintenance rates of nutrient to as much of the farm as possible rather than load up a smaller area with all the effluent/nutrient.

x. 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.

3.5 Potential Nutrient Loss Effects of Dairying

See the appended Overseer® summary report and related Overseer® input parameter report. The nutrient budget was prepared in Overseer® Version 6.3.1 by Mr. Cain Duncan, Certified Nutrient Advisor, in accordance with the latest version of the OVERSEER Best Practice Data Input Standards (March 2018).

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.

The nutrient budget has been prepared for a dairy farm including both the WW1 and WW2 dairy platforms and includes the wintering activity (i.e. 1,250 cows wintered in barns on site).

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

Table 3: Nutrient loss summary for WW1&2 dairy platform.

Indices	WW1&2	Average NZ Dairy Farm
N/loss to water, kg N/ha/yr	40	24-42
N conversion efficiency, %	44 %	27-35

Indices	WW1&2	Average NZ Dairy Farm
P loss to water, kg/ha/yr	0.7	0.5-1.6

3.6 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. The total effluent discharge area is up to approximately 240 hectares.

Account for the higher strength nature of slurry effluent when applying slurry. There are approximately 300 hectares available for effluent and slurry at WW2 and Horner Block.

4 Good Management Practices

4.1 Land

Key strategies to achieve this objective:

i. Fence off all waterways;

ii. Maintain riparian vegetation;

iii. 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;

vi. Ensure adequate buffer zones from waterways during tillage;

vii. Maintain sustainable stocking rate; and

viii. Stock management to avoid excessive pugging, e.g. winter cows in barn, stand cows off pastures during inclement weather, especially 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. Subject to soil moisture and weather conditions, irrigate effluent at every practical opportunity to keep the storage pond as empty as possible;

iv. 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 handling system and the farm's drainage networks and the potential for Braxton soil types to develop cracks;

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

vi. Record each application of slurry effluent, including paddock numbers and quantity applied. Apply a standard depth if possible;

vii. 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;

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

ix. 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; and

x. Use monitoring bore data to inform on decisions regarding effluent and land management.

4.3 Physiographic Zones and Transport Pathways

The physiographic zones are shown on a map in Figure 5. These zones have the potential for N and P to leach to waterways and groundwater through artificial drainage, deep drainage and overland flow 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 for WW2.

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

Note: Due to the flat topography at the property, overland flow is not deemed to be a particular risk for soils except close to waterways and at 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 over winter.

A policy of good practice will be undertaken on farm over the coming 12-month period (see table 5). All policies will be reviewed in June 2019.

Table 5. General good management practices (June 1 2018 – 31 May 2018).

Strategy Type	Summary of Management Practices
Capital	Fencing and enhancing riparian areas according to an agreed riparian enhancement plan where practical;
	Upgrading FDE handling equipment as new technology improves the utility and reduces risks of these systems.
	Upgrade/install culverts or bridges at stock crossings;
	Increase wintering barn facilities;
Operational	Utilising a nutrient management plan;

Strategy Type	Summary of Management Practices
	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 IWG 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 the silage pad and underpass is implemented;
	Restricted grazing of draining pastures in autumn/spring;
	Wintering barns are used as stand-off pads during inclement 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;
	Programmed maintenance is done in and around FDE, and piping infrastructure around the dairy shed, silage bunkers, cow yards etc.;

Strategy Type	Summary of Management Practices

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

WW2 and Horner Block are classed 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) have particular 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 low risk of contaminant loss to surface waters via overland flow. CSAs close to waterways are managed appropriately. Any risk of contaminant loss to surface waters from tracks and lanes via overland flow is 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
Avoid accumulation of surplus N in the soil, particularly during autumn and winter	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, accounting for the higher nutrient content of slurry compared to dairy shed effluent.	
	Wintering barn is also used to house cows during May, August and September as required, and as a stand-off pad during wet weather at other times	
	Cut and carry feed where practical	
	Time N application to meet pasture demand using split applications	

Mitigation	Good Management Practise	Key transport pathway
	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 as soon as possible	
Protect soil structure, particularly in swales and near stream areas.	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 as soon as possible	
	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 barn is used during wet periods to prevent pastures from pugging.	
Reduce phosphorus use or loss	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 appropriately.	
Avoid preferential flow of effluent through drains or soil cracks	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.	

Mitigation	Good Management Practise	Key transport pathway
	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	Restrict grazing crops and 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	
	Plant riparian 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.

The nutrient budget analysis predicts an average annual N loss of 40 kg/hectare and an average annual P loss of 0.7 kg/hectare. Key drivers of controlling nutrient losses are regarded as key mitigation measures. These are as follows:

N loss - key changes/mitigations

i. Removal of summer and winter crop;
ii. Removal of cows & young stock wintered outside on crop (IWG);
iii. Expansion of size and use of wintering barn facilities;
iv. More efficient use of N fertiliser.

P loss – key mitigations

v. Decrease in winter crop area;
vi. Maintaining Olsen P at target level of 30;
vii. Expansion of size and use of wintering barn facilities.

Pending the granting of a consent for expansion of dairy farming, these key mitigation measures (i to vii inclusive) will be implemented in the 2019/2020 season. In the future any material change to the farming system will be modelling 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 are to be completed and any damaged sections or breakages/breaches are to be repaired immediately;

iii. Calves or other stock that are found in the riparian areas are to 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.

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 Area of Cultivation

For winter 2019, no areas of cultivation into fodder crops (brassica or beet) have been sown and no cropping is anticipated in the future.

Note: The move to grass to grass re-grassing is dependent on the farming system changing; 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 although there will be no IWG in June/July 2019.

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 - 10% of the farm's effective area will undergo cultivation into new grass each year. Where grass to grass re-grassing occurs, paddocks are sprayed off and direct drilled with grass seed or undergo full cultivation if necessary.

Forage brassica or beet crop – not anticipated 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 October/November;

Surplus grass is harvested as baleage when possible. 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 possible;

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

iv. Plough lines will be kept 3 metres back from the top of drain banks. This ensures at least a 3 m buffer along waterways.

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 off the milking platform (in wintering barns) during June and July, as well during May, August and September as required. No IWG of any fodder crop is WW2 is anticipated in the future, starting June 2019.

In the case of all grazing within the Environment Southland defined winter period, the following management will be employed. These procedures are also applicable to returning stock in early spring.

7.2 Pasture

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. The proposed stand-offs will reduce pugging damage through less time on pasture and more settled stock.

Back fencing

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

- If break fencing is to be used, the breaks, once eaten off, will be back fenced;
- Breaks should be sequenced to insure that grazing is towards the watercourse; and
- If baleage is used, place baleage in the paddock before soil becomes too wet thereby preventing heavy vehicles from damaging the ground.

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 the fenced buffer zones along the water ways, but higher risk areas over tiles, drainage depressions (swales) or cracked soils will be temporarily fenced off and not grazed in the critical source areas.

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 Collected Agricultural Effluent

8.1 Overview of the Proposed Effluent Collection, Storage and Irrigation System

Dairy Shed Effluent System

i. During adequate soil moisture conditions the effluent will be discharged from the dairy shed directly to the travelling irrigator;

ii. When soil moisture conditions do not allow for direct effluent discharge from the dairy shed, the effluent from the dairy shed is pumped to the storage pond adjacent to the wintering barn;

iii. The effluent is stored in the pond until soil moisture conditions allow for irrigation to occur;

iv. The effluent from the storage pond is discharged to land via slurry tanker; and

v. A rainwater diversion is used in the off season.

Wintering Barn Effluent System

i. The effluent flows by gravity or is scraped to a concrete collection channel, from where it is pumped to the 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, for discharge to the land; and

iv. A rainwater diversion is used in the off season.

8.2 Effluent System Volumes

Effluent Sources

i. Cowshed

ii. Rainwater captured on the yard area and milk vat stand area.

iii. The wintering barn will enable 625 cows to be wintered, with effluent collected in the effluent storage pond adjacent to the wintering barn.

iv. Silage pad – total area is 1,200 m^2. Leachate drains to the effluent storage pond. Rainwater is diverted to farm drainage.

v. Underpass – has its own effluent system.

Effluent Volume

The total average effluent generated <u>per day</u> at the dairy shed should be approximately 40 m^3.

The total volume of effluent generated by wintering cows in the barn over some of May, all of June and July, some of August and some of September is 3,048 m^3.

Leachate from the silage pad has been allowed for in the Massey DESC.

Effluent Storage Volume

The existing storage pond has a pumpable volume of approximately 3,751 m^3. The Massey Dairy Effluent Storage Calculator 90% storage probability volume for is 3,203 metres cubed, so the pond has sufficient storage for 800 cows plus wintering barn effluent and silage pad effluent.

8.3 Effluent Application Rate and Depth

The irrigator system's application rates, application depths and uniformities are to be checked annually in accordance with section 4: Land Application "A Farmer's Guide to Managing Farm Dairy Effluent – A Good Practice Guide for Land Application Systems" (2015).

Application Depth

Travelling irrigator:

The minimum application depth of the travelling irrigator is 8-9 mm per application, this is achieved when the travelling irrigator is set at the fastest speed. When soil conditions allow a higher application depth can be obtained by reducing the speed of the travelling irrigator. The specified pump will deliver 16 – 18 m^3 per hour. The travelling irrigator system has a safety system, which automatically switches the system off in the event of an effluent system failure, such as irrigator stoppage or breakdown.

Slurry tanker with a trailing shoe

The slurry tanker's application depth is set by tractor speed. It has an on-board GPS system, allowing the area and travel speed to be monitored. At a travel speed of 8-9 km/hour, the application depth is 2 mm. By speeding up the tractor speed, the application depth is lowered further. The maximum depth will not exceed 2.5 mm/application.

Umbilical system

The umbilical system may be used as a contingency irrigation method. The umbilical system will apply effluent at a maximum depth of application of 3 mm for each individual application. Its application depth can be lowered by speeding up travel speed.

Dairy shed effluent

Where the composition of the effluent is not known, use the following conservative figures as a guide.

1 mm of irrigated dairy shed effluent depth equals:

2.5 kg per hectare of N

3.0 kg per hectare of K

0.3 kg per hectare of P

So if 10 mm depth of effluent is irrigated over 1 ha, the nutrient application will be:

25.0 kg per hectare of N, 30.0 kg per hectare of K and 3.0 kg per hectare of P

Note: Due potential to animal health issues, it is advised that not more than half the annual potassium requirement be applied per application of effluent i.e. the annual requirement of potassium (is 60 - 80 kg per hectare per annum).

Wintering barn effluent

The nutrient concentration of wintering barn effluent is much higher due to lack of dilution. The slurry effluent in the ponds is predominantly composed of wintering barn effluent, with minor dilution from rain falling on the pond and dairy shed effluent, which is diverted to the ponds when ground conditions are unsuitable for irrigation.

The nutrient content of pond effluent (slurry) has been tested as part of a 2011 AgResearch study "Characterising dairy manures and slurries – Case study 15." The nutrient content of slurry at the applicant's pond was measured at:

N	3,200 g/m^3
P	800 g/m^3
K	4,400 g/m^3
S	400 g/m^3

Applying 17.2 m^3/hectare applies slurry effluent at a depth of 1.7 mm. Discharging slurry effluent at 17.2 m^3/hectare applies:

N	49 kg
P	12 kg
K	67 kg
S	6 kg

8.4 Effluent Irrigation Records

As each paddock is irrigated the daily pumping time will be recorded. This will also provide an annual record of the total depth of effluent applied.

Application Log book

As each paddock is irrigated the irrigator placement location and date is recorded in a farm diary and on a map. These provide an annual record of when and where effluent and slurry has been applied.

The following good management practice measures are consistently used:

- The travelling irrigator system is always operated at high speed system. This results in an application depth of 8 – 9 mm per application;
- The slurry tanker with the trailing shoe is operated with the aid on an on-board GPS system. The volume of effluent applied per hectare is controlled. This ensures a low application depth is achieved (< 2.5 mm).
- A visual assessment of uniformity and intensity of effluent application is carried out daily to ensure each system is operating properly;
- Care is taken to monitor drainage to ensure there are no adverse effects from effluent application;
- Irrigation records can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

Records can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

Maintenance Log Book

Exercise book with a page for each of the following recording the relevant date, time, person responsible and action taken.

i. Pond levels

ii. Pump servicing and maintenance

iii. Fail safe/controller maintenance

8.5 Effluent irrigation decisions

Drainage monitoring and crack formation monitoring is carried out on an ongoing basis, which helps to inform decision making on effluent discharge.

The following effluent decisions are made on farm prior to the discharge of effluent:

Slurry

- Check Heddon Bush soil moisture site to determine if the current soil moisture is suitable for irrigation;
- Ensure ground is dry enough (cannot use tractor with slurry tanker and trailing shoe machine if ground conditions are unsuitable as the slurry tanker weighs over 50 T when full of slurry);
- Check for any cracks in the discharge area – if any cracks present do not discharge slurry where the cracks are, either move to an area with no cracks or do not discharge;
- Check wind direction to ensure the wind direction is not towards neighbouring houses;
- Use GPS system to control the volume applied per hectare. Increase speed of tractor if a smaller application depth is required.

Dairy shed effluent

- Check Heddon Bush soil moisture site to determine if the current soil moisture is suitable for irrigation;
- Check for any cracks in the discharge area – if any cracks present do not discharge slurry where the cracks are, either move to an area with no cracks or do not discharge;
- Check wind direction to ensure the wind direction is towards neighbouring houses;
- Ensure travelling irrigator is operating on a high speed setting, which will apply effluent to a depth less than the soil moisture deficit.

8.6 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:

- Keeping a higher pasture cover;
- Discharging effluent little and often to ensure the soil moisture is kept as high as possible, preventing the soil from drying out and cracking.

Before each effluent application 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.

9 Effluent System Management

9.1 Person in Charge

The person in charge of the effluent management system will be the farm manager; M Wright

9.2 Effluent System training

Training

All new staff will be trained in the operation of the effluent system as and when employed. Details are to be recorded in the staff training log.

Resources – Shed Operations Manual.

i. Effluent system operational guidelines - also displayed in the pump house;

ii. Irrigation map marked up with drainage outfalls, irrigation areas etc; and

iii. Copies of Environment Southland consents.

9.3 Effluent Minimisation

There are management practices and operational methodologies that can be used to minimise effluent voided on lanes, tracks and hardstands and around gateways. These include:

i. Allowing the herd to walk in rather than be driven;

ii. Splitting the herd into small herds for faster movement;

iii. Not using tracks and lanes as standoffs;

iv. Do not supplement feed cows on or along the edges of lanes;

v. Wet the yard before the cows arrive;

vi. Minimisation of freshwater shed water use in yard hose down; and

vii. Ensure there are no excessive volumes lost through the D gate platform washer.

9.4 Effluent Pumping

The specified travelling irrigator pump will deliver 16 – 18 m^3/hr approximately depending on the distance of the irrigator from there pump and the height above the pump (i.e. static head).

9.5 Discharge Area

The proposed effluent discharge area is shown in figure 1, less buffers from dwellings, bores, waterways and boundaries. The maximum area is approximately 297 hectares less buffers.

9.6 Paddock Selection

Paddocks will be selected according to their moisture status and grazing management history. A sequence of paddocks can be pre-planned for effluent irrigation. As each area is grazed and then spelled for the required period it can then be irrigated.

Prior to irrigation occurring a visual assessment of the soil will be made along with data from Environment Southland's soils moisture irrigation site at www.es.govt.nz. If paddocks are pugged or are likely to have very low infiltration rates the effluent irrigation depth will be reduced or the paddock rescheduled for irrigation after the soil conditions have improved.

The critical factor is that paddocks should not be irrigated with effluent when, or where, irrigation will result in the soils reaching field capacity. Field capacity is the point at which drainage starts either by passing down through the soil profile or flowing over the surface (overland flow).

Effluent irrigation is to be avoided when the soil temperature is less than 5º C.

The following will be marked up on the dairy shed map. These will be updated each year as crop/re-grassing rotations, drainage, fencing changes etc. affect the relative risks.

High and low risk

At least 50 hectares is considered to be in the low risk soil category for dairy effluent discharge with the remaining area considered to be in the high-risk soil category for dairy effluent discharge. The low risk area is found at the east.

There are low risk soils at the Horner support block also. These are found at the mid-west of the block.

Therefore the discharge of dairy effluent needs to be carefully managed with differed irrigation used when necessary.

Tile lines

These, where known, are marked on Figure 4, and irrigation should not be carried out directly over them if there is any risk of irrigation creating drainage.

Wind

Consideration needs to be given when high winds are predicted for example in the equinox seasons to ensure that spray drift does not end up in unintended places such as within minimum distances from waterways or outside the farm boundary.

9.7 Coverage Area

There shall not be any discharge of dairy shed effluent onto land within:

i. 20 metres of any surface watercourse;

ii. 100 metres of any potable water abstraction point;

iii. 20 metres of any boundary, (unless the adjoining landowner's consent is obtained to do otherwise);

iv. 200 metres of any residential dwelling other than residential dwellings on the property;

v. Effluent shall not be discharged onto any land area that has been grazed within the previous 7 – 10 days; and

vi. Effluent shall not be discharged over tiles/mole drains where the soil is at or near field capacity.

9.8 Effluent Irrigation - Conditions

Field Moisture Conditions

Paddocks to which effluent is to be applied should be visually inspected, prior to irrigation to gain an understanding of an any high traffic areas to be avoided, location of water troughs, tiles, drains etc.

Near Field Capacity

When soils are near field capacity, the depth of application is to be limited to less than the soil moisture deficit. During operation of the system the irrigated area will be checked to ensure there is no ponding. If necessary, irrigation is to be deferred to the storage pond. The slurry tanker can achieve very low application depths, so can be used when soils are closer to field capacity.

Drier Ground

As the soil moisture deficit increases, the speed of the travelling irrigator can be reduced to increase the application depth of effluent.

9.9 Drainage Monitoring

Map

i. There will be a map in the cowshed that shows all known tile lines on the property along with their outfalls (and any open inlets);

ii. This is to be updated as the tile network is expanded or unknown installations are located; and

iii. It is to be updated when paddocks are re-moled.

Tile End Marks

I. All tile outfalls are marked on the watercourse banks with a yellow painted stake; and

ii. Each has a unique identifier.

Monitoring

i. Tile outfalls should be regularly monitored when effluent irrigation is occurring in their vicinity or when it is possible that there may be moles that run to the tiles when ground moisture conditions plus the proposed irrigation volumes are approaching field capacity; and

ii. If there is any discolouration of drainage water irrigation should stop immediately.

9.10 Solids' Removal

Timing

i. De-sludging the storage pond is best done when there are paddocks to be cultivated or lea awaiting cultivation; and

ii. Emptying will only be done when ground conditions are suitable.

Discharge of solids

Solids can either be spread thinly, less than 10 mm thick on short pasture or on crop ground where they can be worked in.

9.11 Off Season Water Diversion

All the sources of effluent are fitted with "not in use" clean water/rainwater diversion systems. These are separate from the roof water systems. The areas from which the rainwater is to be diverted should be well washed with clean water and inspected for any effluent residues prior to the diversion being enacted. The location of these diversion points is on the dairy shed plan in the shed office.

10. Monitoring, Maintenance and Operating Procedures

10.1 Daily

i. Minimise water use at the cow shed;

ii. Check the storage and irrigation system for operating faults during and following use;

iii. Evaluate the soil moisture situation and calculate the optimum settings for the next effluent application;

iv. Check and record in the log any tile outfalls draining from the irrigation area after effluent irrigation;

v. Update the effluent irrigation log with settings, location, depth and method of application;

vi. Check lane/track edge cutouts to ensure they are not blocked and there is no risk of large single point discharges. (especially after heavy rainfall events); and

vii. Check the trough in the paddock the cows are leaving to ensure it has not been leaking due to animal activity.

10.2 Weekly

Storage Facilities

i. Check inlet and outlet pipes are clear of blockages;

ii. Check and clean grates and sumps in dairy shed and yard as required; and

iii. Check galleries/floor drainage around storage structures.

Effluent Pump, Motor and Controls

i. Check pump and motor, grease if required;

ii. Check mechanical switch gear is operating efficiently;

iii. Note and follow up any unusual noises when the pump is operating;

iv. Check anti siphon devices for blockages; and

v. Note operating pressure during irrigation and confirm it is in the 'normal' range.

Pipelines

i. Check for leaks and blockages in pipes and joiners; and

ii. Check for hydrant leaks.

Safety

i. Check guards and fittings;

ii. Signage; and

iii. Equipment.

10.3 Annual Maintenance

i. Check pumps and motors and have them serviced by a qualified technician;

ii. Service slurry tanker system as required;

iii. Assess condition of pipeline, repair and replace parts as necessary;

iv. Update irrigation maps for new fences, tiling, moling etc;

v. Training of new staff in system operation; and

vi. Refresher and training of all staff on the property in the, purpose and use of safety equipment and fittings.

10.4 End of Season

i. Ensure the storage pond is pumped down as far as is practical;

ii. Turn on rainwater diversion for dairy shed;

iii. Drain pumps and/or set frost lamps;

iv. Check pumps and pipes for wear and tear and perform any maintenance required; and

v. Check the lining of the pond is still intact i.e. not damaged.

10.5 Beginning of Season

i. Turn off rainwater diversion; and

ii. Prime pumps and check their operation.

10.6 Breakdowns

i. In the event of power failure, pump or motor breakdown:

- Contact repairer immediately to assess problem;
- Limit or cease water use in the dairy yard and scrape effluent where possible; and
- Complete repairs or install the back-up pump before the next milking, depending on the storage available. Where necessary arrange for a backup petrol, diesel or PTO driven pump.

ii. In the event of pipe blockages:

- For underground pipes: Clear if possible or if too difficult, contact blocked drain repairer to water blast;
- For drag hoses: open camlock joiners to locate and clear blocks in pipe sections; and
- If not able to clear blockages, replace the blocked section.

10.7 General:

i. Under no circumstances are storage facilities to be allowed to overflow;

ii. There shall be no ponding of effluent in the discharge area;

iii. Make full use of the discharge area;

iv. There shall be no discharge of effluent to frozen or snow covered ground;

v. The discharge will be managed to ensure aerosols, spray drift and odour do not travel past the property boundary; and

vi. The general state of the property is to be monitored, particularly areas where environmental contamination with effluent could be a problem. This includes races, silage storage and feeding areas. Preventative action should be taken before problems arise.

11 Other Environmental Issues

11.1 Lanes and Races

Run-off from races can in some situations constitute an illegal discharge to land. These can 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. 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

v. 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 divot/cutouts not being restored. All lane edges and culverts should be checked after lane maintenance.

11.2 Silage pad

A concrete silage pad (1,200 m^2) is located adjacent to the 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.

Only wilted silage is used to minimise the risk of creating leachate

11.3 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.

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

11.4 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.

11.4 Animal Pests

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

ii. Magpies – trap, shoot etc.

12 Emergency Response

12.1 Storage Overflow

Where the storage is approaching full and rain events plus continued use could risk overflow, it is recommended that low application depth effluent irrigation be carried out on the driest part of the farm available. Spreading the effluent very thinly over a larger area over a period is preferable to a point source discharge from the pond.

12.2 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.

12.3 Drainage

Overland Flow

See Ponding Section 12.2.

Discharge Ex-Tile

See Effluent in Open Drains Section 12.3.3

Effluent in Open Drains

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

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

iii. If possible pump out and disburse with the vacuum tanker.

12.4 General Procedures

i. Follow consent conditions/notes, mitigate where possible;

ii. Advise Regional Council where the consent requires this;

iii. Seek help; and

iv. Advise authorities.

12.5 Emergency Contacts

Manager – Mr. M Wright

Environment Southland – 0800 768 845 or 03 2115115

Dairy Green Limited – 03 215 4381

13 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. Cultivation Areas

v. Intensive Winter Grazing

vi. 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.

vii. 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 WW1de
2.			
3.			

WOLDWIDE RUNOFF – PROPOSAL AND AEE

1. Executive summary

Woldwide Runoff (WRO) is a dry stock support block which currently supports all of the five Woldwide dairy farms by providing grazing for dry stock associated with the farms.

This document supports the concurrent resource consent applications for Woldwide 1&2(WW1&2) and Woldwide 4 (WW4) and Woldwide 5 (WW5) which seek various resource consents under the PSWLP for farming activities. This document details the activities currently occurring at WRO and how these activities are proposed to change if the proposals for the abovementioned four dairy farms are approved and enacted. An assessment of effects is provided in this document to enable the Council to be able to fully understand all effects associated with the proposal on WRO.

2. Existing use of WRO

WRO is a dry stock grazing block which also contains a commercial forestry operation, native bush block, commercial gravel extraction operation and land for supplement production. WRO is considered by Environment Southland to form both an individual landholding as well as being part of the landholdings for WW1&2, WW4 and WW5.

In summary, the existing use of the WRO landholding includes:

- The use of land (732ha) for dry stock farming
- The use of land (160ha) for commercial pine plantation and native bush
- The grazing of R1 and R2 heifers plus mating bulls and carry over cows from WW1&2, WW3, WW4 and WW5
- The use of land for intensive winter grazing of dry stock (52 hectares in 2018)

Status of activities at WRO

The land use consent applications for the farming activities for WW1&2, WW4 and WW5 seek consent for all activities located on the landholding which are directly associated with the operation of the respective dairy farms for 365 days of the year.

The proposed farming activity for WW1&2, WW4 and WW5 includes the grazing of dry stock all year round at WRO. Dry stock includes R1 and R2 grazing, mating bull grazing and carry over cow grazing. In this respect, WRO is considered to be part of the landholding for WW1&2, WW4 and WW5 and the grazing of dry stock at WRO has been included in the respective land use consent applications.

When considering WRO as an individual landholding, the use of land at WRO for the current and proposed activities in their entirety would otherwise be a **permitted activity** under Rule 20(a) of the PSWLP:

- There is no dairy platform on the landholding
- There is no associated discharge permit which specifies a maximum number of cows

- A FEMP in accordance with Appendix N of the PSWLP has been prepared for the landholding and implemented (see attached).
- The landholding contains no more than 100ha of intensive winter grazing
- The good management practices for intensive winter grazing specified in Rule 20(a)(iii)(3) have been implemented and detailed in the FEMP.
- A vegetated strip including stock inclusion will be in place adjacent to any water bodies in accordance with the setbacks in Rule 20(a)(iii)(4-6)

The applicant accepts that the activities at WRO which form part of the farming activity on WW1&2, WW4 and WW5 require land use consent as detailed above. However, it is important to note that when viewing WRO as an individual landholding then the current and proposed activities would otherwise be a permitted activity under the PSWLP and would remain so at any point in the future so long as they comply with any requirements, conditions and permissions specified in the RMA, detailed in Rule 20(a) and any applicable regional plans.

The applicant has included WRO in the respective land use consent applications as part of the farming activity and landholding at the request of Environment Southland staff, however the matter of whether it should technically be included in the respective farming activity and the landholdings for WW1&2, WW4 and WW5 lies in the interpretation of the term "landholding" in the PSWLP and in the conclusions from an Environment Southland legal opinion. This is a matter that will be raised and discussed in the upcoming hearing process.

3. Property description

Woldwide Runoff is located 20km to the west of Otautau, on the western side of the Longwood Ranges. WRO is comprised of two separate blocks. The Merrivale Block is owned by Woldwide Runoff Limited and the Merriburn block is leased. The Merriburn lease block is under a 5-year lease agreement, with Woldwide Runoff Limited having first right of renewal.

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
Proposed land use	Both blocks are run as a single operating unit.

	Grazing of R1 and R2 heifers, grazing of carry over cows and grazing of mating bulls all year round (includes intensive winter grazing) Production of baleage 100ha of commercial pine plantation 60ha beech forest under sustainable management
Dry stock in 2017/2018 season	1265 R1 1265 R2 37 carry over cows 70 mating bulls

Figure 1: Current/Proposed farm boundary for WRO. [1]

[1] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

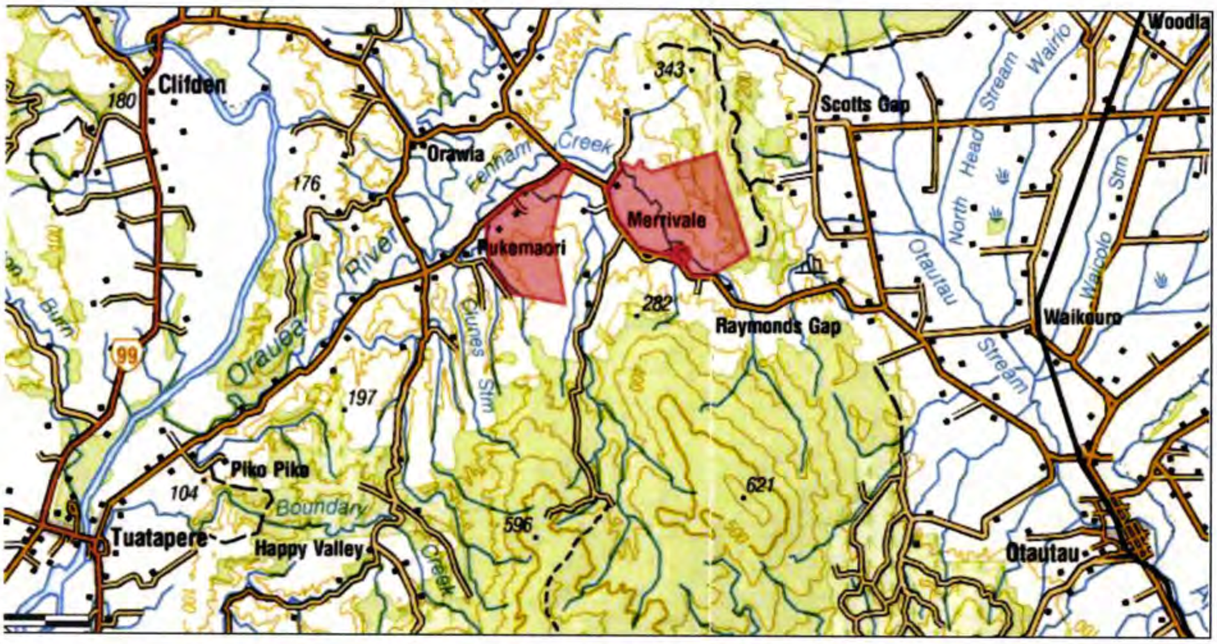


Figure 2: General location of WRO[2]

Figures 3 and 4 show the mapped farm boundaries and features of interest on the original part of the runoff block and the leased part of the runoff block respectively.

[2] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

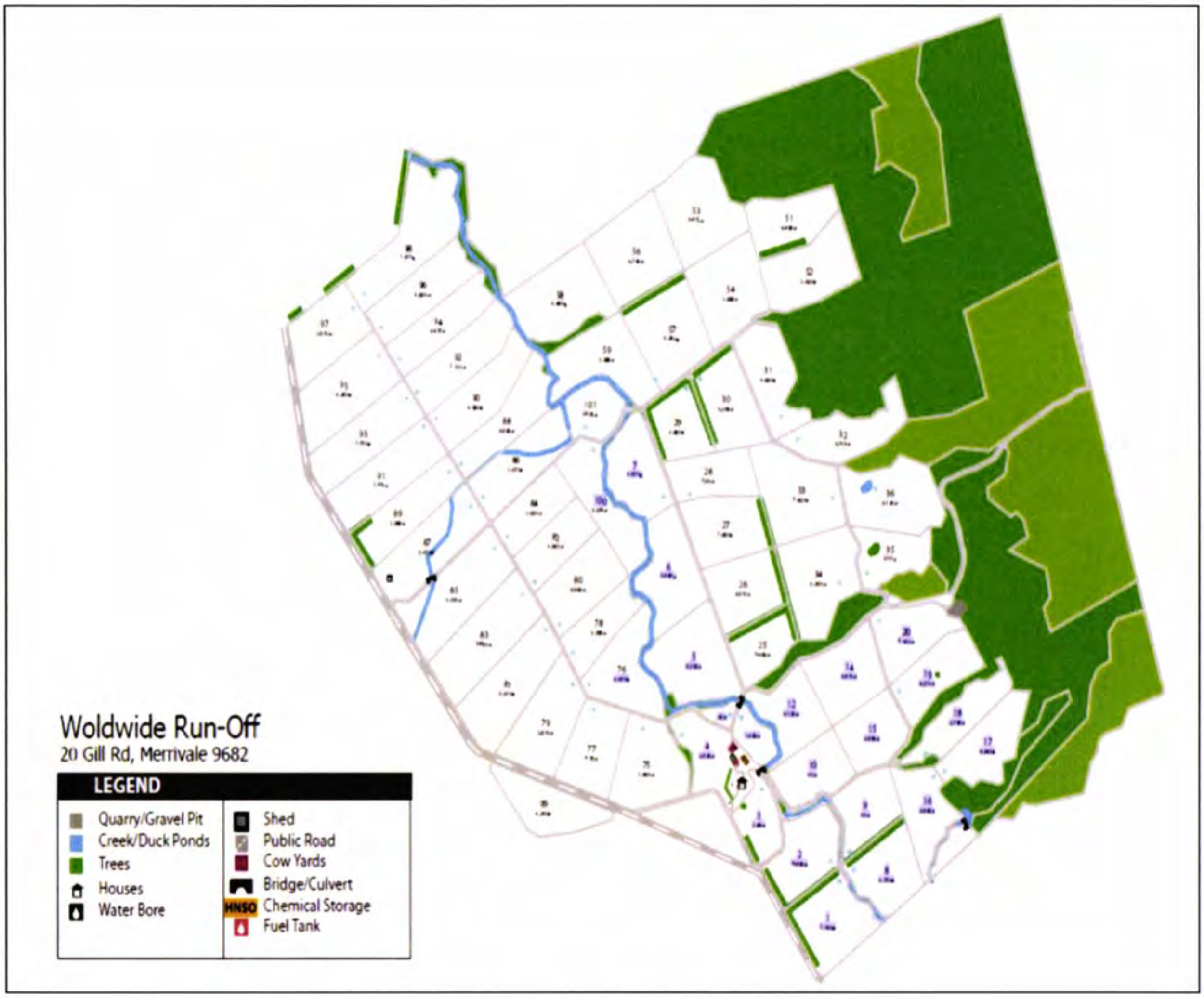


Figure 3: Farm map for Merrivale block

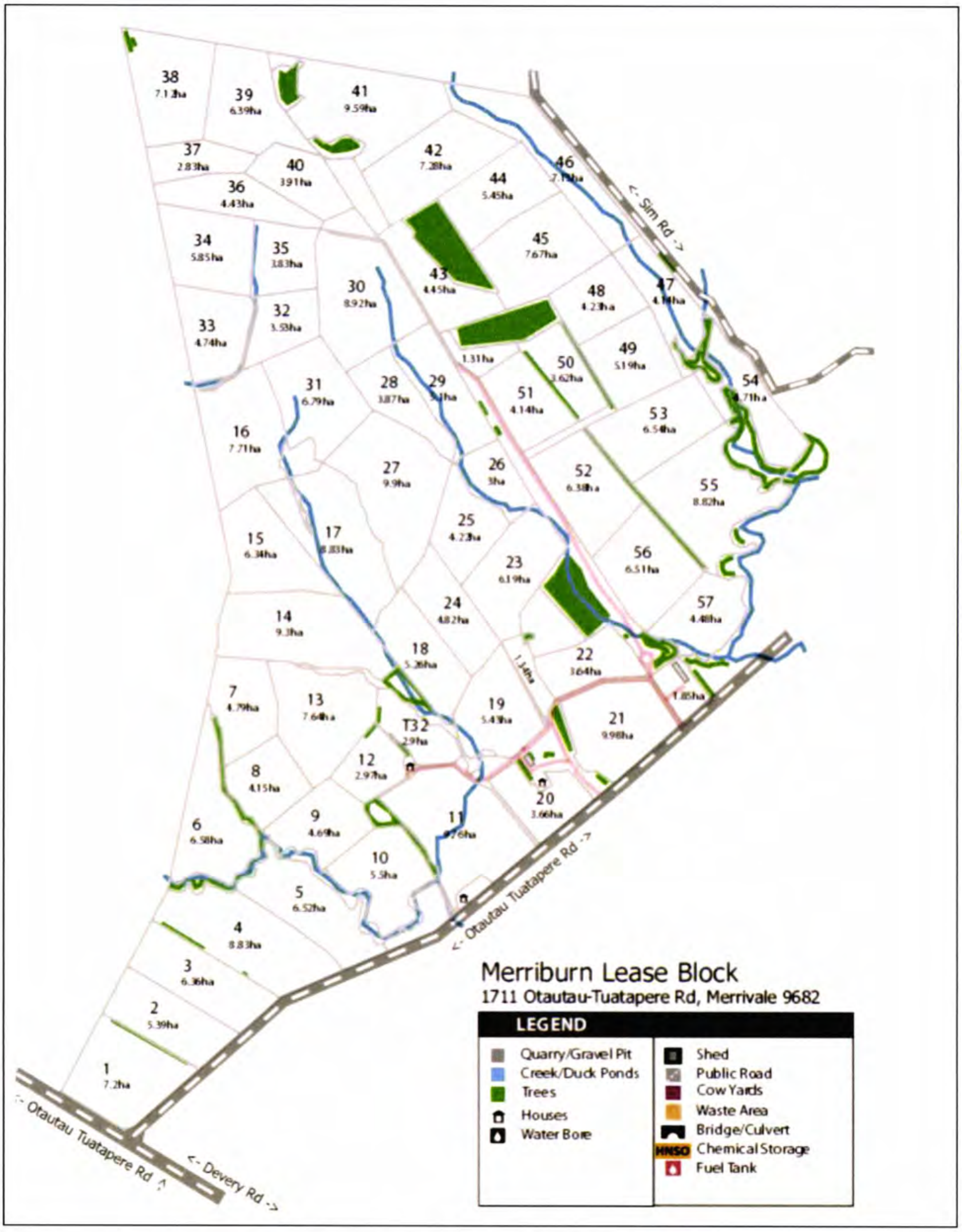


Figure 4: Farm map for Merriburn block (leased)

4. Soils and Physiographic Zones

The Merrivale block contains Malakoff, Waimatuku and Makarewa soils and the Merriburn lease block contains Aparima, Orawia and Makarewa soils. These soils are a mixture of heavier wetter soils and free draining soils.

Figure 5: Soil map[3]

The Merrivale block is classified as Hill Country, Oxidizing and Gleyed physiographic zones. The Merriburn lease block is classified as Hill Country, Oxidizing, Gleyed, Marine terraces and Peat physiographic zones.

[3] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

Figure 6: Physiographic zones[4]

5. Surface water receiving environment

WRO is located within both the Fenham and Merry Creek catchments. Both creeks are tributaries of the Orauea River which flows south-westerly towards Tuatapere township and joins the Waiau River. There is a SOE monitoring site on the Orauea River at Orawia Pukemaori Road which is used to measure water quality information data. The Land and Water website (www.lawa.org.nz) collates this water quality data and provides the most recent water quality data and trends available. **Table 1** below gives a summary of the state and trend measured at this site for key river water quality indicators.

Table 1: Summary of Measurement and State of Orauea River at Orawia[5]

	State	Quality	NOF Band Annual Median	Trend
E. coli	In the worst 25% of all lowland rural sites	315 n/100ml (median 5 year)	E	Likely improving
Clarity	In the worst 25% of all lowland rural sites	1.13 metres (median 5 year)	N/A	Indeterminate
Total Oxidised N	In the worst 25% of all lowland rural sites	0.415 g/m^3 (median)	A - median	Meaningful improvement
Total N	In the worst 50% of all lowland rural sites	0.73 g/m^3 (median)	N/A	Indeterminate
Ammoniacal N	In the best 25% of all lowland rural sites	0.0005 g/m^3 (median)	A – 99% species protection level.	N/A
Dissolved Reactive P	In the worst 50% of all lowland rural sites	0.011 g/m^3 (median)	N/A	Indeterminate

[4] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

[5] https://www.lawa.org.nz/explore-data/southland-region/river-quality/waiau-river/orauea-river-at-orawia-pukemaori-road/

The water quality medians indicate that the Orauea catchment is degraded in regards *E. coli*, however there is a definite trend of improvement. High *E. Coli* levels are a concern for overall water quality within a waterway due to human health risks. Typically, *E. coli* contamination of waterways is caused by stock contact with surface water, point source discharges from septic tanks, wastewater treatment at upstream towns and effluent discharges to land reaching surface water. A high proportion of land within the Orauea catchment is both intensive and extensive sheep farms which is likely to contribute to the high *E. coli* levels because stock on sheep farms are not excluded from waterways in the same manner in which it is compulsory on dairy farms. The other activities listed above may also be contributing factors. *E. coli* is rated as E band in the National Objectives Framework (NOF) of the National Policy Statement for Freshwater Management. An E band rating equates to an average infection risk of greater than 7%.

Conversely, total oxidised nitrogen concentration has improved and is rated as A band under the NOF which means that water quality is considered suitable for the designated use and associated with a high conservation values ecosystem where there is unlikely to be effects even on sensitive species. The national bottom line value is 6.9 mg/L which far exceeds the 0.415 mg/L median at this site.

The median dissolved reactive phosphorus (DRP) is below ANZECC guideline levels and is not showing an evident trend. The raw data shows that DRP is low on the majority of the sampling dates, with spikes most likely occurring during rainfall events where phosphorus can be transported to surface water bodies via runoff and erosion.

The overall impact of the trends in nutrient concentrations is not clear at this stage, however the receiving water is considered low in relation to nitrogen and phosphorus concentrations overall. There is very limited published information on periphyton extent or macroinvetebrate community status in the Orauea River, so it is difficult to assess the current status or trend in biological quality of the stream. However, it is accepted that any increase in nutrient concentrations is likely to create the potential for an increase in periphyton and/or other plant biomass in the stream.

Ecological indicators are measured at the lower catchment *Waiau River at Tuatapere* SOE site with 5-year medians for MCI score, taxonomic richness score and %EPT available. The median MCI score is good at 103 with an indeterminate trend. The median Taxonomic Richness score is 15 and the median %EPT is 47%. One NOF water quality indicator for the *Waiau River at Tuatapere* site shows evidence of land use impacts (periphyton) and three indicators show minimal evidence of land use impacts (*E.coli*, macroinvertebrates and nitrate toxicity). The periphyton parameter indicates moderate nutrient levels and/or natural flow or habitat disruption. In this case the nuisance periphyton levels are likely to be primarily due to natural flow disruption due to the diversion of c.95% of the flow of the Waiau River to Doubtful Sound for hydroelectricity generation.

Over the summer period in 18/19, Environment Southland monitoring of the Waiau River at Tuatapere has confirmed the presence of toxic algae benthic cyanobacteria in the lower Waiau. Given the relatively low level of nutrients N and P in the lower Waiau, it likely that natural flow disruption is a major factor contributing to the growth of algae, including toxic algae in the lower Waiau.

The lower Waiau River also has a significant issue with the invasive stalked diatom *Didymosphenia geminate*, commonly known as didymo or "rock snot." Didymo blooms smother river beds with nuisance mats of algae and typically occur in rivers with low nutrient concentrations, i.e. low levels of N and P. Didymo blooms can lead to changes in communities of invertebrates and other algae on the river bed.

The available physical/chemical data show the Waiau River catchment to be in relatively good health. Nitrate, DRP and *E.coli* levels are relatively low and water clarity is moderately good. Some biological indicators such as the MCI index indicate good water quality with minimal land use effects whereas others such as periphyton levels are elevated at times. The toxic benthic algal bloom seen in the 18/19 summer period is indicative of land use effects, such as natural flow disruption and possibly nutrient losses to an extent although this complex issue is poorly understood.

Surface water is the primary receiving environment for contaminants lost from WRO due to the nature of the soils, topography and drainage channels.

Figure 7: Topomap showing both WRO blocks (marked with X) and SOE site *Orauea River at Orawia Pukemaori.*[6]

6. Groundwater receiving environment

WRO is located in an area of unclassified groundwater management zone. Groundwater nitrate levels in the vicinity of WRO are in the range 0.01 – 1.0 g/m^3, regarded as pristine to modern day background levels. Due to a combination of the topography, depth of groundwater and drainage channels there is a low risk of nitrate accumulation in groundwater in this area. This is supported by the very low mapped nitrate levels.

[6] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

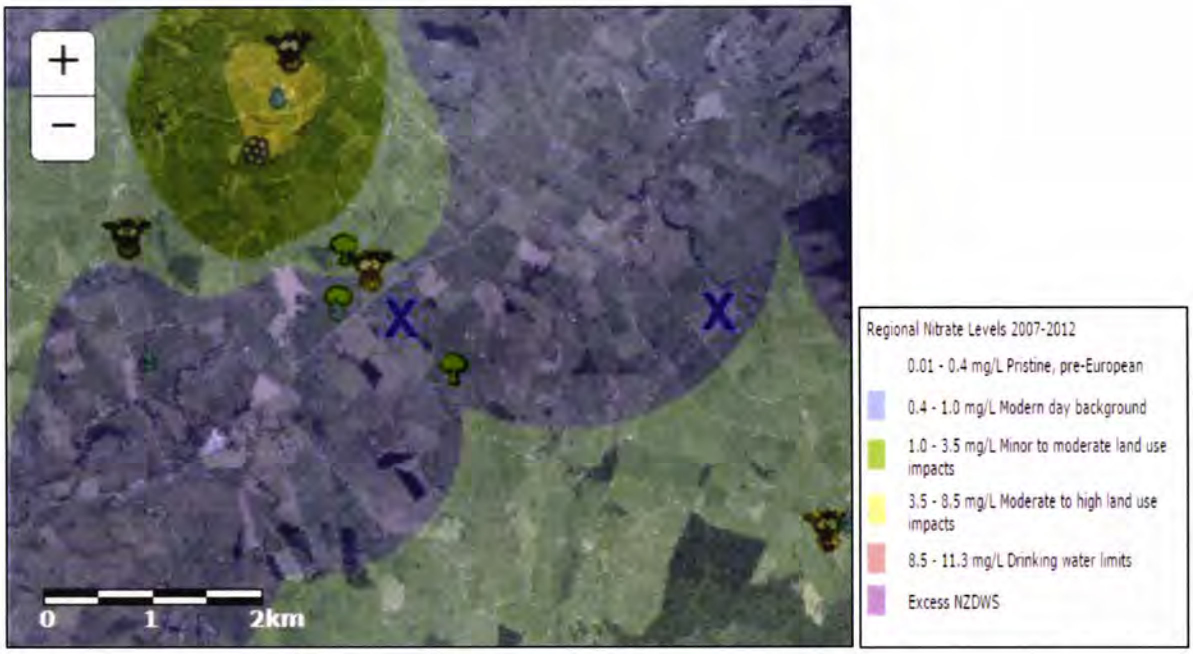


Figure 8: Groundwater nitrate in the vicinity of WRO (approximate location of WRO blocks marked with X)[7]

7. Contaminant Pathways

The production of grass for stock grazing and supplements requires the input of nutrients into the farming system. On a stock grazing block, excess nutrients are primarily lost to the environment from the deposition of dung and urine spots on pasture. For this property the main contaminant pathways are identified as overland flow, deep drainage and artificial drainage due to the variety of different soil types and physiographic zones on the farm. Woldwide Runoff predominantly grazes young dry stock (R1 and R2 heifers), which cause less soil damage and related effects due to their smaller size and lighter weight than mature cows, in addition the lease arrangement for Merriburn Block prohibits the wintering of adult cows.

Contaminant Pathways – Overland Flow and Artificial drainage

Loss of nutrients via overland flow and artificial drainage presents the highest risk to the environment on the wetter, poorly drained soils on this property primarily in the Gleyed physiographic zone. These areas have high vulnerability to waterlogging, and in some areas require subsurface artificial drainage, which can become a mechanism for the rapid transfer of contaminants to the water bodies they drain to. The applicant will avoid and mitigate the risk of contaminant loss via overland flow and artificial drainage by:

- Ensuring critical source areas are left as buffer zones for cropping and fenced off to exclude stock;
- Re-sowing bare soils as soon as possible;
- Avoid grazing very wet soils by opening the breaks up to reduce tramping damage;
- Using good management practice for intensive winter grazing on either grass or forage crop – back fencing, CSA management, last bite grazing, portable troughs etc.; (See FEMP)
- Ensure water ways are fenced off to exclude stock and existing riparian vegetation is maintained;

[7] Beacon mapping service, Environment Southland website, accessed 13 February 2019.

- Time fertilizer application to meet pasture demand and apply in a little and often manner;
- Protecting steeper, erosion prone land with trees.

Contaminant Pathways – Deep drainage

Loss of nutrients via deep drainage presents the highest risk to the environment on the free draining soils mainly within the Oxidizing physiographic zone. These areas have high vulnerability for nutrients, particularly N, leaching through the soil profile which has the potential to reach groundwater and surface water receiving environments. The applicant will avoid and mitigate the risk of contaminant loss via deep drainage using the same measures as above, with the primary goal to avoid the accumulation of excess N in the soil profile prior to high drainage periods.

- Maintaining stocking rates at sustainable levels;
- Avoiding the over-application of fertilizer by matching application to pasture demand and undertaking in a little and often manner;
- Utilizing pasture species which result in less N loss;
- Utilizing soil testing to guide fertilizer usage;
- Time fertilizer application to meet pasture demand and apply in a little and often manner.

8. Good Management Practices (GMPs)

GMP adopted on WRO are detailed in the attached FEMP.

9. Description of activities

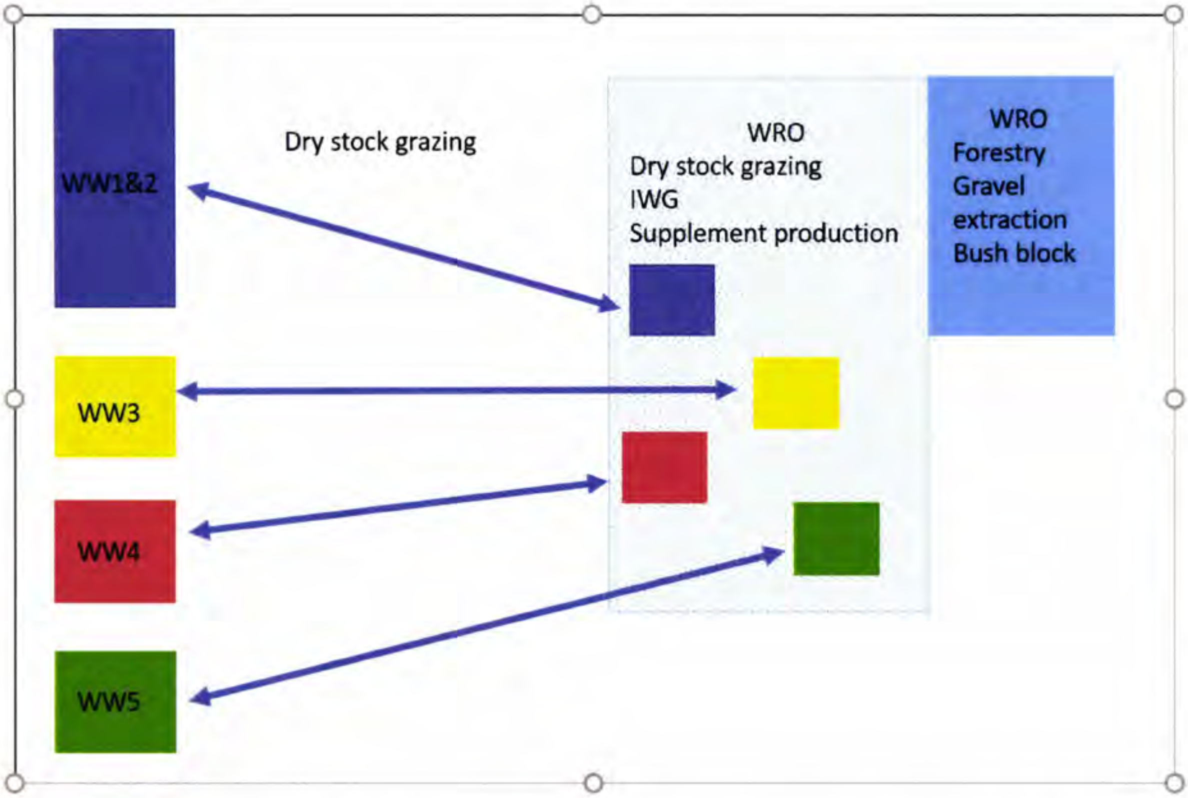
A year end nutrient budget has been completed by Cain Duncan CNMA for the 2017/2018 season to give an indication of the nature and scale of the activities which occurred at WRO during this one reporting year. The nutrient budget and accompanying report are appended to this application and should be referred to for a full description of the farm system at WRO during the 2017/18 year.

The applicant has now had WRO in its entirety (with the combination of the two separate blocks) for two and a half seasons. When the Merriburn block was initially leased it was heavily pugged and pasture productivity and fertility was low. Over the last two and a half seasons, the applicants have focussed on pasture renewal and increasing fertility. The 2018/19 season has seen the benefit of pasture and soil development with a big lift in pasture production. The applicants have found that they may need to alter the activities on this block in light of the increased productivity in order to farm it sustainably and economically making use of the quantities of feed available.

10. Proposed Activities

The diagram below presents a schematic impression of the relationship between the applicants five dairy farms and WRO. The diagram shows the individual dairy platforms sending dry stock grazing to the grazing block part of WRO (hatched box). The dry stock grazing, IWG and supplement production for the five dairy farms rotates through this grazing block of WRO every year. The legal descriptions of the land within the hatched box area is included in the separate land use consents for WW1&2, WW4 and WW5. The number of dry stock sent from each dairy farm is represented by the corresponding coloured boxes within the blue hatched area. A proposed condition of consent would specify the maximum number and class of stock grazed on WRO from each farm.

The solid blue WRO box contains activities which are not part of the respective farming activities (forestry, gravel extraction and bush block) and the legal descriptions of the land within this area will not be included on the respective land use consents.



The activities on WRO which will be covered under the land use consent applications for the farming activities on WW1&2, WW4 and WW5 include the grazing of dry stock (R1, R2, mating bulls and carry over cows) all year round:

- All R1 heifers currently grazed all year round at WRO continues unchanged.
- R2 heifers currently grazed from the time of transitioning from R1s and May of the following season on WRO continues unchanged.
- For future seasons during June and July, R2s from WW1&2 will be intensively winter grazed on WRO or housed in existing wintering barns at WW1&2 dairy platform (approximately 125 R2s).
- R2 heifers from WW4 and WW5 may spend the winter period in the wintering barns on WW4 and WW5 dairy platforms in some seasons.
- R2 heifers from WW4 and WW5 may be intensively winter grazed at WRO in some seasons.
- Mating bulls required for all five dairy farms will be on WRO all year round. Mating bull numbers may fluctuate marginally in future seasons.
- Carry over cows from all five dairy farms will be on WRO all year round. Carry over cow numbers may fluctuate marginally in future seasons.

The applicant has not provided an Overseer nutrient budget which models the proposed farm system due to concerns with providing a model which is representative of a long-term scenario farm system at WRO. The reasons behind this include:

- The increasing fertility levels on WRO combined with the large size of the block make it very difficult for the applicant to predict exactly what the block is capable of in terms of stocking rate, crop growth and pasture production much further into the future than the upcoming season.
- The siting of non-farming activities on the block which will not be covered under the land use consent applications.
- The large impact climatic conditions have on the management of a large support block which is more dramatic, variable and pronounced than a dairy farm system.
- The need and desire for flexibility (within reason) in the management of the farm system based on the above factors.

The applicant recognises that the Consent Authority needs certainty around the scale and nature of the activities proposed at WRO and the likely effects of these activities which have been detailed in the AEE. The applicant proposes the following input restrictions as consent conditions for the proposed land use consents applicable to activities at WRO. These input consent conditions are requested in place of any consent conditions referring to a nutrient output restriction based on an Overseer nutrient budget model:

For WW1&2

- A maximum of 417 R1 heifers grazed all year round at WRO from WW1&2
- 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 at WRO and during June and July in the WW1&2 wintering barns

For WW4

- A maximum of 286 R1 heifers grazed all year round at WRO from WW4
- A maximum of 286 R2 heifers grazed all year round at WRO from WW4 or
  A maximum of 286 R2 heifers grazed between August and May at WRO and during June and July in the WW4 and WW5 wintering barns

For WW5

- A maximum of 270 R1 heifers grazed all year round at WRO from WW5
- A maximum of 270 R2 heifers grazed all year round at WRO from WW5 or
  A maximum of 270 R2 heifers grazed between August and May at WRO and during June and July in the WW4 and WW5 wintering barns

On all land use consents

- A maximum of 100 hectares of winter fodder crop for intensive winter grazing at WRO

This recommendation to impose these input restrictions as consent conditions as opposed to an Overseer nutrient output restriction consent condition has been carefully considered by the applicant and recognises the inherent complications in including WRO on the resulting individual land use consents for WW1&2, WW4 and WW5. The primary complication that arises is that compliance and the enactment of individual consents must be able to stand alone and must not be reliant on third parties or third party actions. For example, if the land use consent granted for WW4 farming activities on WRO are restricted with a consent condition requiring an overall WRO Overseer nutrient output limit be complied with, then compliance with the land use consent relies on the actions of several third parties: WW1&2 Ltd, WW3 Ltd and WW5 Ltd. This would inadvertently link all of the dairy farm systems together and create a scenario of reliance on compliance by third parties which may deem the land use consents unenforceable. This notion has been widely considered in case law. Common law derived from the House of Lords decision in *Newbury DC v Secretary of State for the Environment* determined that any resource consent condition needs to satisfy a range of criteria in order to be valid. This created what is known as the *Newbury* validity tests, of which (b) is particularly relevant to this application:

> (a) The condition must be imposed for a [resource management] purpose and not an ulterior purpose;
>
> (b) <u>The condition must fairly and reasonably relate to the activities authorised by the consent to which the condition is attached</u>; (emphasis added) and
>
> (c) The condition must not be so unreasonable that a reasonable planning authority, duly appreciating its statutory duties, could not have approved such a condition.

The individual applications for WW1&2 and WW4 and WW5 do not seek the authorisation of activities on any of the other landholdings. Since *Newbury*, the validity tests above have been modified by New Zealand courts and a review of case law strongly indicates that consent conditions relying on the actions or compliance by third parties are not valid.

The imposition of the 100-hectare winter fodder crop restriction is linked back to the permitted activity threshold in Rule 20 (a) of the PSWLP, which WRO would otherwise be able to operate under as an individual landholding in its own right.

11. Assessment of Environmental Effects

The table below describes the proposed activities occurring on WRO under the proposal.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Capital fertilizer applications to lift Olsen P levels	The 2017/18 year end Overseer model included capital phosporus fertilizer applications to lift Olsen P levels. In future, capital fertilizer applications may be undertaken for K and S also. Capital fertilizer applications will apply larger quantities of N, P, K and S to land in order to increase fertility. These applications of larger quantities of nutrients have the potential to result in losses to the environment if applied at rates which exceed the plants ability to utilize these applied nutrients. Excess applied N likely to be lost to water bodies via nutrient leaching and artificial drainage channels. Excess applied P	Capital fertilizer application timings avoid high drainage periods such as late autumn and winter and periods when soil temperature is less than 7 degrees to mitigate against excess N leaching through the soil profile. All other fertilizer applications will use a little and often approach to avoid the application of excess nutrients which cannot be utilized. Regular soil testing to guide capital fertilizer requirements to avoid the application of excess N and P which cannot be used for plant uptake to mitigate against losses via artificial drainage.	Capital fertilizer applications will only be done as required by the latest soil test results and will be undertaken where P, K or S levels are below agronomical optimum levels. P = 20-30 K = 6-10 S= 10-12 The target Olsen P level on this block is 25. Capital P fertilizer applications will be applied at a maximum of 100kg P/ha which may require P fertilizer applications to be split.	Capital fertilizer applications are only undertaken where there is a nutrient deficit and are done at a rate which meets this deficit and avoids the application of excess nutrients. There is a low risks of adverse effects eventuating as application will meet pasture demand. The fertilizer regime described in the nutrient budget will be the default fertilizer regime and capital fertilizer applications will only be done according to soil test results and completed using GMP principles which should adequately mitigate adverse effects on water quality.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	likely to be lost to water bodies via overland flow, particularly on the sloping land. Excess N and P in water bodies may lead to water quality degradation resulting in ecological stresses on aquatic life and human health consequences such as blue baby syndrome.			
Cultivation of new pastures	Short term increase in potential sediment, microbial and phosphorus losses to the environment which can cause ecological stresses on plants and animals due to sedimentation, algae blooms and water temperature increases in waterways and estuaries	Re-sow bare paddocks as soon as possible Use buffer zones around critical source areas and use direct drilling if possible. Cultivation will be undertaken to meet permitted activity criteria in Rule 25(a) of the PSWLP maintaining a 5 meter buffer zone	Further mitigations not required as the imposition of buffer zones reduces the risk of overland flow of sediment and phosphorus when cultivating land. Riparian buffer zones will be installed with stock fencing and vegetated filter areas.	Adverse effects should be adequately avoided as this is a low risk activity in this location. GMPs provide adequate mitigation of effects.
Intensive winter grazing	Potential for significant amounts of contaminants	Buffer zones maintained between crop cultivation and	The intensive winter grazing of R1 calves will occur on a similar scale as the 2017/18 year. Mitigation	Adverse effects potentially still exist from this activity due to the

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Potential future increase in the scale of the activity	(N, P, sediment and microbials) to be lost to both surface and groundwater bodies as a result of the complete de-vegetation of pasture/crop, treading damage on soil structure and runoff following rainfall events. Nutrient losses from this activity occur via deep drainage through the soil profile into the underlying aquifer or via overland flow into adjacent waterways or artificial drainage channels. Excessive nutrient losses can cause nutrient accumulation in groundwater and excessive nutrient load in waterways causing water quality degradation and	critical source areas to provide an area where runoff can be filtered and captured limiting risks of entering water. Grazing direction will be away from buffer zones/critical source areas leaving last bite to provide a buffer zone for nutrient capture through until the end of the fodder grazing period. Back fencing and portable water troughs to limit treading damage over already de-vegetated ground. Cultivation of paddocks timed to avoid paddocks sitting bare for long periods of time which reduces risks of contaminant losses through leaching and overland flow. All other GMPs listed in rule 20 will be implemented by May 2019.	measures include choosing suitable fodder crop paddocks which are predominantly flat with no waterways, away from critical source areas and on paddocks which may require additional fertility. Paddock selection is important to avoid and mitigate the risk of the direct runoff of nutrients to water bodies (particularly P, sediment and microbials). The intensive winter grazing of R2 heifers will be a new activity on this block in the future and would require the cultivation of an additional approximately 48ha of fodder crop. Currently this activity is located on the WW5 dairy platform and Gladfield block. It has been located on the WW1&2 platform (Marcel/SH96) in recent years. The current location of this intensive winter grazing activity within the highly sensitive Heddon Bush/Central Plains area results in significantly higher contaminant losses due to the nutrient leaching risks of the soils in this location. Suitable fodder crop paddocks will be chosen which are predominantly flat with no waterways or artificial drainage channels, away from critical source areas and on paddocks which may require additional fertility and concurrently, fertilizer usage	high level of contaminant losses which occur from intensive winter grazing despite the implementation of GMPs and mitigations. The GMPs and the mitigations proposed will mitigate adverse effects to a certain extent, with the long-term goal of the applicant to abolish intensive winter grazing from the dairy platforms/Central Plains area and overall to reduce the frequency and scale of intensive winter grazing at WRO by utilizing the wintering sheds in preference to fodder crop over winter.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	the resulting ecological stress on plants and animals when the life-supporting capacity of the water is compromised by excess nutrients.	Bare soils are cultivated using full cultivation and timed to avoid paddocks siting bare for long periods of time which reduces risks of losses of excess nutrients remaining from the grazing activity to the environment via overland flow and leaching.	may be able to be reduced given the soil nutrient levels following cropping. The siting of this activity on WRO in the future on heavier soils presents a lower risk of nitrate accumulation in groundwater and therefore a lower risk of water quality effects. The area surrounding WRO is currently low in groundwater nitrate levels and is low risk of nutrient leaching and is considered a more appropriate choice to site intensive winter grazing than the Central Plains area. Approximately 125 R2 heifers will be wintered in existing barns at the WW1&2 dairy platform. In some years, R2 heifers will be wintered in respective wintering sheds on the dairy platforms at WW4 and WW5. The final decision on whether stock will be in the sheds or at WRO rests in the feed available and overall pasture management of WRO in the preceding season – often heavily dictated by climatic conditions.	

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Fertilizer application regime across entire block	The application of nutrients in fertilizer has the potential to result in direct nutrient losses to the environment if fertilizer is applied either in excess to plant requirements or at a time when it cannot be utilized for pasture/crop production. Nitrogen losses from fertilizer application most likely to occur via deep drainage. Phosphorus losses from fertilizer most likely to occur via soil loss and/or direct loss through runoff or erosion. Adverse effects of inappropriate fertilizer application or excess application include a loss	Time N, P, K and S fertilizer application to meet crop and pasture demand using split applications and avoid high risk times of the year i.e when soil temperature is less than 7 degrees, during drought periods and during periods when soils are at field capacity. Reduce use of P fertilizer where Olsen P values are above agronomic optimum. Maintain Olsen P levels at around 20-30. Use nutrient budgeting and annual soil testing to manage nutrient inputs from fertilizer and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.	Fertilizer applications occur in August, September, November, December and January on different blocks avoiding high drainage and high-risk periods that occur in late summer, late autumn, mid spring and during the winter. Fertilizer on crop blocks is applied in December which is considered a low risk month due to lower rainfall and higher soil temperatures. The fertilizer regime will remain flexible and will be undertaken to match pasture and crop requirements.	Adverse effects both avoided and mitigated with use of GMPs for fertilizer usage

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	of excess nutrients to water causing water quality degradation in both groundwater and surface water bodies. Water quality degradation can adversely impact aquatic plant and animal ecosystems and impact on human health.			
Potential increase in contaminant losses in the future	The future use of WRO is highly likely to involve an increase in the scale of intensive winter grazing which is likely to increase contaminant losses. Higher contaminant loss activities increase the risk of the leaching of nutrients (N, P and microbials) through the soil profile from urine and dung spots or transported via subsurface drainage.	Use of selective grazing to avoid grazing very wet paddocks during adverse weather conditions to reduce risks of pugging and treading damage to soil structure which can accelerate contaminant losses. Increase the size of feed breaks during adverse conditions to give animals more of the paddock to graze than the volume of feed required to reduce stocking rate on wet and vulnerable pasture to avoid pugging and treading damage of feed.	Overall stocking rate of cows grazing from August to May is kept to a level similar with an extensive operation and with its current level. Areas of native forest and commercial forest are maintained to balance out areas of dairy support land and non-grazed areas. Intensive winter grazing is sited on this block to shift it away from the higher risk Central Plains/Heddon Bush area which is classified as higher risk for water quality degradation.	Adverse effects both avoided and mitigated with use of GMPs and mitigation measures which site activities in the appropriate location where receiving environments are less susceptible to water quality degradation.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	Increased nutrient losses as total figures to groundwater and surface water bodies may potentially cause water quality degradation which can cause ecological stresses on aquatic plants and animals from algal growth, temperature increases and eutrophication. Human health concerns can also arise from microbial contamination of waterways upon contact and risks of blue baby syndrome from nitrate accumulation in groundwater	Use nutrient budgeting to manage nutrient inputs and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.		

12. Broad scale/cumulative effects assessment

The AEE above concludes that the implementation of targeted mitigation measures on-farm will ensure that adverse effects on water quality from activities within the proposal are either avoided or mitigated to levels that are consistent with the relevant regional plan water quality objectives whilst still maintaining a viable, efficient and profitable farm system. The amount of nutrients lost from the farm system which may end up in the receiving water bodies depends on a wide range of different factors often collectively referred to as attenuation rates. Similarly, the catchment hydrology and characteristics are critical in affecting the resultant concentration and/or mass loadings of nutrients and other contaminants in water bodies.[8]

This broad scale/cumulative effects assessment includes a catchment scale assessment in relation to attenuation and hydrology processes, characteristics of the catchment and consideration of the state of the receiving environment. This assessment also assesses the proposed activity in its entirety against the actual existing environment, i.e. not using a permitted or consented baseline approach. The term "practicable minimum" is used frequently and is used to portray the fact that any farming activity results in nutrient losses to the environment of some scale and that the applicant has reduced nutrient losses as far as they are practically able to do so given available mitigations, innovations and technology whilst still maintaining an efficient and profitable farm system that meets their social and economic needs. The term "practicable minimum" does not refer to an effect on the environment. The summary to this AEE concludes that water quality will be maintained in the receiving environments given the proposed mitigations, the characteristics of the catchment and the predicted changes to water quality as a result of the proposed activity.

Attenuation

A 2011 report by Clint Rissmann undertook regional groundwater denitrification potential and aquifer sensitivity analysis throughout the Southland region. Unfortunately, the area surrounding WRO and the Orauea catchment was not analysed in this report and therefore the denitrification potential in this area remains largely unknown.

However, we can surmise that the risks of nitrogen losses from below the root zone ending up in groundwater and eventually surface water bodies is low in the vicinity of WRO due to the low mapped groundwater nitrate levels, the presence of heavy soils, the depth of groundwater and the general topography of the site. The applicant has recognised that this catchment is low risk for groundwater contamination and decided it is more environmentally beneficial to site higher contaminant loss activities (particularly high N loss activities such as intensive winter grazing) on WRO in the future in preference to the siting of these activities within the higher risk Central Plains area which is where these activities are currently occurring. The proposed activities located on WRO would otherwise be a permitted activity which strongly suggests that the proposed scale and nature of the activities is likely to result in less than minor adverse effects on the environment.

Groundwater nitrate concentrations are of particular concern to human health. The risk of bottlefed infants getting 'blue baby syndrome' from consuming high nitrate nitrogen water is widely accepted and is the primary driver for the current NZ Drinking water standard for nitrate nitrogen. Other studies

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[8] Enfocus, *Using Overseer in Water Management Planning*, October 2018.

indicate that other contaminants, or dietary nitrate sources, may also play a role in the syndrome.[9] A recent Danish study suggested a link between groundwater nitrates and bowel cancer. The study found that those people exposed to nitrate levels in excess of 9.3 mg/L (NZ drinking water standard is 11.3 mg/L) had a 15% increased carcinogenic risk. In December 2018, Agriview NZ published an article attempting to correlate the Danish study within the New Zealand agricultural context. The article noted that "most of the international research conducted throughout the past four decades on this topic has found either a negligible or only slight correlation between nitrates in drinking water and colon/bowel cancer rates" and also that "the idea that colon cancer is heavily influenced by diet surfaces in many of the studies evaluating its link to the intake of nitrate through drinking water." The article further noted "Ian Shaw, professor of toxicology at the University of Canterbury, says it is this very factor that makes the associations between water nitrate and colon cancer unconvincing:

"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."

In other words, attributing high colon cancer rates to nitrates in drinking water would be oversimplifying things to a considerable level. One must consider the variations of diet and lifestyle also considered potential factors for increasing colon cancer risk, and this is something the Danish study failed to do."[10]

Given the level of current science, effects on human health should be protected under the proposal which is likely to result in less than minor adverse effects on groundwater quality due to the imposition of mitigation measures to address nitrate accumulation and the siting of intensive winter grazing within a catchment which is low risk for nitrate accumulation, has deep groundwater and heavy soils.

Phosphorus, Sediment and Microbial losses

The loss of P, sediment and microbials via erosion, overland flow and artificial drainage presents the highest risk on this property. Loss of contaminants via erosion and will be partly mitigated by the presence of established vegetation along the riparian margins, fencing to exclude stock and the low stocking rate.

These contaminants may also enter artificial drainage channels if applied to land inappropriately via fertilizer application, intensive winter grazing activities or by the inappropriate grazing of animals during high drainage periods (such as late autumn and mid-spring). The low stocking rate will partly mitigate potential losses via artificial drainage channels as less urine and dung deposition per hectare will occur.

Another factor to consider is the risk of P, sediment and microbial losses directly to surface water bodies within this catchment via overland flow – primarily occurring from runoff from laneways and via critical source areas. Overall losses of these contaminants directly to waterways is considered low risk on this property due to the low stocking rate. Overseer gives an estimate of what P may be lost directly to the

[9] https://en.wikipedia.org/wiki/Blue_baby_syndrome accessed 8 February 2019

[10] https://www.agriview.nz/forum/2018/12/11/investigating-the-nitrate-colon-cancer-link accessed 8 February 2019

environment from laneways, waterway crossings and critical source areas in the 'other sources' output within the model. The model does not consider sediment and microbial losses, however as all three contaminants typically enter surface water bodies via the same transport pathways then P loss modelled by Overseer can be used as a proxy for estimating sediment and microbial losses to the environment also.

The problem with the 'other sources' output estimated by Overseer is that it is not spatially explicit and does not account for site-specific mitigation measures which may be in place on a farm to mitigate losses directly to waterways from these laneways and critical source areas. The GMPs implemented on WRO specifically address and seek to minimise contaminant losses from these areas.

GMPs and mitigation measures to reduce P, sediment and microbial losses

The applicant will be implementing specific critical source area GMPs that will seek to minimise potential P loss via overland flow from these new lanes and/or culvert crossings such as the fencing of waterways, establishing vegetated riparian margins, contouring lanes to direct runoff to pasture, installing bargeboards on culvert crossings and locating laneways away from waterways.

P losses have therefore been reduced to the practicable minimum. The implementation of targeted GMPs and mitigation measures should result in effects on the environment which are less than minor.

Hydrology of the catchment

The property is located in an area of unclassified groundwater management zone. This means that little information is available on groundwater and surface water connectivity, recharge and groundwater levels. Local anecdotal evidence strongly suggests that groundwater is very deep on the western side of the Longwoods ranges in the location of WRO as neighbours have had extreme difficulty drilling for groundwater. Despite the lack of knowledge and deep groundwater, there is expected to be some level of steady discharge of groundwater to surface water bodies. The discharge of groundwater to surface water bodies provides for mixing and dilution of nutrients from either source (groundwater or surface water). The dilution of nutrients can reduce the concentration of these nutrients in these water bodies which can lead to less prevalence of the adverse effects of water quality degradation.

Catchment Characteristics

The WRO farm sits within the wider Orauea catchment. The Orauea River is a cobble/gravel bedded river which drains pastoral land from near the town of Nightcaps to its confluence with the Waiau River near Tuatapere. According to a 2014 Aqualinc Report, the wider Waiau River catchment is large at 827,299 ha and is comprised of 33 dairy farms, 3 forestry blocks and 311 sheep and beef farms. Approximately 23% of the catchment is pastoral farmland. [11]

Nutrient Load

We have used some of the workings in this Aqualinc report to illustrate how nutrient load from a particular farm impacts on the resulting concentration of nutrient within the end receiving environment.

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

Total nutrient load within the Waiau River catchment have been estimated in the Aqualinc report.

The table estimates the total source load within the catchment at 4970 T N/year undergoing attenuation to result in an estimated 1864 T N/year as a nutrient load within the receiving waters at the Te Waewae Lagoon at the base of the catchment. Attenuation is estimated to be 62% which is the highest rate of attenuation seen across the subject 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)

Figure 9: Estimated loads of nitrogen and phosphorus in the eight study catchments[12]

The report then estimated how much these loads may reduce if mitigation scenarios are imposed on all farms within the catchment. For the Waiau River catchment, N could be reduced by 29% and P reduced by 39% and an overall improvement to water quality of 16% under the full suite of mitigations (M3).

The full suite of mitigations assessed by Aqualinc includes:

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

Figure 10: Description of mitigations assumed to apply under each mitigation level[13]

The referenced Aqualinc report classified off-site grazing blocks which support dairy farms as sheep and beef farms. We have used the same classification and consider that WRO is currently operating at what could be considered M3 level for sheep and beef farms. WRO contains forested areas in swales and

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

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

duckponds which are act in a similar manner to wetlands. WRO does not contain a feed pad due to its low stocking rate and nature of the major stock class it grazes; i.e. young dairy stock.

The Overseer model predicts that 19,868 kg N was lost below the root zone from the entire farm at WRO in 2017/18. Based on the N load data from figure 10, WRO contributes in the vicinity of 0.4% of the nitrogen load to the Waiau River catchment. This equates to 22 kg N/hectare across WRO annually. Overseer predicts that 4,721 kg N was lost to below the root zone from the 52ha fodder crop block. If the area of the fodder crop block is increased to the maximum of 100ha then an additional 3,552 kg N would be lost to below the root zone (using a subsequent reduction in pastoral block losses for the lowest per hectare N loss pastoral block). Combining both figures, then a change to the farm system to increase to 100ha of fodder cropping may result in total farm losses below the root zone predicted by Overseer to be 23,420 kg N. Assuming the Waiau catchment's attenuation rate of 62%, this represents 0.47% of the estimated realised catchment N load detailed in the Aqualinc report for the Waiau catchment.

The Overseer model predicts that 23 kg P is lost below the root zone from the 52ha fodder crop block. If the area of the fodder crop block is increased to the maximum of 100ha then Overseer predicts that no additional P would be lost to below the root zone due to the fact that pastoral blocks are modelled to lose more P than the fodder crop block. The overall farm system P losses at 529 kg P represents 1.5% of the catchment P load detailed in the Aqualinc report for the Waiau catchment.

The figures above show that the nutrient load from the applicant's operation represents a small proportion of the total Waiau River catchment nutrient load.

Nutrient Concentration

As described above, the proposal may see an increase in the contribution to N source contaminant load of 0.07% if intensive winter grazing is increased on WRO to 100ha. The proposal would see a decrease in the contribution to P contaminant load if intensive winter grazing is increased. Sediment and microbial contaminant losses are likely to decrease at a similar scale given they are lost to the environment under the same contaminant pathway processes as phosphorus.

A concurrent increase in the concentration of nitrogen in these waterways is possible. The median concentration of nutrients in the Orauea River between 2009 and 2017 are described above. These concentrations would include the implementation of M3 level mitigations on WRO but will not show the expected increase in nutrient load under the proposal. For example, WRO contributes in the vicinity of 0.4% of the nitrogen load to the Waiau River catchment and the proposal is likely to result in an increase of 0.07% to nitrogen load. Nitrogen concentrations are then likely to follow suit and result in a 0.028% increase to median nitrogen concentrations in the catchment. This increase represents such a miniscule amount that it is unlikely to show an increase in water quality degradation effects within this catchment. The water quality parameters measuring nitrogen in the receiving environments in this catchment are rated A band under the NOF standards and therefore the proposal is unlikely to result in adverse effects on water quality.

If we use phosphorus as a proxy for *E.coli* then the proposal is likely to result in a decrease in E. coli load to the receiving water bodies and therefore result in no adverse effects on water quality.

Both receiving waters are showing some signs of water quality degradation, but not at a level witnessed in many of the other lowland water bodies in other areas of Southland. The Orauea River has high *E.coli* levels but these are showing a meaningful improvement trend. Total oxidised nitrogen is also showing improvement and total phosphorus is not showing any trends. The Waiau River on the whole has good water quality. *E.coli* levels are improving, total oxidised nitrogen is rated A band with no evident trends and total phosphorus levels are low and not showing any trend. The applicant recognises that their proposal introduces more intensive winter grazing (of young dairy stock) into this catchment. However, as can be seen from the calculations above and the existing water quality medians, this catchment has the capacity for a negligible increase in N contaminants.

Summary

The proposal results in an expected negligible increase in total N lost to the environment and a predicted reduction in total P, sediment and microbial losses to the environment. Water quality will be maintained in the receiving environment.

1.0 Overview

This report provides details and commentary on the nutrient budgeting that has been undertaken for Woldwide Runoff (WR) and forms part of two wider resource consent applications for expanded dairying at Woldwide 1, 2, 4 & 5. Background information and details of the nutrient budgeting for Woldwide 1, 2, 4, 5 and Horner Block can be found in the associated nutrient budget analysis dated the 2nd August 2018.

WR is comprised of two separate blocks being the 385ha (~338ha effective) Merriburn Block and the 507ha (~321ha effective) Merrivale Block. The Merrivale Block is owned by the De Wolde's with the Merriburn Block being leased; however they are both run as a single farm. The two properties are located in Western Southland to the north east of Tuatapere.

WR is used to graze young stock from five dairy farms with baleage being made during periods of surplus grass production. Baleage is used to supplement the winter grazing of young stock at WR and is also sold to Woldwide Farms, Woldwide 4 and Woldwide 5. In addition to the raising of young stock and baleage production, WR also has approximately 100ha of commercial pine plantation and 60ha of Beech forest under a sustainable management plan.

In 2017/18 there were 1265 rising 1 year olds (R1's) at WR and 1265 rising 2 year olds (R2's). R2 numbers were trimmed to approximately 1150 in March due to a cull of empty cows (not in calve). In addition to the R1's and R2's there were 37 empty carry over cows and 70 mating bulls (1st November to 10th January) grazing on WR

In 2017/18 there was 52ha of Kale grown on the property (36.5ha on Merriburn and 15.5ha on Merrivale) to facilitate the wintering of the 1265 R1's between the 20th May and the 10th August. In addition to Kale, R1's were also feed approximately 1188 bales of baleage (240kg/DM).

Fertiliser inputs into the nutrient budget are based on purchase records from Ravensdown for the 2017-18 season, with soil test results entered as an Olsen P level of 25, which is the long term objective for WR. On certain areas of the Merrivale Block capital applications of phosphorus were applied in 17/18 to lift Olsen P levels.

	Total 17/18	**Per/ha 17/18**
Nitrogen Loss (kg/N)	19868	22
Phosphorus Loss (Kg/P)	529	0.6
Pasture Production (kg/DM)		10928

2.0 Modelling Inputs

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

2.1 Blocks

WR has been split into the following blocks:

Block Name	**Soil Type**	**Size (ha)**
Merriburn	Ihak_23a.1	140
Merriburn	Apar_6a.1	27.5
Merriburn Lower Fert	Ihak_23a.1	139.7
Merriburn Lower Fert	Apar_6a.1	21.1
Merriburn No Fert	Ihak_23a.1	9.5
Merrivale	Waiki_36a.1	176.5
Merrivale	Makar_3b.1	31.9
Merrivale Lower Fert	Waiki_36a.1	42.7
Merrivale Lower Fert	Malok_3a.1	27.7
Merrivale No Fert	Malok_3a.1	28.1
Merrivale No Fert	Waiki_36a.1	14.3
Kale	Rotating	Rotating (52ha)
Effective Farm Area		**659**
Plantation Forest		100
Beech Forest		60
Non-Productive		73
Total Farm Area		**892**

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

2.2 Climate Data

- Location setting = Southland
- Climate station tool used for block climate data
  - 1147 - 1185mm of rainfall
  - 9.9 - 10°C mean annual temperature
  - 731-1450mm daily rainfall pattern. Low variation.
  - 737 - 743mm mean annual PET

2.3 Farm System Inputs

Description	**17/18 Season**			
Stock on Farm	R1's – Friesian July – 0 Aug – 0 Sep – 0 Oct – 0 Nov – 1265 Dec – 1265 Jan – 1265 Feb – 1265 Mar – 1265 Apr – 1265 May – 1265 June – 1265	R2's – Friesian July – 1265 Aug – 1265 Sep – 1265 Oct – 1265 Nov – 1265 Dec – 1265 Jan – 1265 Feb – 1265 Mar – 1150 Apr – 1150 May – 1150 June – 0	Carry Overs July – 37 Aug – 37 Sep – 37 Oct – 37 Nov – 37 Dec – 37 Jan – 37 Feb – 37 Mar – 37 Apr – 37 May – 37 June – 37	Mating Bulls July – 0 Aug – 0 Sep – 0 Oct – 0 Nov – 70 Dec – 70 Jan – 23 Feb – 0 Mar – 0 Apr – 0 May – 0 June – 0
Crop Area & Inputs	52ha Kale (15.5ha Merrivale & 36.5ha Merriburn) - 12T/DM/ha - Direct Drilled November - 46kg/ha/N; 49kg/ha/P; 48kg/ha/K applied in December - Grazed 24hrs a day 20th May to 10th August by R1's (entered as June, July August in Overseer as can't use part months) - Re-sown to grass in October			
Supplements	Made on Farm - 1188 (240kg/DM) bales of baleage = 285T/DM → Feed on Kale Crop - 2854 (240kg/DM) bales of baleage = 685T/DM → Exported off WR			
Fertiliser	Merriburn 136kg/N/ha (Sep, Dec, Feb) 20kg/P/ha (Dec) 26kg/K/ha (Dec)	Merriburn Lower Fert 36kg/N/ha (Sep, Dec, Feb) 25kg/P/ha (Dec) 16kg/K/ha (Dec)	Merrivale 165kg/N/ha (Aug, Nov, Sep, Feb) 59kg/P/ha (Nov & Jan) 99kg/K/ha (Nov & Jan)	Merrivale Lower Fert 57kg/N/ha (Sep & Nov) 22kg/P/ha (Nov) 25kg/K/ha (Nov)

3.0 Modelling Results

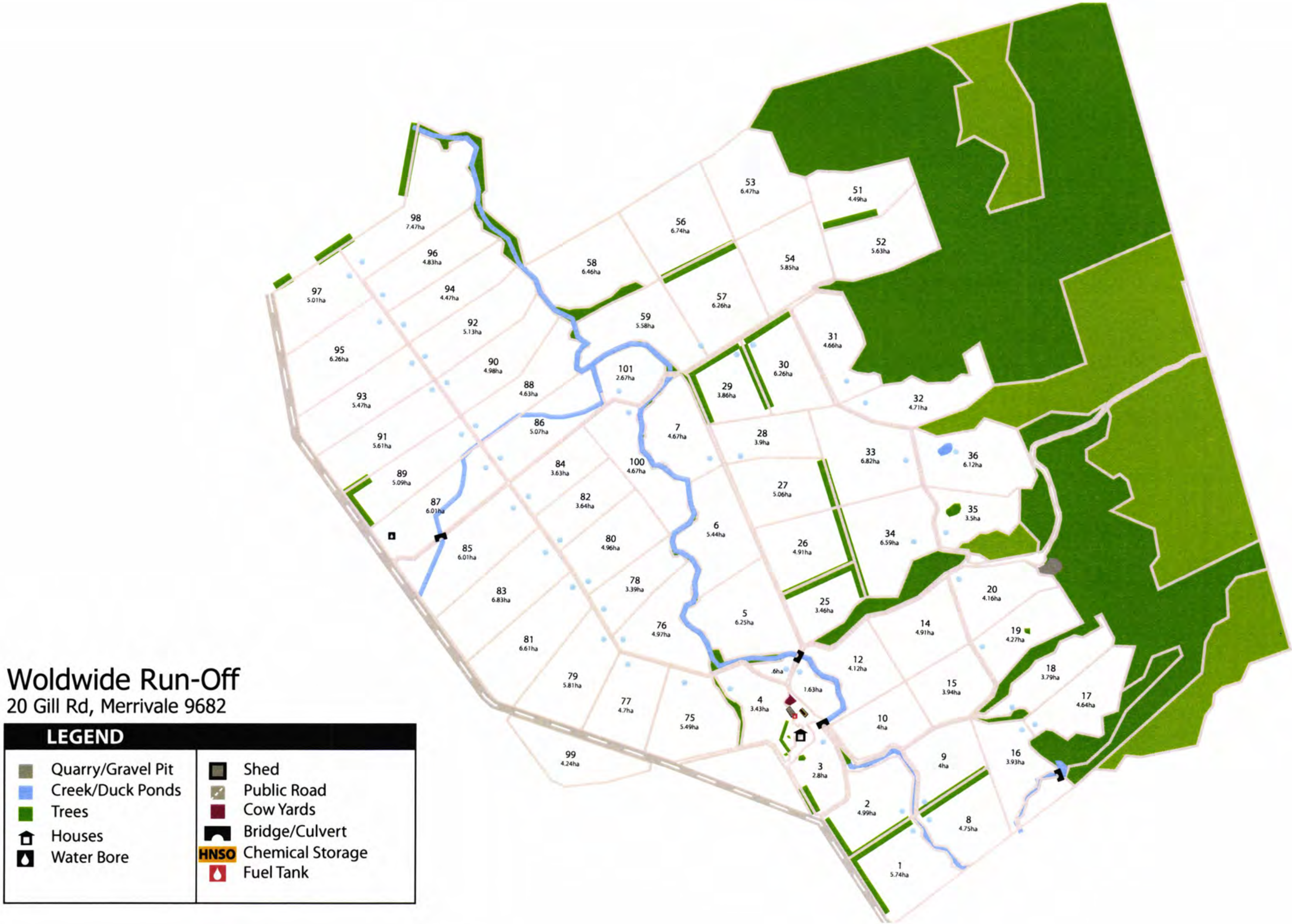
	Total 17/18	Per/ha 17/18
Nitrogen Loss (kg/N)	19868	22
Phosphorus Loss (Kg/P)	529	0.6
Pasture Production (kg/DM)		10928

4.0 Proposed Scenario

No proposed scenario has been modelled as the operation of WR is planned to continue within the nutrient loss parameters outlined in Section 3.0. On this basis the proposed nutrient budget is identical to that produced for the 17/18 season.

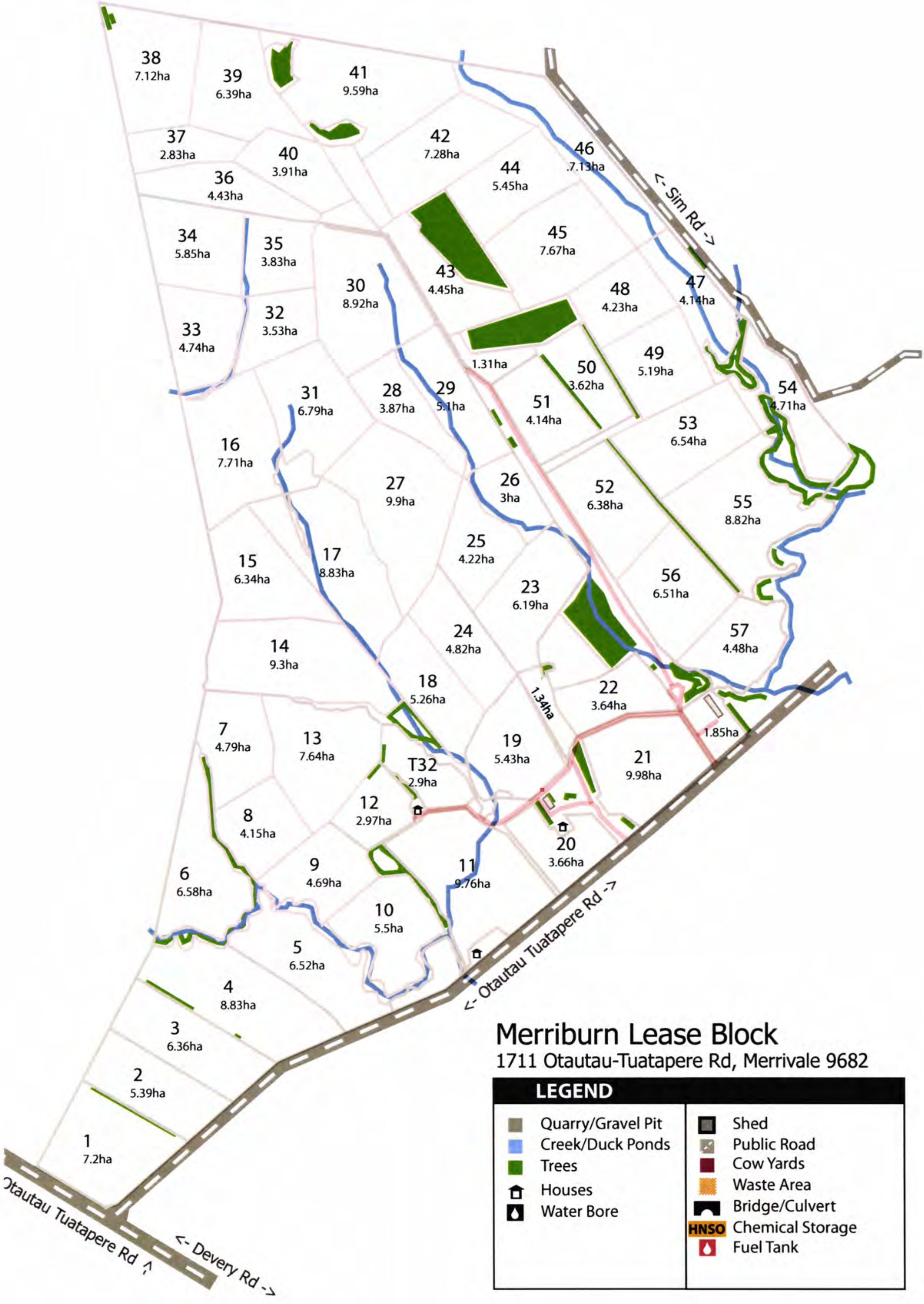
Appendix 1 – Block & Farm Maps

Woldwide Run-Off
20 Gill Rd, Merrivale 9682

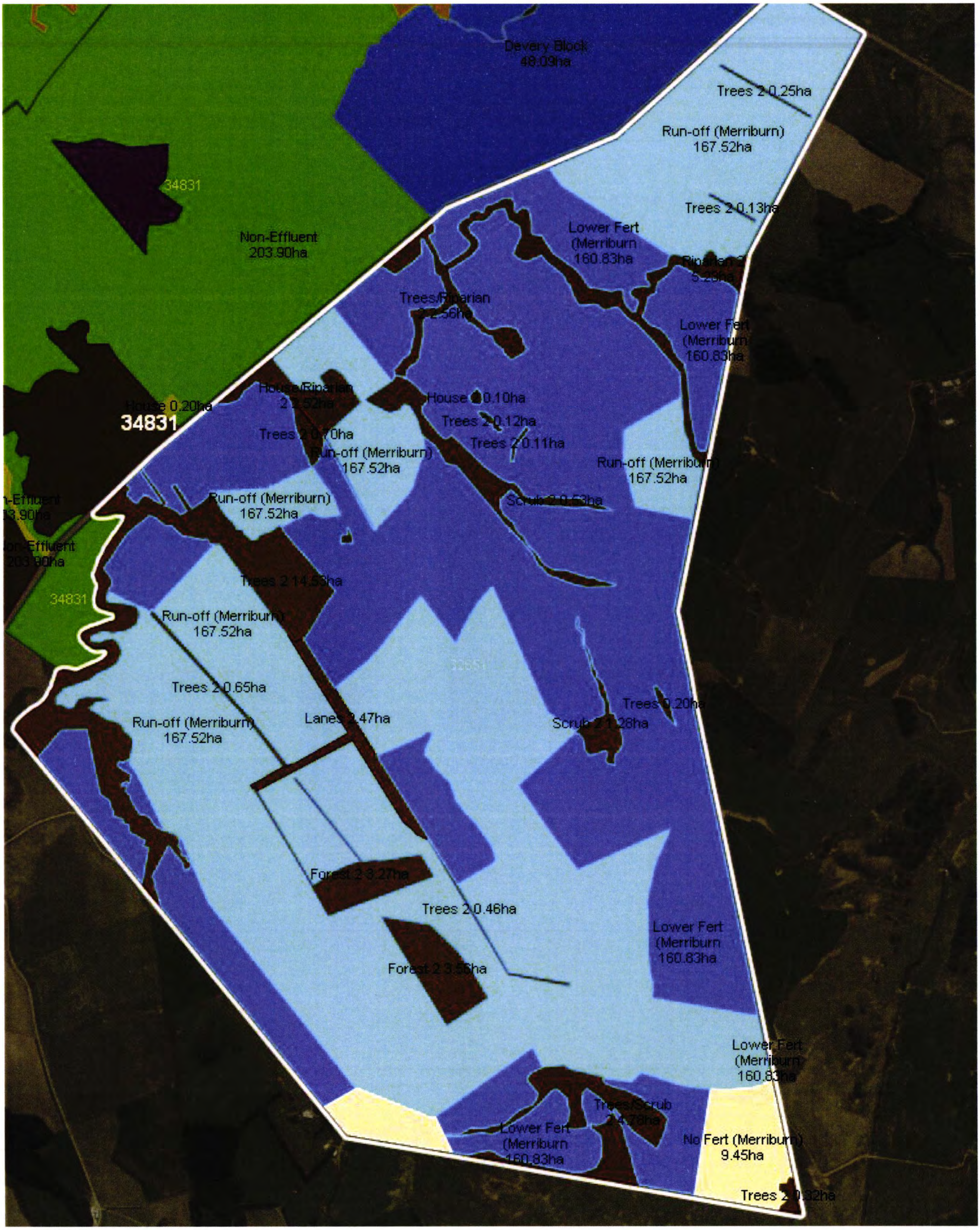


Merriburn Lease Block

1711 Otautau-Tuatapere Rd, Merrivale 9682




Run-off (Merrivale)
208.40ha
42.49ha
32651
Run-off Lower
Fert (Merrivale)
70.40ha
Trees 0.34ha


Devery Block
48.09ha
Trees 2 0.25ha
Run-off (Merriburn)
167.52ha
34831
Non-Effluent
203.90ha
Trees 2 0.13ha
Lower Fert
(Merriburn
160.83ha
Trees/Riparian
Lower Fert
(Merriburn
160.83ha
House/Riparian
House 0.20ha
34831
House 0.10ha
Trees 2 0.12ha
Trees 2 0.70ha
Run-off (Merriburn)
167.52ha
Trees 2 0.11ha
Run-off (Merriburn)
167.52ha
Run-off (Merriburn)
167.52ha
Trees 2 14.53ha
34831
Run-off (Merriburn)
167.52ha
Trees 2 0.65ha
Run-off (Merriburn)
167.52ha
Lanes 2.47ha
Scrub 2 1.28ha
Forest 2 3.27ha
Trees 2 0.46ha
Lower Fert
(Merriburn
160.83ha
Forest 2 3.56ha
Lower Fert
(Merriburn
160.83ha
Trees/Scrub
Lower Fert
(Merriburn
160.83ha
No Fert (Merriburn)
9.45ha

Appendix 2 – Nutrient Budgets & Block Reports

Version 6.3.0, on 2018-10-31 02:42:51

Abe De Wolde
Woldwide Runoff

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide Runoff (Merrivale & Merriburn) (17/18)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	79	25	33	31	0	0	0
Rain/clover N fixation	41	0	2	5	3	7	31
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	14	4	1	2	7	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements	14	2	15	1	3	1	1
To atmospheric	28	0	0	0	0	0	0
To water	22	0.6	8	36	24	6	25
Change in internal pools							
Plant material	1	0	-7	2	0	0	0
Organic pool	38	7	1	-5	0	0	0
Inorganic mineral	0	2	-15	0	-2	-3	-3
Inorganic soil pool	3	9	34	0	-31	3	7

Version 6.3.0, on 2018-10-31 02:44:59

Abe De Wolde
Woldwide Runoff

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide Runoff (Merrivale & Merriburn) (17/18)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Merriburn (Ihak_23a.1) ##	2646	21	4.5	132	136
Merriburn (Apar_6a.1) ##	445	18	3.9	132	136
Merriburn Lower Fert (Ihak_23a.1) ##	2486	20	4.2	100	72
Merriburn Lower Fert (Apar_6a.1) ##	332	17	3.8	100	72
Merriburn No Fert (Ihak_23a.1)	204	21	4.6	86	0
Merrivale (Waiki_36a.1) ##	5015	31	6.1	139	165
Merrivale (Makar_3b.1) ##	603	21	4.2	140	165
Merrivale Lower Fert (Waiki_36a.1)	882	21	N/A	95	57
Merrivale Lower Fert (Malok_3a.1)	683	25	N/A	97	57
Merrivale No Fert (Malok_3a.1)	769	27	N/A	88	0
Merrivale No Fert (Waiki_36a.1)	327	23	N/A	86	0
Kale	4721	91	**15.3**	150	82
Plantation Forest	250	2	N/A		
Beech Forest	180	3	N/A		
Other farm sources	325				
Whole farm	19868	22			
Less N removed in wetlands	0				
Farm output	19868	22			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Abe De Wolde
Woldwide Runoff
Client reference:
Farm name: Woldwide Runoff (Merrivale & Merriburn) (17/18)

Cain Duncan
Fonterra

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Merriburn (Ihak_23a.1) ##	72	0.6	Low	Low	n/a
Merriburn (Apar_6a.1) ##	14	0.6	Low	Low	n/a
Merriburn Lower Fert (Ihak_23a.1) ##	73	0.6	Low	Low	n/a
Merriburn Lower Fert (Apar_6a.1) ##	11	0.6	Low	Low	n/a
Merriburn No Fert (Ihak_23a.1)	5	0.5	Low	n/a	n/a
Merrivale (Waiki_36a.1) ##	97	0.6	Low	Medium	n/a
Merrivale (Makar_3b.1) ##	62	2.1	High	High *	n/a
Merrivale Lower Fert (Waiki_36a.1)	32	0.8	Low	Low	n/a
Merrivale Lower Fert (Malok_3a.1)	22	0.8	Medium	Low	n/a
Merrivale No Fert (Malok_3a.1)	21	0.7	Medium	n/a	n/a
Merrivale No Fert (Waiki_36a.1)	10	0.7	Low	n/a	n/a
Kale	23	0.4	n/a	n/a	n/a
Plantation Forest	12	0.1	n/a	n/a	n/a
Beech Forest	6	0.1	n/a	n/a	n/a
Other farm sources	70				
Whole farm	529	0.6			

** Fertiliser loss is outside the range for New Zealand data - see comments for each block

Has a fodder crop rotating though, results for pastoral block component only

Appendix 3 – Fertiliser Records

Nutrient summary report

WOLDWIDE RUNOFF LTD - 60842387

Query range : 01 Jun 2017 to 31 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
1	16/08/2017	5.3	RZR - AMM SE	134	48	-	-	13	-	-
	08/12/2017	5.2	WW R/off Post Cut Maintenance	1410	22	55	102	67	317	3
	13/02/2018	5.3	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**110**	**50**	**93**	**73**	**289**	**3**
10	16/08/2017	1.7	RZR - AMM SE	130	46	-	-	12	-	-
	13/02/2018	3.8	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**67**	**-**	**-**	**5**	**-**	**-**
100	16/08/2017	3.9	RZR - AMM SE	139	50	-	-	13	-	-
	05/09/2017	3.8	UREA BULK	151	69	-	-	-	-	-
	21/11/2017	4	WW R/off Post Cut Maintenance	1403	22	55	101	67	316	3
	12/02/2018	4.1	Urea	111	51	-	-	-	-	-
	Area weighted total				**161**	**47**	**87**	**68**	**271**	**2**
101	16/08/2017	2.1	RZR - AMM SE	135	48	-	-	13	-	-
	05/09/2017	2.3	UREA BULK	135	62	-	-	-	-	-
	21/11/2017	2.5	WW R/off Post Cut Maintenance	1426	23	56	103	68	321	3
	12/02/2018	2.5	Urea	113	52	-	-	-	-	-
	Area weighted total				**161**	**52**	**97**	**74**	**302**	**3**
12	16/08/2017	3.4	RZR - AMM SE	137	49	-	-	13	-	-
	08/01/2018	3.7	WW R/Off Pot super/Flexi/Lime	1052	23	34	33	41	275	3

	13/02/2018	3.7	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**107**	**30**	**30**	**48**	**246**	**3**
14	08/01/2018	4.6	WW R/Off Pot super/Flexi/Lime	1035	23	33	32	40	271	3
	13/02/2018	4.7	UREA BULK	106	49	-	-	-	-	-
	Area weighted total				**67**	**31**	**30**	**38**	**252**	**3**
15	22/11/2017	2	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	219	-	-	-	-	-	-
	08/01/2018	1.3	WW R/Off Pot super/Flexi/Lime	1152	25	37	36	45	301	3
	14/03/2018	3.1	UREA	107	49	-	-	-	-	-
	Area weighted total				**47**	**12**	**12**	**15**	**101**	**1**
16	22/11/2017	3.1	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	224	-	-	-	-	-	-
	13/02/2018	3.7	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**46**	**-**	**-**	**-**	**-**	**-**
16b	22/11/2017	0.4	SELENIUM SELPRILL DOUBLE 2%SE DG *	230	-	-	-	-	-	-
	13/02/2018	0.8	UREA BULK	121	55	-	-	-	-	-
	Area weighted total				**45**	**-**	**-**	**-**	**-**	**-**
17	22/11/2017	3.8	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	233	-	-	-	-	-	-
	Area weighted total				**-**	**-**	**-**	**-**	**-**	**-**
18	22/11/2017	3.3	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	227	-	-	-	-	-	-
	Area weighted total				**-**	**-**	**-**	**-**	**-**	**-**

19	13/02/2018	4.1	UREA BULK	110	50	-	-	-	-	-
	Area weighted total				**48**	**-**	**-**	**-**	**-**	**-**
2	16/08/2017	4.4	RZR - AMM SE	131	47	-	-	13	-	-
	08/12/2017	4.6	WW R/off Post Cut Maintenance	1413	23	55	102	67	318	3
	13/02/2018	4.7	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**110**	**51**	**94**	**73**	**293**	**3**
20	08/01/2018	3.3	WW R/Off Pot super/Flexi/Lime	1051	23	34	33	41	275	3
	Area weighted total				**19**	**27**	**27**	**33**	**221**	**2**
25	22/11/2017	3.2	WW R/Off Pot super/Flexi/Lime	1003	22	32	31	39	262	3
	13/02/2018	3.3	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**69**	**29**	**29**	**36**	**240**	**3**
26	22/11/2017	4.3	WW R/Off Pot super/Flexi/Lime	1015	22	32	32	40	265	3
	13/02/2018	4.5	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**65**	**28**	**28**	**35**	**233**	**2**
27	22/11/2017	3.8	WW R/Off Pot super/Flexi/Lime	1049	23	34	33	41	274	3
	13/02/2018	4.3	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**60**	**25**	**25**	**31**	**208**	**2**
28	22/11/2017	3.5	WW R/Off Pot super/Flexi/Lime	1030	23	33	32	40	269	3
	13/02/2018	3.8	UREA BULK	108	49	-	-	-	-	-
	Area weighted total				**68**	**30**	**29**	**37**	**244**	**3**
29	16/08/2017	3.4	RZR - AMM SE	135	48	-	-	13	-	-
	08/01/2018	3.3	WW R/Off Pot super/Flexi/Lime	1009	22	32	32	39	264	3
	13/02/2018	3.5	UREA BULK	110	51	-	-	-	-	-

	Area weighted total				**108**	**27**	**27**	**45**	**224**	**2**
2A	05/09/2017	1.6	AMMO 36 BULK	138	49	-	-	13	-	-
	12/02/2018	1.9	UREA BULK	123	56	-	-	-	-	-
	Area weighted total				**87**	**-**	**-**	**10**	**-**	**-**
3	16/08/2017	2.4	RZR - AMM SE	138	49	-	-	13	-	-
	22/11/2017	2.3	WW R/Off Pot super/Flexi/Lime	1028	23	33	32	40	269	3
	13/02/2018	2.5	UREA BULK	110	50	-	-	-	-	-
	Area weighted total				**105**	**27**	**26**	**44**	**221**	**2**
30	16/08/2017	4	RZR - AMM SE	128	46	-	-	12	-	-
	13/02/2018	4.4	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**79**	**-**	**-**	**10**	**-**	**-**
31	08/01/2018	4.1	WW R/Off Pot super/Flexi/Lime	1058	23	34	33	41	277	3
	Area weighted total				**21**	**30**	**29**	**37**	**246**	**3**
32	22/11/2017	4.2	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	237	-	-	-	-	-	-
	Area weighted total				**-**	**-**	**-**	**-**	**-**	**-**
33	21/11/2017	4.5	WW R/off Post Cut Maintenance	1471	23	57	106	70	331	3
	13/02/2018	5.7	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**58**	**38**	**71**	**47**	**220**	**2**
34	22/11/2017	5.9	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	224	-	-	-	-	-	-
	13/02/2018	6.2	UREA BULK	107	49	-	-	-	-	-
	Area weighted total				**46**	**-**	**-**	**-**	**-**	**-**
35	22/11/2017	2.8	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	234	-	-	-	-	-	-

	Area weighted total				**-**	**-**	**-**	**-**	**-**	**-**
36	22/11/2017	5.3	SELENIUM SELPRILL DOUBLE 2%SE DG CL *	225	-	-	-	-	-	-
	Area weighted total				**-**	**-**	**-**	**-**	**-**	**-**
4a	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
4b	16/08/2017	3	RZR - AMM SE	142	51	-	-	14	-	-
	22/11/2017	3.2	WW R/Off Pot super/Flexi/Lime	1031	23	33	32	40	270	3
	13/02/2018	3	UREA BULK	112	51	-	-	-	-	-
	Area weighted total				**110**	**30**	**30**	**49**	**249**	**3**
4c	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
5	16/08/2017	5.6	RZR - AMM SE	132	47	-	-	13	-	-
	30/11/2017	6	MURIVALE KALE	392	58	66	28	3	-	-
	Area weighted total				**98**	**63**	**26**	**14**	**-**	**-**
51	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
52	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
53	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
54	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
56	16/08/2017	6.3	RZR - AMM SE	133	48	-	-	13	-	-
	08/01/2018	6.3	WW R/Off Pot super/Flexi/Lime	990	22	32	31	39	259	3
	13/02/2018	6.5	UREA BULK	108	49	-	-	-	-	-
	Area weighted total				**112**	**29**	**29**	**48**	**240**	**3**
57	16/08/2017	5.5	RZR - AMM SE	128	46	-	-	12	-	-
	22/11/2017	5.9	WW R/Off Pot super/Flexi/Lime	988	22	32	31	39	258	3
	13/02/2018	5.9	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**108**	**30**	**29**	**47**	**244**	**3**
58	16/08/2017	6	RZR - AMM SE	137	49	-	-	13	-	-

	05/09/2017	5.9	UREA BULK	128	59	-	-	-	-	-
	08/12/2017	5.8	WW R/off Post Cut Maintenance	1417	23	55	102	67	319	3
	13/02/2018	6.1	UREA BULK	105	48	-	-	-	-	-
	Area weighted total				**166**	**49**	**91**	**72**	**285**	**3**
59	16/08/2017	5.2	RZR - AMM SE	137	49	-	-	13	-	-
	05/09/2017	5.2	UREA BULK	135	62	-	-	-	-	-
	08/01/2018	4.9	WW R/Off Pot super/Flexi/Lime	1007	22	32	32	39	263	3
	13/02/2018	5.3	UREA BULK	106	49	-	-	-	-	-
	Area weighted total				**168**	**28**	**28**	**47**	**230**	**2**
6	16/08/2017	5	RZR - AMM SE	136	48	-	-	13	-	-
	30/11/2017	5.3	MURIVALE KALE	396	59	67	28	3	-	-
	Area weighted total				**102**	**65**	**27**	**15**	**-**	**-**
7	16/08/2017	4	RZR - AMM SE	133	48	-	-	13	-	-
	30/11/2017	4.4	MURIVALE KALE	404	60	68	28	3	-	-
	Area weighted total				**97**	**64**	**27**	**14**	**-**	**-**
75	16/08/2017	5.2	RZR - AMM SE	129	46	-	-	12	-	-
	05/09/2017	5.3	UREA BULK	129	59	-	-	-	-	-
	22/11/2017	5.2	WW R/Off Pot super/Flexi/Lime	997	22	32	31	39	261	3
	08/01/2018	5	WW R/Off Pot super/Flexi/Lime	973	21	31	31	38	254	3
	Area weighted total				**141**	**59**	**58**	**84**	**482**	**5**
76	16/08/2017	4.5	RZR - AMM SE	147	52	-	-	14	-	-
	05/09/2017	4.5	UREA BULK	136	63	-	-	-	-	-
	22/11/2017	4.6	WW R/Off Pot super/Flexi/Lime	999	22	32	31	39	261	3
	12/02/2018	4.5	Urea	117	54	-	-	-	-	-
	14/03/2018	4	UREA	104	48	-	-	-	-	-

	Area weighted total				**212**	**30**	**29**	**49**	**244**	**3**
77	16/08/2017	4.5	RZR - AMM SE	133	47	-	-	13	-	-
	05/09/2017	4.6	UREA BULK	134	61	-	-	-	-	-
	28/10/2017	4.5	Post Cust - Grazed mix	1062	36	27	65	33	256	5
	08/01/2018	4.5	WW R/Off Pot super/Flexi/Lime	1033	23	33	32	40	270	3
	Area weighted total				**161**	**58**	**93**	**83**	**504**	**7**
78	16/08/2017	3.3	RZR - AMM SE	141	50	-	-	13	-	-
	05/09/2017	3.3	UREA BULK	134	62	-	-	-	-	-
	28/10/2017	3.2	Post Cust - Grazed mix	1064	36	27	65	33	256	5
	08/12/2017	3	WW R/off Post Cut Maintenance	1513	24	59	109	72	340	3
	12/02/2018	3.3	Urea	113	52	-	-	-	-	-
	Area weighted total				**214**	**78**	**159**	**109**	**545**	**7**
79	16/08/2017	5.7	RZR - AMM SE	132	47	-	-	13	-	-
	05/09/2017	5.6	UREA BULK	130	60	-	-	-	-	-
	28/10/2017	5.7	Post Cust - Grazed mix	1051	36	27	64	33	253	4
	08/01/2018	5.6	WW R/Off Pot super/Flexi/Lime	1002	22	32	31	39	262	3
	21/02/2018	5.6	UREA BULK	110	50	-	-	-	-	-
	Area weighted total				**209**	**57**	**93**	**82**	**498**	**7**
8	13/02/2018	4.5	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**47**	**-**	**-**	**-**	**-**	**-**
80	16/08/2017	4.7	RZR - AMM SE	129	46	-	-	12	-	-
	05/09/2017	4.9	UREA BULK	126	58	-	-	-	-	-
	12/02/2018	4.9	Urea	107	49	-	-	-	-	-
	Area weighted total				**149**	**-**	**-**	**12**	**-**	**-**

81	16/08/2017	6.3	RZR - AMM SE	124	44	-	-	12	-	-
	05/09/2017	6.4	UREA BULK	124	57	-	-	-	-	-
	28/10/2017	6.4	Post Cust - Grazed mix	1028	35	26	63	32	248	4
	08/01/2018	6.4	WW R/Off Pot super/Flexi/Lime	1042	23	33	33	41	272	3
	13/02/2018	5.1	UREA BULK	102	47	-	-	-	-	-
	Area weighted total				**189**	**58**	**93**	**82**	**503**	**7**
82	16/08/2017	3.4	RZR - AMM SE	123	44	-	-	12	-	-
	05/09/2017	3.5	UREA BULK	119	55	-	-	-	-	-
	28/10/2017	3.6	Post Cust - Grazed mix	1107	37	28	68	35	267	5
	08/12/2017	3.4	WW R/off Post Cut Maintenance	1525	24	59	110	73	343	3
	12/02/2018	3.6	Urea	100	46	-	-	-	-	-
	Area weighted total				**198**	**83**	**168**	**112**	**578**	**7**
83	16/08/2017	6.7	RZR - AMM SE	128	46	-	-	12	-	-
	05/09/2017	6.7	UREA BULK	129	59	-	-	-	-	-
	28/10/2017	4.7	Post Cust - Grazed mix	1062	36	27	65	33	256	5
	28/10/2017	1.9	Post Cust - Grazed mix	1001	34	26	61	31	241	4
	08/01/2018	6.5	WW R/Off Pot super/Flexi/Lime	1135	25	36	36	44	297	3
	12/02/2018	6.7	Urea	111	51	-	-	-	-	-
	Area weighted total				**210**	**61**	**96**	**86**	**527**	**7**
84	16/08/2017	3.2	RZR - AMM SE	125	45	-	-	12	-	-
	05/09/2017	3.5	UREA BULK	139	64	-	-	-	-	-
	28/10/2017	3.5	Post Cust - Grazed mix	1084	37	28	66	34	261	5

	08/12/2017	3.3	WW R/off Post Cut Maintenance	1466	23	57	106	70	330	3
	12/02/2018	3.6	Urea	113	52	-	-	-	-	-
	Area weighted total				**209**	**79**	**160**	**107**	**552**	**7**
85	16/08/2017	6.4	RZR - AMM SE	135	48	-	-	13	-	-
	05/09/2017	6.6	UREA BULK	133	61	-	-	-	-	-
	28/10/2017	6.3	Post Cust - Grazed mix	1083	37	28	66	34	261	5
	08/12/2017	6.6	WW R/off Post Cut Maintenance	1407	22	55	101	67	317	3
	12/02/2018	6.7	Urea	113	52	-	-	-	-	-
	Area weighted total				**203**	**75**	**153**	**104**	**524**	**7**
86	16/08/2017	4.4	RZR - AMM SE	139	50	-	-	13	-	-
	05/09/2017	4.5	UREA BULK	137	63	-	-	-	-	-
	08/12/2017	4.1	WW R/off Post Cut Maintenance	1537	24	60	111	73	346	3
	Area weighted total				**118**	**49**	**91**	**71**	**283**	**3**
87	16/08/2017	5.5	RZR - AMM SE	147	52	-	-	14	-	-
	05/09/2017	5.4	UREA BULK	142	65	-	-	-	-	-
	08/12/2017	0	WW R/off Post Cut Maintenance	1300	21	51	94	62	293	3
	08/12/2017	5.4	WW R/off Post Cut Maintenance	1490	24	58	107	71	335	3
	21/02/2018	5.4	UREA BULK	113	52	-	-	-	-	-
	Area weighted total				**173**	**52**	**96**	**76**	**299**	**3**
88	16/08/2017	4	RZR - AMM SE	135	48	-	-	13	-	-
	05/09/2017	4.3	UREA BULK	142	65	-	-	-	-	-
	28/10/2017	4.3	Post Cust - Grazed mix	1050	35	27	64	33	253	4

	08/12/2017	4.1	WW R/off Post Cut Maintenance	1444	23	56	104	69	325	3
	Area weighted total				**156**	**75**	**153**	**103**	**525**	**7**
89	16/08/2017	4.8	RZR - AMM SE	127	45	-	-	12	-	-
	05/09/2017	4.8	UREA BULK	136	62	-	-	-	-	-
	28/10/2017	0.6	Post Cust - Grazed mix	982	33	25	60	31	237	4
	28/10/2017	4.1	Post Cust - Grazed mix	1026	35	26	63	32	247	4
	08/12/2017	4.8	WW R/off Post Cut Maintenance	1371	22	53	99	65	309	3
	21/02/2018	4.9	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**203**	**75**	**151**	**103**	**519**	**7**
9	13/02/2018	3.3	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**42**	**-**	**-**	**-**	**-**	**-**
90	16/08/2017	4.1	RZR - AMM SE	130	46	-	-	12	-	-
	05/09/2017	4.8	UREA BULK	134	62	-	-	-	-	-
	28/10/2017	4.9	Post Cust - Grazed mix	1096	37	28	67	34	264	5
	29/01/2018	4.7	WW R/off Post Cut Maintenance	1410	22	55	102	67	317	3
	Area weighted total				**155**	**79**	**162**	**107**	**557**	**7**
91	16/08/2017	5.3	RZR - AMM SE	114	41	-	-	11	-	-
	05/09/2017	5.4	UREA BULK	112	52	-	-	-	-	-
	28/10/2017	1.6	Post Cust - Grazed mix	1081	37	28	66	34	260	5
	28/10/2017	3.8	Post Cust - Grazed mix	1063	36	27	65	33	256	5
	08/12/2017	5.4	WW R/off Post Cut Maintenance	1287	20	50	93	61	290	3
	Area weighted total				**142**	**75**	**152**	**102**	**527**	**7**

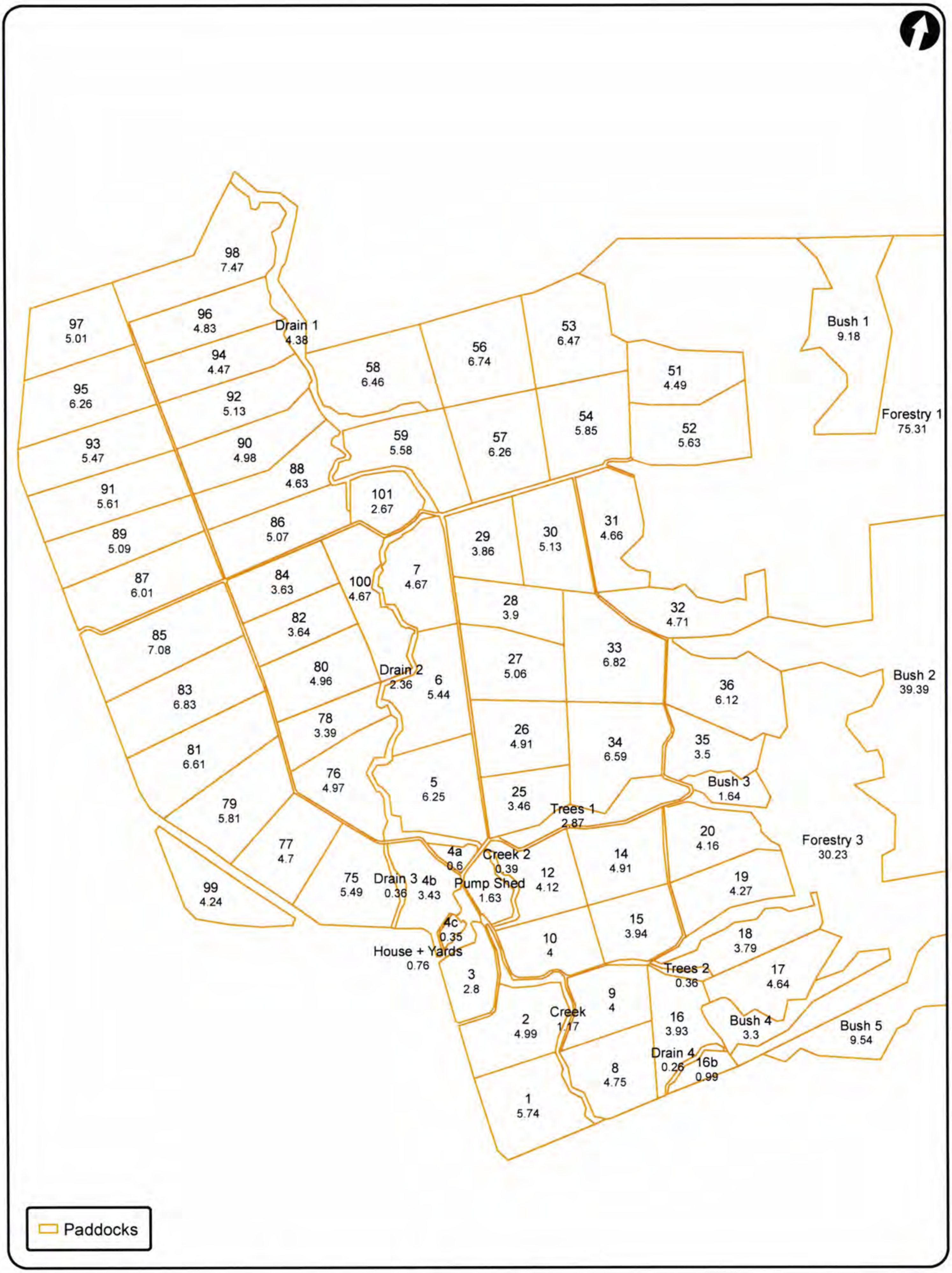
92	16/08/2017	4.4	RZR - AMM SE	124	44	-	-	12	-	-
	05/09/2017	4.9	UREA BULK	119	55	-	-	-	-	-
	21/11/2017	4.7	WW R/off Post Cut Maintenance	1356	22	53	98	65	305	3
	Area weighted total				**110**	**48**	**89**	**69**	**277**	**2**
93	16/08/2017	5.3	RZR - AMM SE	133	48	-	-	13	-	-
	05/09/2017	5.3	UREA BULK	133	61	-	-	-	-	-
	28/10/2017	5.3	Post Cust - Grazed mix	1062	36	27	65	33	256	5
	08/12/2017	5.3	WW R/off Post Cut Maintenance	1324	21	52	95	63	298	3
	21/02/2018	5.4	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**211**	**77**	**156**	**106**	**539**	**7**
94	16/08/2017	3.7	RZR - AMM SE	129	46	-	-	12	-	-
	05/09/2017	4.3	UREA BULK	130	60	-	-	-	-	-
	28/10/2017	4.3	Post Cust - Grazed mix	1002	34	26	61	31	241	4
	08/12/2017	4.2	WW R/off Post Cut Maintenance	1458	23	57	105	69	328	3
	Area weighted total				**149**	**78**	**157**	**105**	**538**	**7**
95	16/08/2017	6.1	RZR - AMM SE	121	43	-	-	12	-	-
	05/09/2017	6.1	UREA BULK	119	55	-	-	-	-	-
	28/10/2017	6	Post Cust - Grazed mix	977	33	25	60	31	235	4
	08/12/2017	6.1	WW R/off Post Cut Maintenance	1409	22	55	102	67	317	3
	21/02/2018	6.1	UREA BULK	100	46	-	-	-	-	-
	Area weighted total				**194**	**78**	**158**	**107**	**539**	**7**
96	16/08/2017	4.2	RZR - AMM SE	125	45	-	-	12	-	-
	05/09/2017	4.4	UREA BULK	122	56	-	-	-	-	-

	28/10/2017	4.7	Post Cust - Grazed mix	1019	34	26	62	32	245	4
	08/12/2017	4.6	WW R/off Post Cut Maintenance	1388	22	54	100	66	312	3
	Area weighted total				**145**	**77**	**156**	**105**	**537**	**7**
97	16/08/2017	4.7	RZR - AMM SE	135	48	-	-	13	-	-
	05/09/2017	4.8	UREA BULK	133	61	-	-	-	-	-
	28/10/2017	4.9	Post Cust - Grazed mix	1027	35	26	63	32	247	4
	08/12/2017	4.6	WW R/off Post Cut Maintenance	1407	22	55	101	67	317	3
	21/02/2018	4.9	UREA BULK	113	52	-	-	-	-	-
	Area weighted total				**210**	**76**	**155**	**105**	**533**	**7**
98	16/08/2017	6.6	RZR - AMM SE	144	51	-	-	14	-	-
	05/09/2017	6.8	UREA BULK	130	60	-	-	-	-	-
	28/10/2017	7.1	Post Cust - Grazed mix	1059	36	27	65	33	255	4
	08/12/2017	0.5	WW R/off Post Cut Maintenance	1728	28	67	125	82	389	3
	08/12/2017	7.1	WW R/off Post Cut Maintenance	1420	23	55	102	68	320	3
	21/02/2018	5.3	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**193**	**83**	**167**	**114**	**573**	**7**
99	**Area weighted total**				**-**	**-**	**-**	**-**	**-**	**-**
Weighted average rate based on applied areas and rates for selected areas					**109**	**38**	**62**	**51**	**254**	**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

Merrivale

0 80 160 320 480 640 Metres

ravensdown

11 October 2018

Nutrient summary report

WOLDWIDE RUNOFF LTD - 60842387

Query range : 01 Jun 2017 to 31 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
2A	05/09/2017	1.6	AMMO 36 BULK	138	49	-	-	13	-	-
	12/02/2018	1.9	UREA BULK	123	56	-	-	-	-	-
	Area weighted total				**87**	**-**	**-**	**10**	**-**	**-**
A1	05/09/2017	4	AMMO 36 BULK	139	50	-	-	13	-	-
	12/02/2018	4	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**89**	**-**	**-**	**12**	**-**	**-**
B1	05/09/2017	6.2	AMMO 36 BULK	129	46	-	-	12	-	-
	24/11/2017	5.9	Post Cut mix to be cut again	355	58	10	54	12	22	7
	12/02/2018	6.4	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**146**	**9**	**49**	**23**	**20**	**7**
B2	05/09/2017	7.7	AMMO 36 BULK	144	52	-	-	14	-	-
	10/01/2018	7.8	Merriburn Grazed MaintenanCE+N	887	43	23	-	29	240	5
	12/02/2018	8.2	UREA BULK	115	53	-	-	-	-	-
	Area weighted total				**132**	**21**	**-**	**37**	**211**	**5**
barn lane?	05/09/2017	1.1	AMMO 36 BULK	122	44	-	-	12	-	-
	12/02/2018	1.2	UREA BULK	105	48	-	-	-	-	-
	Area weighted total				**78**	**-**	**-**	**10**	**-**	**-**
C1	05/09/2017	5.9	AMMO 36 BULK	129	46	-	-	12	-	-
	24/11/2017	6	Post Cut mix to be cut again	352	57	10	53	12	21	7
	12/02/2018	6.2	UREA BULK	110	50	-	-	-	-	-

	Area weighted total				**146**	**9**	**50**	**22**	**20**	**7**
C2	05/09/2017	6.2	AMMO 36 BULK	137	49	-	-	13	-	-
	10/01/2018	6.1	Merriburn Grazed MaintenanCE+N	894	44	24	-	29	242	5
	12/02/2018	6.3	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**136**	**22**	**-**	**39**	**225**	**5**
C3	05/09/2017	3.7	AMMO 36 BULK	148	53	-	-	14	-	-
	08/12/2017	3.2	Post Cust - Grazed mix	1118	38	29	68	35	269	5
	Area weighted total				**67**	**20**	**47**	**35**	**184**	**3**
D1	05/09/2017	4	AMMO 36 BULK	133	48	-	-	13	-	-
	24/11/2017	4	Post Cut mix to be cut again	358	58	10	54	12	22	7
	12/02/2018	4.2	UREA BULK	114	53	-	-	-	-	-
	Area weighted total				**150**	**9**	**51**	**23**	**20**	**7**
D2	05/09/2017	4.5	AMMO 36 BULK	150	54	-	-	14	-	-
	24/11/2017	4.4	Merriburn Grazed Maintenance+N	932	45	25	-	30	252	6
	12/02/2018	4.7	UREA BULK	112	51	-	-	-	-	-
	Area weighted total				**133**	**21**	**-**	**38**	**216**	**5**
D3	05/09/2017	2.5	AMMO 36 BULK	138	50	-	-	13	-	-
	Area weighted total				**30**	**-**	**-**	**8**	**-**	**-**
E1	05/09/2017	1	AMMO 36 BULK	135	48	-	-	13	-	-
	24/11/2017	0.8	Merriburn Grazed Maintenance+N	972	47	26	-	31	263	6
	12/02/2018	1.2	UREA BULK	120	55	-	-	-	-	-
	Area weighted total				**114**	**15**	**-**	**29**	**157**	**4**
E2	05/09/2017	2.1	AMMO 36 BULK	135	48	-	-	13	-	-
	24/11/2017	2.9	Merriburn Grazed Maintenance+N	992	48	26	-	32	269	6

	12/02/2018	3.3	UREA BULK	112	52	-	-	-	-	-
	Area weighted total				**113**	**21**	**-**	**33**	**212**	**5**
E3	05/09/2017	3.2	AMMO 36 BULK	141	51	-	-	14	-	-
	11/01/2018	1.1	Merriburn Grazed Maintenance+N	872	42	23	-	28	236	5
	12/02/2018	4	UREA BULK	118	54	-	-	-	-	-
	Area weighted total				**100**	**6**	**-**	**18**	**60**	**1**
F1	05/09/2017	3	AMMO 36 BULK	132	47	-	-	13	-	-
	24/11/2017	2.2	Merriburn Grazed Maintenance+N	924	45	24	-	30	250	6
	12/02/2018	3.7	UREA BULK	116	53	-	-	-	-	-
	Area weighted total				**98**	**12**	**-**	**23**	**122**	**3**
F2	05/09/2017	6.7	AMMO 36 BULK	144	52	-	-	14	-	-
	11/01/2018	7.3	Merriburn Grazed Maintenance+N	913	44	24	-	30	247	6
	12/02/2018	7.3	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**134**	**23**	**-**	**40**	**236**	**5**
F3	05/09/2017	4.8	AMMO 36 BULK	140	50	-	-	13	-	-
	11/01/2018	5.2	Merriburn Grazed Maintenance+N	901	44	24	-	29	244	6
	12/02/2018	5.3	UREA BULK	113	52	-	-	-	-	-
	Area weighted total				**136**	**23**	**-**	**40**	**232**	**5**
F4	05/09/2017	0.7	AMMO 36 BULK	145	52	-	-	14	-	-
	Area weighted total				**9**	**-**	**-**	**2**	**-**	**-**
G1	05/09/2017	1.4	AMMO 36 BULK	120	43	-	-	11	-	-
	24/11/2017	1.4	Merriburn Grazed Maintenance+N	865	42	23	-	28	234	5
	21/02/2018	1.5	UREA BULK	102	47	-	-	-	-	-
	Area weighted total				**120**	**20**	**-**	**35**	**206**	**5**
G2	05/09/2017	5.6	AMMO 36 BULK	145	52	-	-	14	-	-

	24/11/2017	5.6	Merriburn Grazed Maintenance+N	956	47	25	-	31	259	6
	11/01/2018	6.6	Merriburn Grazed Maintenance+N	957	47	25	-	31	259	6
	12/02/2018	7.1	UREA BULK	114	53	-	-	-	-	-
	Area weighted total				**169**	**43**	**-**	**63**	**435**	**10**
G3	05/09/2017	5.8	AMMO 36 BULK	145	52	-	-	14	-	-
	Area weighted total				**31**	**-**	**-**	**8**	**-**	**-**
G4	**Area weighted total**				-	-	-	-	-	-
H1	05/09/2017	0.6	AMMO 36 BULK	136	49	-	-	13	-	-
	24/11/2017	0.6	Merriburn Grazed Maintenance+N	936	46	25	-	30	253	6
	21/02/2018	0.7	UREA BULK	104	48	-	-	-	-	-
	Area weighted total				**113**	**19**	**-**	**34**	**194**	**4**
H2	16/08/2017	4.2	RZR - AMM SE	139	50	-	-	13	-	-
	24/11/2017	4.1	Post Cut mix to be cut again	358	58	10	54	12	22	7
	Area weighted total				**100**	**9**	**50**	**23**	**20**	**7**
H3	05/09/2017	3.2	AMMO 36 BULK	141	51	-	-	14	-	-
	24/11/2017	3.1	Merriburn Grazed Maintenance+N	930	45	25	-	30	252	6
	21/02/2018	3.3	UREA BULK	119	55	-	-	-	-	-
	Area weighted total				**124**	**20**	**-**	**35**	**200**	**5**
H4	16/08/2017	2.3	RZR - AMM SE	140	50	-	-	13	-	-
	24/11/2017	0.3	Post Cut mix to be cut again	374	61	10	57	12	23	8
	08/12/2017	2.1	Post Cust - Grazed mix	1137	38	29	70	36	274	5
	21/02/2018	2.1	UREA BULK	126	58	-	-	-	-	-
	Area weighted total				**119**	**23**	**58**	**39**	**210**	**4**

H5	05/09/2017	3.6	AMMO 36 BULK	140	50	-	-	13	-	-
	Area weighted total				**28**	**-**	**-**	**7**	**-**	**-**
H6	**Area weighted total**				-	-	-	-	-	-
R1	05/09/2017	6.2	AMMO 36 BULK	138	49	-	-	13	-	-
	06/12/2017	6.6	DAP Boron/ Potash and Slugbait	399	46	52	56	3	-	1
	Area weighted total				**87**	**49**	**53**	**14**	**-**	**1**
R10	05/09/2017	4.2	AMMO 36 BULK	134	48	-	-	13	-	-
	29/01/2018	3.9	WW R/off Post Cut Maintenance	1389	22	54	100	66	313	3
	12/02/2018	4.3	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**99**	**41**	**77**	**61**	**239**	**2**
R11	05/09/2017	3.6	AMMO 36 BULK	137	49	-	-	13	-	-
	24/11/2017	3.6	Post Cut mix to be cut again	361	59	10	55	12	22	7
	12/02/2018	3.7	UREA BULK	122	56	-	-	-	-	-
	Area weighted total				**155**	**9**	**52**	**24**	**21**	**7**
R12	05/09/2017	8.1	AMMO 36 BULK	135	48	-	-	13	-	-
	19/10/2017	0.1	TZT - AGL SUP	155	-	7	-	9	44	-
	17/11/2017	0.1	GERMINATION MIX	612	32	44	27	54	98	-
	24/11/2017	8.3	Post Cut mix to be cut again	382	62	10	58	13	23	8
	12/02/2018	8.8	UREA BULK	111	51	-	-	-	-	-
	14/03/2018	0.2	UREA	95	44	-	-	-	-	-
	Area weighted total				**138**	**10**	**49**	**22**	**22**	**7**
R13	19/10/2017	7.1	TZT - AGL SUP	171	-	8	-	9	48	-
	17/11/2017	7.6	GERMINATION MIX	731	38	52	32	64	117	-
	14/03/2018	7.8	UREA	113	52	-	-	-	-	-
	Area weighted total				**79**	**52**	**28**	**63**	**139**	**-**
R14	16/08/2017	6.4	RZR - AMM SE	134	48	-	-	13	-	-

	12/02/2018	6.5	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**93**	**-**	**-**	**12**	**-**	**-**
R15	16/08/2017	6	RZR - AMM SE	135	48	-	-	13	-	-
	05/09/2017	2.1	AMMO 36 BULK	122	44	-	-	12	-	-
	24/11/2017	8	Post Cut mix to be cut again	361	59	10	55	12	22	7
	12/02/2018	8.2	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**142**	**9**	**49**	**22**	**20**	**7**
R16	05/09/2017	3.2	AMMO 36 BULK	133	48	-	-	13	-	-
	08/12/2017	3.4	Post Cust - Grazed mix	1078	36	28	66	34	260	5
	10/01/2018	3.2	Merriburn Grazed MaintenanCE+N	1012	49	27	-	33	274	6
	12/02/2018	3.4	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**158**	**47**	**58**	**68**	**457**	**9**
R17	16/08/2017	2.8	RZR - AMM SE	132	47	-	-	13	-	-
	08/12/2017	3.2	Post Cust - Grazed mix	1051	36	27	64	33	253	4
	10/01/2018	3.1	Merriburn Grazed MaintenanCE+N	1029	50	27	-	33	278	6
	12/02/2018	3.3	UREA BULK	112	51	-	-	-	-	-
	Area weighted total				**162**	**48**	**58**	**69**	**474**	**10**
R18	16/08/2017	2.1	RZR - AMM SE	141	50	-	-	14	-	-
	05/09/2017	1.2	AMMO 36 BULK	121	43	-	-	12	-	-
	04/12/2017	3.4	DAP Boron/ Potash and Slugbait	418	48	55	59	3	-	1
	Area weighted total				**82**	**48**	**51**	**13**	**-**	**1**
R19	16/08/2017	3.1	RZR - AMM SE	130	46	-	-	12	-	-
	04/12/2017	3.4	DAP Boron/ Potash and Slugbait	432	50	57	61	3	-	2

	Area weighted total				**82**	**50**	**54**	**12**	**-**	**1**
R2	05/09/2017	3.1	AMMO 36 BULK	152	54	-	-	15	-	-
	24/11/2017	2.9	Merriburn Grazed Maintenance+N	956	47	25	-	31	259	6
	12/02/2018	3.2	UREA BULK	120	55	-	-	-	-	-
	Area weighted total				**133**	**20**	**-**	**37**	**209**	**5**
R20	16/08/2017	4.4	RZR - AMM SE	131	47	-	-	12	-	-
	04/12/2017	4.6	DAP Boron/ Potash and Slugbait	396	46	52	56	3	-	1
	Area weighted total				**88**	**51**	**54**	**14**	**-**	**1**
R21	16/08/2017	4.6	RZR - AMM SE	131	47	-	-	13	-	-
	04/12/2017	5.3	DAP Boron/ Potash and Slugbait	396	46	52	56	3	-	1
	Area weighted total				**79**	**47**	**51**	**12**	**-**	**1**
R3	16/08/2017	2.1	RZR - AMM SE	157	56	-	-	15	-	-
	24/11/2017	3.4	Merriburn Grazed Maintenance+N	960	47	25	-	31	260	6
	21/02/2018	3.3	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**123**	**24**	**-**	**38**	**243**	**5**
R4	05/09/2017	4.8	AMMO 36 BULK	130	46	-	-	12	-	-
	24/11/2017	4.7	Merriburn Grazed Maintenance+N	909	44	24	-	29	246	6
	12/02/2018	5	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**127**	**21**	**-**	**37**	**215**	**5**
R5	19/10/2017	2.6	TZT - AGL SUP	166	-	7	-	9	47	-
	19/10/2017	4.7	TZT - AGL SUP	338	-	15	-	19	95	-
	17/11/2017	4.7	GERMINATION MIX	719	37	52	32	63	115	-
	12/02/2018	5	UREA BULK	121	56	-	-	-	-	-
	Area weighted total				**86**	**63**	**28**	**77**	**209**	**-**
R6	05/09/2017	4.2	AMMO 36 BULK	138	49	-	-	13	-	-

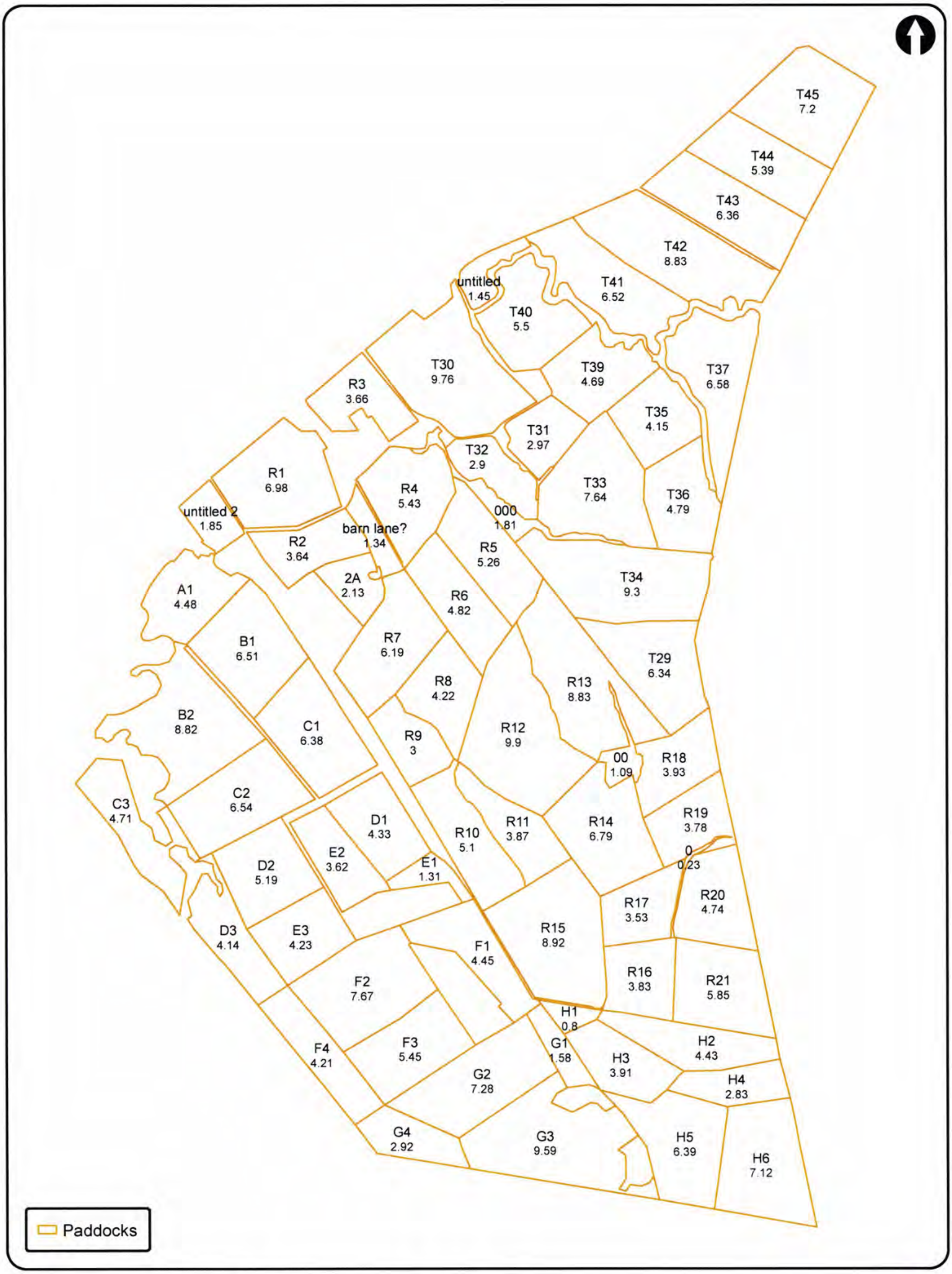
	12/02/2018	4.6	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**92**	**-**	**-**	**12**	**-**	**-**
R7	05/09/2017	4.2	AMMO 36 BULK	133	48	-	-	13	-	-
	12/02/2018	4.3	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**68**	**-**	**-**	**9**	**-**	**-**
R8	05/09/2017	3.6	AMMO 36 BULK	135	48	-	-	13	-	-
	24/11/2017	3.6	Merriburn Grazed Maintenance+N	964	47	26	-	31	261	6
	12/02/2018	4	UREA BULK	115	53	-	-	-	-	-
	Area weighted total				**131**	**22**	**-**	**37**	**222**	**5**
R9	05/09/2017	2.3	AMMO 36 BULK	139	50	-	-	13	-	-
	08/12/2017	2.4	Post Cust - Grazed mix	1128	38	29	69	35	272	5
	12/02/2018	2.7	UREA BULK	118	54	-	-	-	-	-
	Area weighted total				**116**	**23**	**56**	**39**	**219**	**4**
T29	05/09/2017	4.7	AMMO 36 BULK	140	50	-	-	13	-	-
	12/02/2018	5.9	UREA BULK	119	55	-	-	-	-	-
	Area weighted total				**88**	**-**	**-**	**10**	**-**	**-**
T30	16/08/2017	4.5	RZR - AMM SE	145	52	-	-	14	-	-
	24/11/2017	4.6	Merriburn Grazed Maintenance+N	919	45	24	-	30	249	6
	06/12/2017	3.9	DAP Boron/ Potash and Slugbait	413	48	54	58	3	-	1
	Area weighted total				**64**	**33**	**23**	**22**	**118**	**3**
T31	19/10/2017	2.8	TZT - AGL SUP	311	-	14	-	17	87	-
	17/11/2017	2.9	GERMINATION MIX	689	36	49	31	60	110	-
	29/01/2018	2.8	UREA BULK	110	50	-	-	-	-	-
	Area weighted total				**83**	**62**	**30**	**76**	**191**	**-**
T32	19/10/2017	2.6	TZT - AGL SUP	322	-	14	-	18	90	-
	17/11/2017	2.6	GERMINATION MIX	730	38	52	32	64	117	-

	29/01/2018	2.4	UREA BULK	112	52	-	-	-	-	-
	Area weighted total				**77**	**59**	**28**	**72**	**183**	**-**
T33	19/10/2017	7.3	TZT - AGL SUP	163	-	7	-	9	46	-
	17/11/2017	7.4	GERMINATION MIX	704	37	51	31	62	112	-
	29/01/2018	7.2	UREA BULK	109	50	-	-	-	-	-
	Area weighted total				**82**	**56**	**30**	**68**	**152**	**-**
T34	19/10/2017	8	TZT - AGL SUP	160	-	7	-	9	45	-
	17/11/2017	7.8	GERMINATION MIX	684	35	49	30	60	109	-
	14/03/2018	8.2	UREA	106	49	-	-	-	-	-
	Area weighted total				**73**	**48**	**26**	**58**	**130**	**-**
T35	19/10/2017	3.9	TZT - AGL SUP	317	-	14	-	17	89	-
	17/11/2017	4	GERMINATION MIX	683	35	49	30	60	109	-
	29/01/2018	3.7	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**79**	**60**	**29**	**74**	**188**	**-**
T36	05/09/2017	4.7	AMMO 36 BULK	146	52	-	-	14	-	-
	12/02/2018	4.7	UREA BULK	119	55	-	-	-	-	-
	Area weighted total				**105**	**-**	**-**	**14**	**-**	**-**
T37	05/09/2017	6.1	AMMO 36 BULK	145	52	-	-	14	-	-
	24/11/2017	6.2	Merriburn Grazed Maintenance+N	1007	49	27	-	33	272	6
	Area weighted total				**94**	**25**	**-**	**43**	**255**	**6**
T39	19/10/2017	4.1	TZT - AGL SUP	335	-	15	-	18	94	-
	17/11/2017	4	GERMINATION MIX	693	36	50	31	61	111	-
	29/01/2018	3.8	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**71**	**55**	**26**	**67**	**174**	**-**
T40	19/10/2017	5.3	TZT - AGL SUP	321	-	14	-	18	90	-
	17/11/2017	5	GERMINATION MIX	704	37	51	31	62	112	-
	29/01/2018	5	UREA BULK	110	51	-	-	-	-	-
	Area weighted total				**80**	**60**	**28**	**73**	**190**	**-**

T41	16/08/2017	5.8	RZR - AMM SE	138	49	-	-	13	-	-
	06/12/2017	5.8	DAP Boron/ Potash and Slugbait	400	46	52	56	3	-	1
	Area weighted total				**85**	**46**	**50**	**14**	**-**	**1**
T42	16/08/2017	8.5	RZR - AMM SE	136	49	-	-	13	-	-
	17/11/2017	8.3	UREA BULK	110	50	-	-	-	-	-
	08/12/2017	8.2	Post Cust - Grazed mix	1088	37	28	67	34	262	5
	12/02/2018	8.5	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**178**	**26**	**62**	**44**	**245**	**4**
T43	16/08/2017	6.1	RZR - AMM SE	134	48	-	-	13	-	-
	17/11/2017	6.3	UREA BULK	111	51	-	-	-	-	-
	08/12/2017	6.2	Post Cust - Grazed mix	1019	34	26	62	32	245	4
	21/02/2018	6.2	UREA BULK	111	51	-	-	-	-	-
	Area weighted total				**179**	**25**	**60**	**43**	**238**	**4**
T44	16/08/2017	4.9	RZR - AMM SE	127	45	-	-	12	-	-
	17/11/2017	5.2	UREA BULK	99	46	-	-	-	-	-
	08/12/2017	5.2	Post Cust - Grazed mix	1039	35	27	64	33	250	4
	21/02/2018	5.1	UREA BULK	97	45	-	-	-	-	-
	Area weighted total				**161**	**26**	**61**	**42**	**240**	**4**
T45	16/08/2017	6.9	RZR - AMM SE	131	47	-	-	12	-	-
	17/11/2017	6.8	UREA BULK	110	50	-	-	-	-	-
	08/12/2017	6.5	Post Cust - Grazed mix	1048	35	27	64	33	252	4
	21/02/2018	6.9	UREA BULK	108	50	-	-	-	-	-
	Area weighted total				**171**	**24**	**58**	**41**	**227**	**4**
untitled	16/08/2017	1	RZR - AMM SE	155	55	-	-	15	-	-

	06/12/2017	0.9	DAP Boron/ Potash and Slugbait	400	46	52	56	3	-	1
	Area weighted total				**67**	**33**	**35**	**12**	**-**	**1**
untitled 2	24/11/2017	1.6	Merriburn Grazed Maintenance+N	999	49	26	-	32	270	6
	Area weighted total				**41**	**22**	**-**	**27**	**227**	**5**
Weighted average rate based on applied areas and rates for selected areas					**103**	**25**	**25**	**33**	**125**	**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



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

Merriburn

0 80 160 320 480 640 Metres

ravensdown

19 October 2016

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 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)	19055	23016	19112	20723	20477
N Loss/ha (kg)	40 (15)	46	38	41	41
Total P Loss (kg)	345	374	362	357	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)	15,003	15,483	15,089	15,909	15,371

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

	Proposed Dairy Unit
Total N Loss (kg)	20262
N Loss/ha (kg)	40
Total P Loss (kg)	357
P loss/ha (kg)	0.7
Pasture Grown Kg/DM/ha/yr	15,544

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 and is deemed form part of the same landholding as WOL and WTL under the pSWLP.

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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 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 data is not yet available for 2017/18 and pre 2013/14 a significant area of the land subject to the proposed expansion was not under the control of Woldwide farms. On this basis the land use consent for the expanded dairy farm is a discretionary activity under Rule 20(e).

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 and met the aims of Policy 16. There is no modelled increase in total nitrogen or 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 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 supportblock.

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 startspringing.

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 inthree 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 – June 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)	18485	570	19055	40	15
Phosphorus Loss (Kg/P)	337	8	345	0.7	0.2
Pasture Production (Dairy Platform – kg/DM)				15003	

7.2 <u>August 2014 – June 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)	23016	46
Phosphorus Loss (Kg/P)	374	0.7
Pasture Production (Dairy Platform – kg/DM)		15483

7.3 August 2015 – June 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)	19112	38
Phosphorus Loss (Kg/P)	362	0.7
Pasture Production (Dairy Platform – kg/DM)		15089

7.4 August 2016 – June 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)	20723	41
Phosphorus Loss (Kg/P)	357	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 May through to September. During this period, 1400T of silage is proposed be fed in these facilities.

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)	20262	40
Phosphorus Loss (Kg/P)	357	0.7
Pasture Production (Dairy Platform – kg/DM)		15544

9.0 Modelling Inputs

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

9.1 *<u>Blocks</u>*

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 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 35kg/N/ha 9kg/P/ha 48kg/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 <u>*Pre-Expansion Results*</u>

	13/14*	14/15	15/16	16/17	Average
Total N Loss (kg)	19055	23016	19112	20723	20477
N Loss/ha (kg)	40 (15)	46	38	41	41
N Concentration in Drainage (ppm)	7.3 - 12.9 (Pastoral) 16.4 - 27.1 (Crops) 5.9 – 12.5 (Silage/WGYS)	9.9 – 15.7 (Pastoral) 13.5 - 17.6 (Crops) 5.9 – 9.5 (Silage/WGYS)	7.3 – 14.3 (Pastoral) 13.1 - 18.8 (Crops) 4.0 – 9.8 (Silage/WGYS)	8.5 – 15.3 (Pastoral) 18.0 - 23.8 (Crops) 2.9 – 7.5 (Silage)	
Total P Loss (kg)	345	374	362	357	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)	15,003	15,483	15,089	15,909	15,371

* 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)	20262
N Loss/ha (kg)	40
N Concentration in Drainage (ppm)	Pastoral – 7.8 to 17.2 ppm
Total P Loss (kg)	356
P loss/ha (kg)	0.7
Pasture Grown Kg/DM/ha/yr	15,391

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**
Nitrogen Loss (kg/N)	3126	3092	20	19
Phosphorus Loss (Kg/P)	24	23	0.1	0.1
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	Grass Silage – 153.5ha 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.	Grass Silage – 97ha (WOL & WTL Slurry Area) 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. Grass Silage – 56.5ha (Woldwide Three Ltd Slurry Area) 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.

Woldwide One Ltd

1354 Hundred Line Rd, Dunearn 9783

Appendix 2 – Nutrient Budgets & Block Reports

Version 6.3.0, on 2018-08-01 11:22:13

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 13/14 (2013-14)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	217	45	55	45	82	0	1
Rain/clover N fixation	62	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	62	13	42	10	8	7	3
Nutrients removed							
As products	97	16	23	5	21	2	7
Exported effluent	56	8	53	6	14	5	3
As supplements and defoliation	45	6	32	3	7	2	1
To atmospheric	77	0	0	0	0	0	0
To water	40	0.7	18	61	75	4	15
Change in internal pools							
Plant material	-66	-9	-61	-7	-15	-6	-5
Organic pool	78	12	5	-10	1	1	0
Inorganic mineral	0	5	-16	0	5	-3	-4
Inorganic soil pool	13	18	45	0	-16	8	12

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 13/14 (2013-14)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
WOL Effluent (Drum_2a.1) ##	1260	44	**11.8**	271	253
WOL Non Effluent (Brax_4a.1) ##	1139	25	7.3	184	189
WOL Non Effluent (Drum_2a.1) ##	2660	36	9.6	190	189
WTL Effluent (Drum_2a.1) ##	2074	48	**12.9**	289	304
WTL Non Effluent (Brax_4a.1) ##	1456	29	8.4	202	239
WTL Non Effluent (Drum_2a.1) ##	4070	41	11.1	209	239
Swedes (Drum_2a.1)	162	81	**19.6**	266	173
Swedes (Glen_4a.1)	1434	120	**27.1**	264	173
Barley + Silage +WGYS (Drum_4a.1)	885	47	10.2	-56	251
Summer Turnips	1133	72	**16.4**	156	222
Silage + WG YS + Barn Eff (Drum_2a.1)	689	22	5.9	127	470
Silage + WG YS + Barn Eff (Glene_4a.1)	501	42	10.1	141	470
Barley + Silage +WGYS (Glene_4a.1)	408	58	**12.5**	-55	251
Other farm sources	611				
Whole farm	18483	40			
Less N removed in wetlands	0				
Farm output	18483	40			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 13/14 (2013-14)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
WOL Effluent (Drum_2a.1) ##	7	0.2	Low	Low	Low
WOL Non Effluent (Brax_4a.1) ##	28	0.6	Low	Medium	n/a
WOL Non Effluent (Drum_2a.1) ##	16	0.2	Low	Low	n/a
WTL Effluent (Drum_2a.1) ##	10	0.2	Low	Low	Low
WTL Non Effluent (Brax_4a.1) ##	29	0.6	Low	Medium	n/a
WTL Non Effluent (Drum_2a.1) ##	21	0.2	Low	Low	n/a
Swedes (Drum_2a.1)	1	0.3	n/a	n/a	n/a
Swedes (Glen_4a.1)	3	0.2	n/a	n/a	n/a
Barley + Silage +WGYS (Drum_4a.1)	5	0.3	n/a	n/a	n/a
Summer Turnips	5	0.3	n/a	n/a	n/a
Silage + WG YS + Barn Eff (Drum_2a.1)	6	0.2	Low	Low	n/a
Silage + WG YS + Barn Eff (Glene_4a.1)	2	0.1	Low	Low	n/a
Barley + Silage +WGYS (Glene_4a.1)	1	0.2	n/a	n/a	n/a
Other farm sources	204				
Whole farm	337	0.7			

Has a fodder crop rotating though, results for pastoral block component only

Version 6.3.1, on 2019-03-18 01:57:27

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 14/15 (2014-15)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
				(kg/ha/yr)			
Nutrients added							
Fertiliser, lime & other	232	45	61	62	95	0	1
Rain/clover N fixation	62	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	65	13	40	10	7	7	3
Nutrients removed							
As products	94	16	23	5	21	2	6
Exported effluent	55	8	51	6	13	5	3
As supplements	44	4	31	3	8	2	1
To atmospheric	79	0	0	0	0	0	0
To water	46	0.7	18	75	79	4	15
Change in internal pools							
Plant material	-78	-10	-78	-5	-17	-7	-5
Organic pool	105	13	5	-9	1	1	0
Inorganic mineral	0	5	-15	0	-2	-3	-4
Inorganic soil pool	13	21	69	0	2	9	13

Version 6.3.1, on 2019-03-18 01:58:26

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:
Farm name: Woldwide 1,2 & 96 14/15 (2014-15)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
WOL Effluent (Drum_2a.1) ##	1534	53	**14.2**	300	311
WOL Non Effluent (Brax_4a.1) ##	1563	34	9.9	205	225
WOL Non Effluent (Drum_2a.1) ##	3481	46	**12.5**	211	225
WTL Effluent (Drum_2a.1) ##	2547	59	**15.7**	309	339
WTL Non Effluent (Brax_4a.1) ##	1744	34	9.9	205	225
WTL Non Effluent (Drum_2a.1) ##	5949	46	**12.5**	211	225
Kale (Drum_2a.1)	683	60	**13.5**	219	147
Kale (Glen_4a.1)	1529	83	**17.6**	219	147
Fodder Beet (Drum_2a.1)	704	70	**16.4**	181	142
Summer Turnips	990	71	**16.0**	123	191
Silage + WG YS + Barn Eff (Drum_2a.1)	471	22	5.9	146	572
Silage + WG YS + Barn Eff (Glene_4a.1)	1144	39	9.5	156	572
Other farm sources	678				
Whole farm	23016	46			
Less N removed in wetlands	0				
Farm output	23016	46			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

Version 6.3.1, on 2019-03-18 01:58:54

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:
Farm name: Woldwide 1,2 & 96 14/15 (2014-15)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
WOL Effluent (Drum_2a.1) ##	7	0.2	Low	Low	Low
WOL Non Effluent (Brax_4a.1) ##	28	0.6	Low	Medium	n/a
WOL Non Effluent (Drum_2a.1) ##	17	0.2	Low	Low	n/a
WTL Effluent (Drum_2a.1) ##	13	0.3	Low	Low	Low
WTL Non Effluent (Brax_4a.1) ##	29	0.6	Low	Medium	n/a
WTL Non Effluent (Drum_2a.1) ##	27	0.2	Low	Low	n/a
Kale (Drum_2a.1)	4	0.3	n/a	n/a	n/a
Kale (Glen_4a.1)	4	0.2	n/a	n/a	n/a
Fodder Beet (Drum_2a.1)	4	0.4	n/a	n/a	n/a
Summer Turnips	5	0.3	n/a	n/a	n/a
Silage + WG YS + Barn Eff (Drum_2a.1)	3	0.1	Low	Low	n/a
Silage + WG YS + Barn Eff (Glene_4a.1)	3	0.1	Low	Low	n/a
Other farm sources	230				
Whole farm	374	0.7			

Has a fodder crop rotating though, results for pastoral block component only

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 15/16 (2015/16)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	235	34	66	41	54	2	1
Rain/clover N fixation	58	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	75	16	38	10	6	7	3
Nutrients removed							
As products	96	16	23	5	21	2	7
Exported effluent	55	8	50	6	13	5	3
As supplements	59	6	43	4	10	3	2
To atmospheric	77	0	0	0	0	0	0
To water	38	0.7	17	54	72	4	15
Change in internal pools							
Plant material	-73	-9	-69	-6	-15	-6	-4
Organic pool	106	14	5	-8	1	1	0
Inorganic mineral	0	5	-20	0	-2	-3	-4
Inorganic soil pool	11	9	58	0	-37	10	11

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 15/16 (2015/16)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
WOL Effluent (Drum_2a.1) ##	1541	53	**14.3**	306	337
WOL Non Effluent (Brax_4a.1) ##	1144	25	7.3	194	203
WOL Non Effluent (Drum_2a.1) ##	2785	37	10.0	201	203
WTL Effluent (Drum_2a.1) ##	2271	52	**14.1**	299	328
WTL Non Effluent (Brax_4a.1) ##	1305	26	7.5	201	237
WTL Non Effluent (Drum_2a.1) ##	4853	38	10.2	207	237
Fodder Beet (Glen_4a.1)	1553	86	**18.8**	155	75
Fodder Beet (Drum_2a.1)	226	56	**13.1**	155	75
Summer Turnips	979	68	**15.3**	83	134
SH 96 Silage + WG YS + Barn Eff (Drum	624	22	6.0	148	572
SH 96 Silage + WG YS + Barn Eff (Glen	487	41	9.8	158	572
Marcel Silage + WG YS + Barn Eff (Dru	161	15	4.0	97	433
Marcel Silage + WG YS + Barn Eff (Gler	522	29	7.0	105	433
Other farm sources	661				
Whole farm	19112	38			
Less N removed in wetlands	0				
Farm output	19112	38			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

Version 6.3.1, on 2019-03-18 02:02:23

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 15/16 (2015/16)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
WOL Effluent (Drum_2a.1) ##	7	0.2	Low	Low	Low
WOL Non Effluent (Brax_4a.1) ##	27	0.6	Low	Medium	n/a
WOL Non Effluent (Drum_2a.1) ##	16	0.2	Low	Low	n/a
WTL Effluent (Drum_2a.1) ##	12	0.3	Low	Low	Low
WTL Non Effluent (Brax_4a.1) ##	26	0.5	Low	Low	n/a
WTL Non Effluent (Drum_2a.1) ##	25	0.2	Low	Low	n/a
Fodder Beet (Glen_4a.1)	5	0.3	n/a	n/a	n/a
Fodder Beet (Drum_2a.1)	2	0.4	n/a	n/a	n/a
Summer Turnips	5	0.3	n/a	n/a	n/a
SH 96 Silage + WG YS + Barn Eff (Drum	4	0.1	Low	Low	n/a
SH 96 Silage + WG YS + Barn Eff (Glen	1	0.1	Low	Low	n/a
Marcel Silage + WG YS + Barn Eff (Dru	2	0.2	Low	Low	n/a
Marcel Silage + WG YS + Barn Eff (Gler	2	0.1	Low	Low	n/a
Other farm sources	227				
Whole farm	362	0.7			

Has a fodder crop rotating though, results for pastoral block component only

Version 6.3.1, on 2019-03-18 02:03:27

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 16/17 (2016/17)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
				(kg/ha/yr)			
Nutrients added							
Fertiliser, lime & other	246	30	59	36	32	5	2
Rain/clover N fixation	57	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	70	15	39	10	7	7	3
Nutrients removed							
As products	103	17	25	6	23	2	7
Exported effluent	56	9	52	6	13	5	3
As supplements	60	7	50	5	12	3	3
To atmospheric	81	0	0	0	0	0	0
To water	41	0.7	18	52	79	3	15
Change in internal pools							
Plant material	-85	-11	-70	-8	-18	-6	-5
Organic pool	117	15	5	-10	1	1	0
Inorganic mineral	0	6	-22	0	-2	-3	-4
Inorganic soil pool	0	2	43	0	-67	12	13

Version 6.3.1, on 2019-03-18 02:04:03

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 16/17 (2016/17)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
WOL Effluent (Drum_2a.1)	1710	57	**15.3**	308	342
WOL Non Effluent (Brax_4a.1)	1385	29	8.5	206	236
WOL Non Effluent (Drum_2a.1)	3323	42	**11.5**	213	236
WTL Effluent (Drum_2a.1)	2463	55	**14.7**	301	324
WTL Non Effluent (Brax_4a.1)	1601	30	8.8	206	241
WTL Non Effluent (Drum_2a.1)	5903	44	**11.9**	213	241
Fodder Beet (Glen_4a.1)	2022	109	**23.8**	221	137
Fodder Beet (Drum_2a.1)	307	77	**18.0**	221	137
SH96 Cut&Carry (Glen_4a.1)	144	12	2.9	70	424
SH96 Cut&Carry (Drum_2a.1)	329	12	3.2	69	424
Marcel Cut&Carry (Glen_4a.1)	518	30	7.1	145	606
Marcel Cut&Carry (Drum_2a.1)	306	28	7.5	157	606
Other farm sources	713				
Whole farm	20723	41			
Less N removed in wetlands	0				
Farm output	20723	41			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Version 6.3.1, on 2019-03-18 02:04:30

Woldwide 1,2 & SH96/Marcel

Cain Duncan
Fonterra

Client reference:

Farm name: Woldwide 1,2 & 96 16/17 (2016/17)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
WOL Effluent (Drum_2a.1)	7	0.2	Low	Low	Low
WOL Non Effluent (Brax_4a.1)	25	0.5	Low	Low	n/a
WOL Non Effluent (Drum_2a.1)	14	0.2	Low	Low	n/a
WTL Effluent (Drum_2a.1)	12	0.3	Low	Low	Low
WTL Non Effluent (Brax_4a.1)	25	0.5	Low	Low	n/a
WTL Non Effluent (Drum_2a.1)	23	0.2	Low	Low	n/a
Fodder Beet (Glen_4a.1)	5	0.3	n/a	n/a	n/a
Fodder Beet (Drum_2a.1)	2	0.4	n/a	n/a	n/a
SH96 Cut&Carry (Glen_4a.1)	1	0.1	n/a	n/a	n/a
SH96 Cut&Carry (Drum_2a.1)	3	0.1	n/a	n/a	n/a
Marcel Cut&Carry (Glen_4a.1)	2	0.1	n/a	n/a	n/a
Marcel Cut&Carry (Drum_2a.1)	2	0.2	n/a	n/a	n/a
Other farm sources	237				
Whole farm	357	0.7			

Abe De Wolde

Cain Duncan

WW1 & WW2 Proposed

Fonterra

Client reference:

Farm name: Woldwide 1&2 Proposed (Mitigations & Slurry) (Future)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	182	29	27	68	58	2	0
Rain/clover N fixation	80	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	200	27	147	21	27	16	9
Nutrients removed							
As products	125	21	30	7	27	3	9
Exported effluent	76	9	71	7	15	7	3
As supplements	0	0	0	0	0	0	0
To atmospheric	88	0	0	0	0	0	0
To water	40	0.7	12	84	51	4	15
Change in internal pools							
Plant material	0	0	0	0	0	0	0
Organic pool	134	14	18	-4	3	2	1
Inorganic mineral	0	4	-16	0	-2	-3	-4
Inorganic soil pool	0	8	62	0	-6	11	12

Version 6.3.1, on 2019-03-18 03:41:21

Abe De Wolde

WW1 & WW2 Proposed

Client reference:

Farm name: Woldwide 1&2 Proposed (Mitigations & Slurry) (Future)

Cain Duncan

Fonterra

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Effluent Blocks (Drum_2a.1)	5388	45	**12.0**	262	271
Non Effluent (Brax_4a.1)	2674	27	7.8	186	209
Non-Effluent (Drum_2a.1)	956	38	10.2	192	209
Non-Effluent (Glen_4a.1)	3429	71	**17.2**	207	209
Barn Slurry (Drum_2a.1)	6987	38	10.2	196	208
Other farm sources	828				
Whole farm	20262	40			
Less N removed in wetlands	0				
Farm output	20262	40			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Abe De Wolde
WW1 & WW2 Proposed
Client reference:
Farm name: Woldwide 1&2 Proposed (Mitigations & Slurry) (Future)

Cain Duncan
Fonterra

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Effluent Blocks (Drum_2a.1)	22	0.2	Low	Low	Low
Non Effluent (Brax_4a.1)	44	0.4	Low	Low	n/a
Non-Effluent (Drum_2a.1)	4	0.1	Low	Low	n/a
Non-Effluent (Glen_4a.1)	5	0.1	Low	Low	n/a
Barn Slurry (Drum_2a.1)	26	0.1	Low	Low	n/a
Other farm sources	256				
Whole farm	357	0.7			

Woldwide Farms Ltd

Horner Block

Client reference:

Farm name: Horner Block -Current (Current)

Cain Duncan

Fonterra

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	441	60	284	47	528	5	0
Rain/clover N fixation	46	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	0	0	0	0	0	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements	413	44	343	34	86	22	18
To atmospheric	20	0	0	0	0	0	0
To water	20	0.1	10	40	58	5	14
Change in internal pools							
Plant material	0	0	0	0	0	0	0
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	-1

Woldwide Farms Ltd
Horner Block
Client reference:
Farm name: Horner Block -Current (Current)

Cain Duncan
Fonterra

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Horner WW1&2 (Brax_4a.1)	987	16	4.7	73	459
Horner WW1&2 (Drum_2a.1)	714	24	6.5	78	459
Horner WW1&2 (Waiau_3a.1)	130	26	6.5	86	459
Horner WW3 (Brax_4a.1)	207	16	4.7	73	459
Horner WW3 (Drum_2a.1)	595	24	6.5	78	459
Horner WW3 (Glene_4a.1)	102	25	6.2	80	459
Horner WW3 (Waiau_3a.1)	378	26	6.5	86	459
Other farm sources	14				
Whole farm	3126	20			
Less N removed in wetlands	0				
Farm output	3126	20			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Version 6.3.1, on 2019-03-18 03:45:36

Woldwide Farms Ltd
Horner Block
Client reference:
Farm name: Horner Block -Current (Current)

Cain Duncan
Fonterra

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Horner WW1&2 (Brax_4a.1)	11	0.2	n/a	n/a	n/a
Horner WW1&2 (Drum_2a.1)	2	0.1	n/a	n/a	n/a
Horner WW1&2 (Waiau_3a.1)	1	0.2	n/a	n/a	n/a
Horner WW3 (Brax_4a.1)	2	0.2	n/a	n/a	n/a
Horner WW3 (Drum_2a.1)	2	0.1	n/a	n/a	n/a
Horner WW3 (Glene_4a.1)	0	0.1	n/a	n/a	n/a
Horner WW3 (Waiau_3a.1)	3	0.2	n/a	n/a	n/a
Other farm sources	1				
Whole farm	24	0.1			

Woldwide Farms Ltd

Horner Block

Client reference:

Farm name: Horner Block - Proposed (Proposed)

Cain Duncan

Fonterra

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	435	65	307	45	528	5	0
Rain/clover N fixation	45	0	2	5	3	6	26
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	0	0	0	0	0	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements	406	44	332	33	86	23	18
To atmospheric	16	0	0	0	0	0	0
To water	19	0.1	8	39	58	5	14
Change in internal pools							
Plant material	0	0	0	0	0	0	0
Organic pool	38	17	0	-22	0	0	0
Inorganic mineral	0	3	-23	0	171	-2	-5
Inorganic soil pool	0	1	-7	0	215	-15	-1

Version 6.3.1, on 2019-03-18 03:46:54

Woldwide Farms Ltd
Horner Block
Client reference:
Farm name: Horner Block - Proposed (Proposed)

Cain Duncan
Fonterra

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Horner WW1&2 (Brax_4a.1)	1005	16	4.7	74	450
Horner WW1&2 (Drum_2a.1)	662	22	6.0	78	450
Horner WW1&2 (Waiau_3a.1)	131	26	6.5	85	450
Horner WW3 (Brax_4a.1)	207	16	4.7	73	459
Horner WW3 (Drum_2a.1)	595	24	6.5	78	459
Horner WW3 (Glene_4a.1)	102	25	6.2	80	459
Horner WW3 (Waiau_3a.1)	378	26	6.5	86	459
Other farm sources	14				
Whole farm	3092	19			
Less N removed in wetlands	0				
Farm output	3092	19			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Version 6.3.1, on 2019-03-18 03:47:25

Woldwide Farms Ltd
Horner Block
Client reference:
Farm name: Horner Block - Proposed (Proposed)

Cain Duncan
Fonterra

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Horner WW1&2 (Brax_4a.1)	10	0.2	n/a	n/a	n/a
Horner WW1&2 (Drum_2a.1)	2	0.1	n/a	n/a	n/a
Horner WW1&2 (Waiau_3a.1)	1	0.2	n/a	n/a	n/a
Horner WW3 (Brax_4a.1)	2	0.2	n/a	n/a	n/a
Horner WW3 (Drum_2a.1)	2	0.1	n/a	n/a	n/a
Horner WW3 (Glene_4a.1)	0	0.1	n/a	n/a	n/a
Horner WW3 (Waiau_3a.1)	3	0.2	n/a	n/a	n/a
Other farm sources	1				
Whole farm	23	0.1			

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 Kerni t	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						
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						
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	560.0	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	1556	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	576882	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

	Average	Top Farm	WWF1	WWF 2	WWF3	WWF4	WWF5
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	-$626.23
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	98.4	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 (	1003.98	0	25	104	20	24	47	220
Barley	6202.52	326	419	534	576	579	398	2606
Palm Kern 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.**

Account	Sub-account	Code	Product	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

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 fertiliser 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 **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: 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 **Store:** Winton Consignment Store								**Delivery Date:** **Carrier:** **Spreader:**						
	450.000	Superten 10K								100						
	1.000	Selenium									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 **Store:** Winton Consignment Store								**Delivery Date:** **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 - mix										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								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
2014/15 WW1 Turnip side dressing		**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:	151.83 tonnes	$78,309.83	$78,309.58

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Stock fluoride poisoning (fluorosis) can occur following application of phosphate (P) fertilisers.

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

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 **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:**	**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 **Store:** Winton Consignment Store									**Delivery Date:** **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 **Store:** Winton Consignment Store									**Delivery Date:** **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 **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
14/15 WW 2 Turnips - Side		**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:	**241.01 tonnes**	**$123,114.48**	**$123,114.28**

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

Block: Fodder Beet [illegible] 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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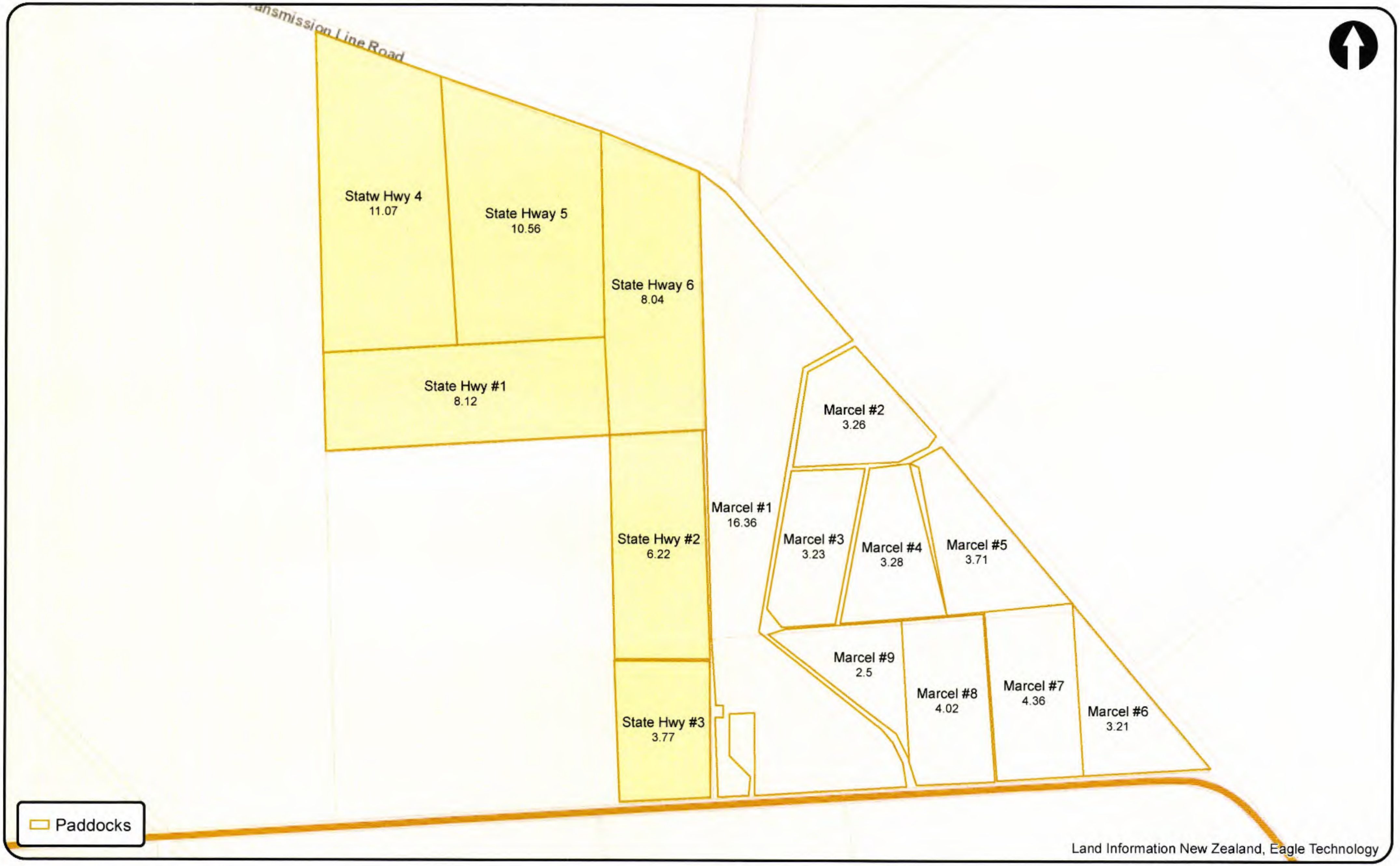
Maintenance Lime should be applied to the Non-effluent area only at 400kg/ha.



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

SH96 map

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	-	-

	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	-

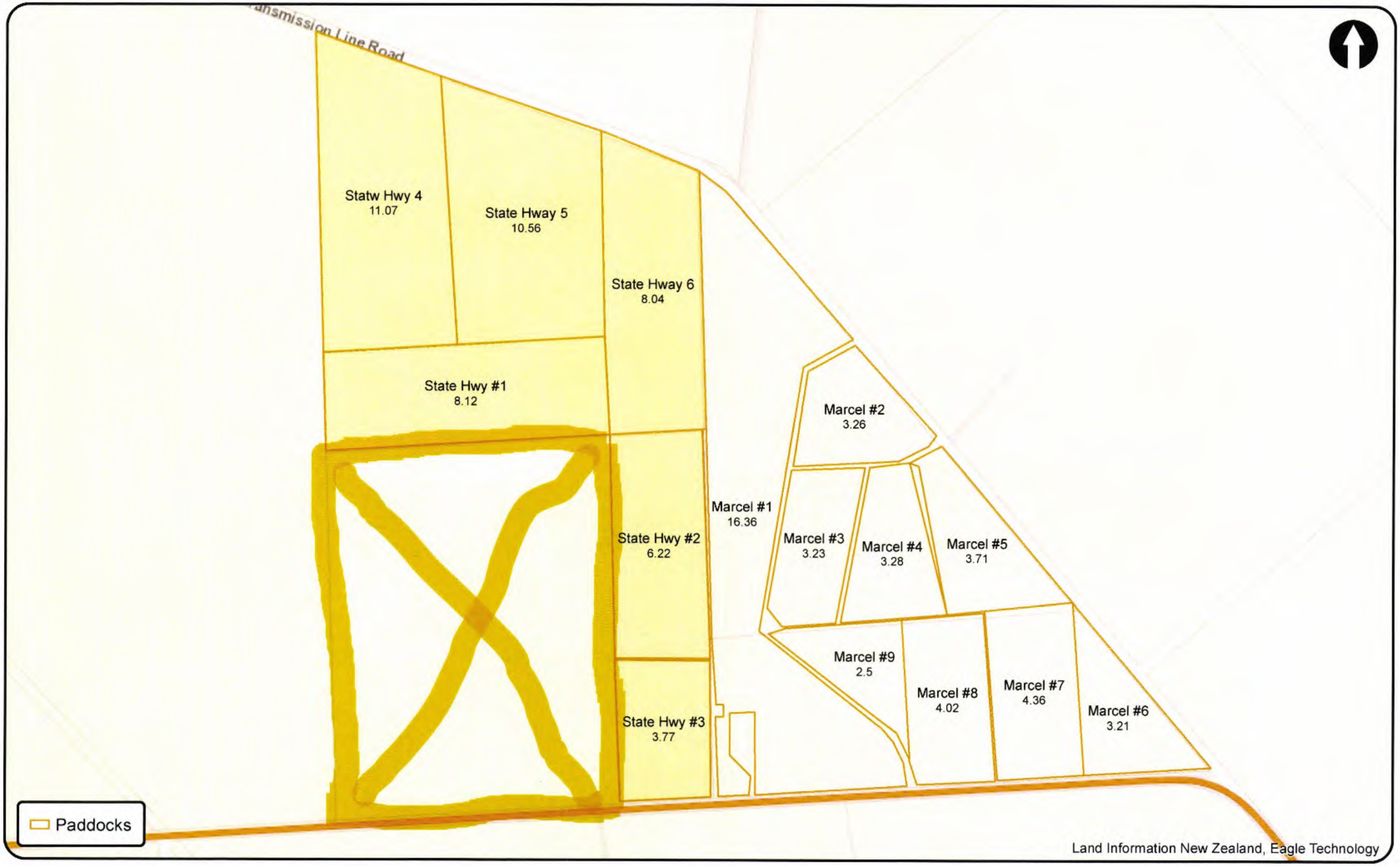
	06/11/2013	3.6	Cropmaster 15	265	40	26	26	20	-	-
	10/01/2014	3.8	Urea	158	73	-	-	-	-	-
	03/12/2014	3.8	Non-Ravensdown product *	321	-	-	-	-	-	-
	06/01/2015	3.8	BAN-Urea	157	72	-	-	-	-	-
	14/10/2015	3.9	Cropmaster 15	381	57	38	38	29	-	-
	17/11/2015	3.9	UREA	210	97	-	-	-	-	-
	02/02/2016	3.9	UREA + 50% 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

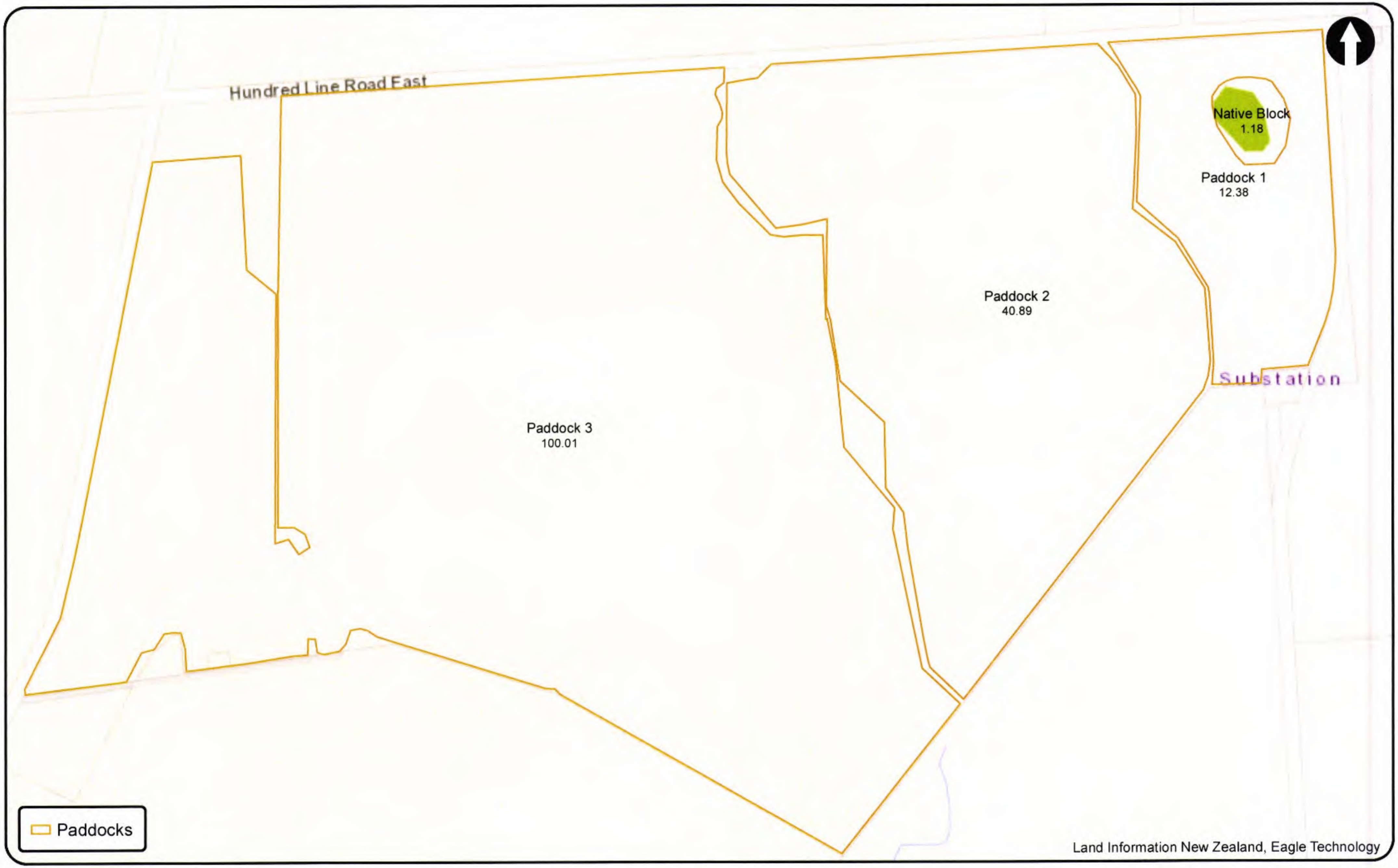
- Superphosphate 150kg/ha
- Urea 120kg/ha
- Potassium Chloride 100kg/ha

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
www.myravensdown.co.nz
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	-

ravensdown

	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

File Note

From:	Alex Erceg
Date:	Friday, 9 August 2019
File Reference:	APP-20191052 & APP-20191140
Subject:	***Woldwide 1, 2, 4 and 5 Application***

Note:

McMurdo Just to introduce, I'm Glen McMurdo, I'm an employee here at Environment Southland, I'm a Senior Investigator but for today's purposes I'm the Chair of the meeting. I don't know anything about the consent that we're discussing today and I haven't been formally introduced to any of the members who are here today that are not from Environment Southland. I'm not sure if everybody knows each other so for the purposes of today this is being recorded and a transcription will be done to provide an accurate record for all parties today, if everybody is in agreement with that, if not let themselves be known. For the purposes of the recording we'll just go round the room and introduce each other.

Present: Mike Freeman (Landpro), Nessa Legg (Dairy Green), Abe de Wolde (Applicant), Alex Erceg (Environment Southland), Jade McCrae (Environment Southland), Aurora Grant (Environment Southland), Michael Durand (*until 11.00am*, (Environment Southland) and Glen McMurdo (Environment Southland and Chair)

McMurdo Just a bit of housekeeping, if any parties need to take a break one will be given, if anyone needs a toilet break there are toilets in the reception area. My role today is purely as Chairperson and if there's no traction on the matter then we'll park it and move on. The reason for today's meeting is to establish a timeline on receiving and considering and responding to proposed amendments relating to applicants Woldwide 1 and 2 and Woldwide 4 and 5 I understand, if I have anything incorrect please correct me. Also to establish a suitable hearing date for the hearing commissioner and to consider the applications today, as I understand it, to identify the scope of the proposed amendments and the hearing date. So, I understand as far as transparency is concerned council wants to raise the matters of interest, I'll leave it over to you Aurora.

Grant It's not on the agenda but like I said to you Mike, if we adopted your agenda it didn't have anything like that to talk about. The other issue up, I will be putting in my Section 42A at this stage so if we're all in agrAEEnce of discussing that at some point today. I think it would be helpful to all parties.

Freeman Definitely. My agenda's got "any other matters".

Grant Ok.

McMurdo Shall we start with, in relation to the applications themselves, the matters, I'm not sure who wants to start?

Grant Probably the applicant, if you can just discuss the changes that have been made to the category, we haven't gotten through all of it yet, but Alex might have identified some changes, so if you could just run us through.

Freeman I could try from my perspective and as you'll appreciate Nessa has virtually gotten back off a plane. In terms of mitigation, obviously, I'm sure you don't want us to go through all the details of what Cain Duncan and Mark Crawford have put together, we can do if needed, they are available if anybody wants more detail, but I think off the top of my head this probably, probably only have a dozen key mitigation measures that are covered in all these detailed reports….

Grant Just to keep this clear can we, are we talking 1 and 2 or 4 and 5? Can we keep them kind of separate because that's how I've assessed, so there's two separate 42A's.

Legg Maybe if you do 4 and 5 and Woldwide runoff then I can…

Freeman Ok, yep.

Grant Ok thank you.

Freeman But there are basic similarities between them in terms of how the winter barns are managed, how fertiliser is managed, lane way management, riparian management, grazing management, cropping management. Management in terms of different soils and characteristics of the soils and physiographic zones.

Grant Has that been included in an updated FEMP?

Freeman Ah, I don't think so that all the FEMP's have caught up with all the mitigation measures yet, cause as you'll appreciate the priority has been put in to getting these detailed and into modelling and the FEMP's would have to follow. But I agree that it's very clear in my mind that the FEMP's would have to lock in what's specified here and our expectation I'm sure would be that the FEMP's would be locked in their conditions. So from my perspective that's an outline of 4 and 5 and Woldwide runoff.

Grant So that will be a further change to come?

Freeman How do you mean a further change to come.

Grant So you will be making changes to the FEMP in light of what's been modelled in the supplementary?

Freeman Yes we will need to.

Erceg And is that aimed to be submitted prior to the finalisation of the 42s or prior to hearing…

Legg I was thinking it would be with evidence coming in, would most suit us since essentially the FEMPs are, the basic documents as they currently are, they just need to be updated which they will be anyway each and every year. But we can, if you think, they need to come in before that it is something we could look at doing.

Grant It would be helpful if the FEMPs along with an updated AEE for each application would be incredibly useful because now, at the moment, I've got almost half a puzzle piece which I'm trying to put together with your older stuff but every change influences the further farm change which may influence my report, and at the moment the report that I've written for both of these application is not going to be helpful for anyone making a decision because it doesn't actually reflect what is happening on the ground now, in light of these changes.

Freeman It's obviously relatively straightforward to transfer all the detailed mitigation measures into an FEMP, it's quite a bigger job to write an AEE.

Grant It is. Yes.

Freeman …when the information…I appreciate what you're saying, that you want as much information in front of you to enable you to write up your 42A reports.

Grant Well to write up a helpful 42A report. I can write one on what information I have in front of me but at the end of the day is that going to be helpful to anyone. Because what we want out of this is a new decision for all parties, so…

Durand The commissioners will expect that of us, our role is to advise them on what we think is the right thing to do so that requires us to be able to assess, adequately assess what you propose to do and what the effects of it will be, so that assessment of effects is a critical part in that, to enable us to advise the panel constructively and effectively.

Freeman Obviously from my perspective I'm just looking at dates and how to achieve that working back from a proposed 16 September hearing week, that brings it back to 26 August, to have 42A reports finished doesn't it, then we, if we then try and produce a comprehensive AEE that covers every aspect, to get that to you in time for you to finalise a 42A report, yeah.

de Wolde I'm just looking at cost to be honest like after you guys stuffed up this thing in December you said you were going to make it easy and we're like a $57,000 bill from you guys for the month of July. I mean the costs are just loading and loading and loading, how big a mountain of information do you need, would it not be possible ?????

Grant I do appreciate that. We did agree on some timeframes for that application to be lodged early January and it wasn't and it wasn't received until the end of March early April.

de Wolde Then May, June, July because Environment Southland couldn't make, I mean we can go through the whole story, you said you were going to make it easy for us to re-lodge. You Michael and you Aurora were at our place apologising for the stuff up and committing to an easy process from here on in and it's been anything but easy and I would just really ask you can you please not have like an unnecessary mountain of information. Can you please just try to join the dots wherever possible and keep the cost acceptable to us. It will well go over a million dollars seriously.

Grant I do appreciate ??? invoices but unfortunately we were ready to go, we were ready to go to hearing. The reports were written on the application that was put in from that and I assessed it and then all the changes came in which is going to put the cost up because all of this new information has to be assessed and somebody has to pay for that and that is what, that's why we're having this meeting.

de Wolde Yep. Well my question is would it be possible for you to join the dots without any, an extra amount of information that we to write and you have to process because it would just flow out of the changes that we have made anyway. It would be the same.

Grant No it won't. It's going to result in an unhelpful 42A report being put into the commissioners and I'm not prepared to put myself up in a professional sense joining the dots without doing it properly I'm sorry.

Durand And also we've got submitters who are part of this process, they aren't here today, but we've got submitters in opposition to what you want to do. They would expect and the community expects that decisions are made on the basis of good advice, good information. So I totally appreciate the amount in costs and the, what's kind of complete information, how far do you have to go, but the council has got to be comfortable that they are putting up useful advice because we've got a duty to the community to do that and we've got a duty to the council to do that. So yeah, changes are proposed to be made and have been made and we need to be able to assess those so we can fulfil our obligation there.

de Wolde For any submitters that are voting I mean, it all flows out of a further reduction to our increment losses doesn't it.

Grant Well at the moment some of us suggest that that may have been but I think I've updated an AEE at the moment the current AEEs are all based on your old losses and like, I mean, I can appreciate you looking at it and saying well common sense says that that's going to have. you know, but unfortunately this is a legal process and the evidence has to be there for me to be able to assess it. And, at the moment I'm trying to join conclusions with things that don't match up because I don't have that missing puzzle piece so it's difficult for me.

Freeman One issue from my perspective, is balancing what, I think you're right, it makes your job easier and more appropriate if you're giving advice to commissioners, if you've got all the information in front of you, but in my mind there are possibly two routes you go down. You sort of put the whole thing on hold while Nessa goes back to square one and completely rewrites that, we go back to square one and completely rewrite that, or you essentially say right, this part has been changed by this much and the part of this that could potentially be properly updated, arguably from our perspective which we need to do anyway for the evidence, for our evidence that would be coming at say the 2 of September, if we were solely looking at assessing the actual effects side of it and not going through, you know, every sentence and every paragraph in this part, which would take a lot of time to make sure that everything is absolutely kosher, if we were focused on this side of it, I don't know, my instinct is for if, for example, if we were aiming to update the existing…..

Grant Like what, like the science….

Legg Just the assessment of the facts and nothing else in the remaining application.

Freeman Yeah, yeah, if we were focused on that from my perspective I think I \'d have a chance, a fighting chance of having that completed by the 19th, which would then give you a full week to finish a 42A report. But that's just off the top of my head for 4 and 5, I don't know what Nessa….

Legg If it was purely limited to Section 7, the assessment of effects, and nothing else, it's something I could do but it wouldn't involve you know, rewriting the whole of Section 7. It would be using what's there and amending it where appropriate based on these changes.

Grant Yes. I'm happy to take the information that's here and say these are the changes, what I really need to know is "so what does that mean". And that should be reflected in an updated AEE because….

Legg So are we agreeing, when you say AEE, is what we've provided and for me it would be that Section 7 of Woldwide 1 and 2's application.

de Wolde I mean from my perspective, I mean the costs are one thing but like I've been forced to intensive winter graze now for three years and any further delays will force me to do it another year. This puts me right past the sewing date for the crops for next year, and it's just like in 2016 we identified we wanted to end intensive winter grazing and we are forced to keep doing it by dilly dallying and more information and added cost and that is just my frustration. I really, really would not like any further slippage in the dates because that's just unmanageable for me to do another year of intensive winter grazing.

McMurdo I think discussing the information leading to the 16th of September is one thing and perhaps we understand what everybody is talking about now, it seems we need to have the discussion already before we actually make it by the 16th of September for the hearing because that might clarify for you as well.

de Wolde That's, from ,my perspective its really important.

Freeman Yes, so is it realistic and if not why not and if so, why.

Grant Ok, so this is what we have put together with everyone around those dates where they are not available. So, I can appreciate….

Freeman You'll have to explain it to us.

Grant Yes I'll do a bit of an explanation. Down the right had side we've got the initials with the people that are involved and if their name's on a date they are not available on that date so immediately on the 16th of September, that date is completely out for me, the whole week.

Freeman Can we ask why?

Grant Yes I am not here. I am not in Invercargill.

Freeman Alright. And there's nobody else.

Grant No. Alex is away but working remotely the entire of September. So this is when the hearing was moved at your guys request from the 5th of August to the 19th of August.

de Wolde No I object to that, that was not our request.

Grant Ok.

de Wolde That's not true.

Grant Ok. It came from your consultants but, it came from Tanya…

Legg I wasn't here.

de Wolde From the 5th.

Legg Yeah, not from the, the 19th.

de Wolde Then It was moved to the 19th of August, yes.

Grant Yes so that, I said that, that we were out for September. September we also have two other hearings on, the 16th of September, that week.

de Wolde From the 19th of August, it was not moved at our request. We were locked in for the 19th of August.

Grant Yes. And then I was given a whole lot of changes to your application.

de Wolde I'm just saying that we were locked in for the 19th of August and we did not request that to be changed.

Grant I made that request Abe because I wasn't in a position to make a helpful assessment of your updated application, so this is unfortunately what happens when people choose to change their application at the very last minute.

Legg I mean Aurora, that's true but the background to that is that there was a big decision in June which we have to take on board what came out of that, you know, it's only reasonable for us to also use that information which you would no doubt have used. It wasn't as if we sat back and just decided hell we're going to change. You know, we have done our best, it was done in…

Grant I'm not even going to answer this.

Durand For the record, just for the transcript, the decision, the Adams decision I think came out 4 weeks before we were told by Mike in his email changes were made, were proposed to be made to the application, and sorry I don't have that email in front of me but I think it said something along the lines of "significant changes to the application" or something that sounded like quite a change. Something new to assess. Subsequent to that I had a letter from Hans van der Wal, from you lawyer saying that actually these were relatively minor changes. But so, the Adams decision, yes that came out some time before this and I mean, I wrote to Mike about this and said that that decision essentially confirmed what we had said for more than a year, it confirmed the plan says what it says about the policy direction. It didn't change anything from our perspective anyway, it confirmed how the policy is to be interpreted and it confirmed how consents can and cannot be granted, so we don't consider, it's pretty academic, we don't really consider whether it changes anything, we don't consider that it actually changes anything. If you think it does, sweet, that's fine. You saw that decision and took several weeks to tell us what you were going to do about it, and that was two days before our 42A report was to be released and it was couched on that day, as something that looked like potentially major changes to the proposal. We sought direction from the commissioners, we received this information, what should we do about it, and they directed that we meet and that the hearing be postponed so we could understand the scale of these changes. And that's where we are now. It's taken that time to come together here. So we sought direction from them, what do you want us to do, cause we didn't want to throw two reports that had taken, like Abe said, a considerable cost and expense, our time and Abe's money, to produce, to advise commissioners. We don't want to put those up to the panel and have them be of no use, or questionable use, because of changes that have been made that haven't been assessed. That's why we asked for direction from the commissioners – what they want us to do about this because we want to be helpful. And that's where we are now. I take it that the Adams decision was an important decision, I think we were all waiting to see what was said but actually it didn't change anything, and it took you some time to tell us, to respond to us about what it meant for you, and you did at the very last possible moment.

Grant	And there is until and Act that would have allowed, you could have used Section 91A to say hold up, we need to assess what this decision means for us, but you didn't use that, so I felt like I was in a position where I had to say we've received all this additional information, I have no time to take it into account, and what you're going receive from the commissioners is an unhelpful 42A report. And in seeing the information that has been provided, the reports in their current form will be not relevant.

Freeman	But anyway, there's 10,000 books written on the causes of the First World War so people don't even agree on what caused the First World War or whatever, so we ,may not….

McMurdo	So apparently the date is the 16th of September.

Freeman	Well it is at the moment but presumably….

de Wolde	Is it true, you cannot make it.

Grant	I can't make it and also like, I would be happy to cancel that but we also have two other hearings booked in that week and doing three, and especially one of your size, is not possible with the council resources that we have. So who's not on here is Lacey (Bragg) as in from here, but she's obviously taken out for these other two hearings. So the week of the 16th of September is not achievable from the council's side, sorry.

Freeman	But obviously what we don't have on this calendar is…

Grant	Is the commissioiners.

Freeman	Yes.

Grant Yes, I know. Which is not very helpful.

Freeman If it would help we could spend half an hour working out something that we're all sort of grumpily happy with and put it to the commissioners and they say "sorry, we're not available".

Grant Yes, I agree.

Durand Well they've asked us to agree on a date, I suggest that maybe it's better if we agree on preferred dates, or maybe a series of options and put that to them and say well here's what we've got, which of those work.

McMurdo How often do they sit?

Durand They're all involved in other things, environmental court stuff, mediation and who knows what, they've got busy calendars as well.

de Wolde Thinking outside the square is it possible to pull us forward or is it not possible.

Grant Not with this statutory timeframe. Legal requirements for securing evidence with this because there's submitters involved and because now I've got to rewrite some….

Freeman Absolute bottom line the commissioners will want at least a full three weeks clear prior to the hearing starting then bang, bang, bang, 42A report, applicant's evidence, submitters evidence, week, week, week.

de Wolde Why have you not communicated that you are unavailable that week? Why have you not communicated that?

Grant I have communicated it.

de Wolde To who?

Grant To the commissioners.

de Wolde Yeah but us…

Grant Pardon?

de Wold Why have you not communicated it to us? I mean you are all working on this potential 16 September date and you're not even available.

Grant No, I…

de Wolde So why have you not communicated prior?

Durand Can we just remind ourselves of the purpose of this meeting which is to look at the availability dates.

de Wolde No, no, you are not chairing. I'm asking because, no, I'm asking I think it's a valid question, like we're all working towards a date which is the 16th of September and you're not even available so why have you not communicated it.

Grant So, I understand you're upset about it but actually we were all working towards the 5th of August. Then your consultants changed it and we were working towards the 19th of August…

de Wolde No, no, no. The 19th of August….

McMurdo It's probably not helpful for anybody to talk about that really because it doesn't t….

de Wolde When it was shifted on the 19th of August, we shifted it to the potential date of 16th of September. We have all been working towards hat day and no worries you aren't even available so I think we should have been entitled to know that that we're all working towards a deadline that's not even valid.

McMurdo Whether you're entitled to or not the date is the 16th, was the 16th so…

de Wolde Well no it's not because Aurora is not available.

McMurdo That's not, the understanding I have from all the information today was based on the new information coming in from the applicants.

de Wolde We are being made aware now of the fact that Aurora is not available the week of the 16th of September. I think we should have been made aware of that earlier. Before we were all working towards that deadline.

McMurdo Ok.

de Wolde My people are working towards it, they're working towards it, the whole farm is working towards it, I think it's upsetting that it's not even an option.

McMurdo Ok. That's noted.

de Wolde We're working towards a potential peaceful outcome and like to get it through here across as sort of as smoothly as Aurora indicated in writing, I don't think this is helpful.

Freeman Ok well Plan B then, Plan B I suppose is a question maybe for yourself Abe, and for you guys Aurora, is the week starting the 7th of October. Can we….

Legg What about the week before it.

Freeman Then, I presume there's nothing down for the week starting the 2nd of September because…

Grant The timeframes are too tight.

Freeman Ok, but Aurora is not available that week if I'm reading it right. So that week starts the 13th of September. But the week starting the 7th of October, then it sort of, well, nobody is indispensable but, are lawyer's less indispensable than everybody else, is Nicole Phillips personal presence essential?

Grant I would be happy to proceed without Nicole and just use her documented evidence.

Freeman And sometimes commissioners might say well we've got a question for her but if she's not available then they may, they may just say right we'll run the rest of the hearing when she is available, gosh she's not available for much at all is she. If she's not available thought, would she be available to say, for example, answer a written question?

Grant I'd have to check with her, but she is one, again not making anyone sound indispensable, but she is one that I would be happy to proceed without.

Freeman She might have a colleague like Nicky Watt or someone like that that might be able to answer a question, if there was you know, some debate about whether the proper protocol was followed in Overseer FM subsection (iii)(5)(a) or whatever.

Grant The other issue here is Cain Duncan is away that first and second week. Unfortunately Cain and I have obviously decided to go to Fiji in the same month but we didn't line up our holidays because I'm off the 21st.

Freeman I just don't understand…

Grant Why people need holidays.

Freeman No I just don't understand why people would go somewhere like Fiji in winter when there's all this snow on the mountains. I just don't understand it.

Grant It's October though.

Freeman Anyway. Seriously, that's an issue for you then, if that's a Plan B week, then Hans said he wasn't available that week. I can't recall exactly what his limitation was, whether it was Court of Appeal, or leave, or another case, I don't know.

de Wolde Like the whole thing, it puts my farming plans out of scope. I mean this was the last deadline, this week was the last deadline for me to base my future decisions for next winter on, my cows will be intensive winter grazed again next winter. I don't think I should be put in the position not having our people there because Aurora can't make it, I think ??? should be there.

Grant For the record, for the recording, it's not just because I'm not available, it's because council is unavailable. We do not have enough resources that week to hold another hearing of this size. We already have two rather large hearings on that week. And, it's not just me that's not available, Alex is also working remotely. He is available to fly down for it but there will be additional costs.

Freeman Because what will happen Abe is, in most respects we can't make decisions on this, all we can do is provide submissions if you like to the commissioners. So if the council makes a submission to the commissioners and says Aurora is not available, Alex is not available for these reasons and for these reasons, and if those reasons sound reasonable to the commissioners, they will not schedule the hearing in that week. That's what will happen in terms of….but by the same token the commissioners will be concerned to meet their duty to avoid unreasonable delay etc etc, so by the same token I very much doubt whether the commissioners would just say, oh gosh, ok, that's all really tricky lets plonk somewhere in December, they won't do that. Well that's my personal view, they won't do that either because that would not be meeting their duty to avoid unreasonable delay, and then they ,might put the heavy word back on yourself Michael, and others, and say something like well, get more resources or whatever. So, somewhere between those two extremes I think we have to come up with a proposal that might not be our preference but there's not much point putting something to the commissioners that we know in advance that they're not going to fly with. So if we, if we…

de Wolde So what proposal are we offereing ???...

Freeman Well, all I'm saying I suppose Abe is, if we just stood our ground and I don't know, told Hans send them a strongly worded letter that says we have to proceed on the 16th…

de Wolde The thing is for my cropping decision it's too late. This was the last deadline. I do remember you guys coming and saying it was going to be painless, and it's been anything but. And the whole August thing, the 5th of August thing, that was because the whole winter was out, on behalf of Environment Southland ??? the very end of the whole window. So, it has been anything but trouble free or cheap or whatever. I just really think if there's three people, why cannot someone else miss out.

Grant Abe sorry I'm going to refuse to shoulder the blame for the 5th of August. Nessa and I had a number of phone conversations about when that ??? would be coming in and that the longer it was delayed in being put in, that it would mean that the hearing would start to clash with Environment Court things going on, people's holidays, consultants who were on holiday, and that was why it was shifted, and, I'd just like to remind you that this is a huge application, it has been processed as we said it would be with no holds, and that is quire outstanding work from the council.

de Wolde I did not experience, I do not know you resource or whatever. All I'm saying is that it puts me in trouble on the farm, I've been living and breathing this stuff for the last three years, I just want to get on with my life.

Grant I absolutely understand.

de Wolde Please, please don't make me suffer any more.

Grant I completely understand.

de Wolde It's like 20 or 30 hours out of my week and I'm a farmer, I'm not like some ??? farm. Please be conscious of that.

McMurdo Is it possible to provide the commission with maybe a couple of different possible dates?

Freeman We'll have to. We'll have to. Just trying to get clear on that week starting the 7th which possibly might be duplicated…

Grant October?

Freeman Yeah. The October months shows that Cain is not available that week as well, whereas in that September one it's just got…

Legg Is he available on the Monday?

Freeman Ahhh, looks like it. That's the same week isn't it, that sort of final week on the September print out and the sort of first full week on the October print out, it's just put in manually.

Grant Just to make sure, if we include Saturday's and Sunday's and the council is prepared to proceed without Nicole being there in person, the 16th to the 20th of October looks like it could be.

Freeman Will you pay my divorce lawyers fees?

Grant Mate, I'll have my own to pay from this. I'm not even joking. Um, but, like that is an option there, where I can see some space/.

Freeman There're not many commissioners that work on weekends.

Grant I know but, they said put forward options so I'm just trying to look at potential options.

Freeman If we, and we probably don't have much choice Abe to a point in terms of looking at a couple of these other options, like the week starting the 7th, but then operationally, would that mean that we would have to go back and look at the dates of when things are happening, because as you say, you'll be making operational decisions.

de Wolde I just want to make sure that we have a proper team on our side. Aurora has going to have a lot of work to do. We have to have our people there as well. So I don't want to sort of go like oh sorry we still have to make it happen or whatever sort of thing. I want to make sure our team is there as well. I mean, why would we sort of be kneecapped before we start because we can't have the proper people on the ground, because the date is bumped at last notice.

Freeman Yeah. Well that sort of points to the week starting the 14th doesn't it. That, that's Cain, only Cain and Nicole Phillips not available but Cain might be available, or by the look of it, would be available towards the end of the week, so if they did want, they will always rearrange people so you know, even an applicant witness might come later in the week or a council expert might come first, they'll shuffle things around.

Legg Woldwide 1 and 2, could be moved second and 4 and 5's could come first, the opposite way around.

Grant Yep, it's just Cain's done the budgets for ???.

Durand Can I just ask a question about the calendar sorry, if you go to the 1st of October, I'm just looking at that box, it looks like Cain Duncan and Nicole Phillips are not available on the 1st, is that correct?

Grant Yes.

Durand Even though their names are quite close to the 8. Oh I see, it's not the names that are adjacent to the dates it's actually, the names are in the boxes, are in the bottom of the date box.

Freeman Shit. Right. Ok.

Durand So the 1st of October, it's Cain Duncan not Nicole Phillips who are not available. On Monday the 30th it's only Nicole Phillips that's not available. As an example. On the 27th of October, everyone is available.

Freeman That's not how I was interpreting it but ok.

Durand I think there are boxes there, they're so faint. So if you're looking at September 16th, the dates we can't do, it's Alex Erceg, AE and AG underneath the 16th.

Grant And also our expert.

Durand Whereas, like the 3rd and 4th of September, everyone is free, those two dates. Just to help understand the table.

Freeman That's very useful.

Durand So that suggests the last week in October is free. Correct? 27th to the 1st.

Grant Yep.

Freeman But also, with some juggling of experts, the week starting the 30th of September or the week starting the 7th of October.

Legg Yeah. the week of the 30th of September, Cain is here on Monday. That week works doesn't it, Cain can be here on the Monday.

Freeman So it's option sort of 1, 2, 3 isn't it. starting the 30th, starting the 7th, starting the 28thg.

Grant What would your preferred option be given that one of those weeks your experts….

Freeman I just turn my calendar off.

de Wolde One question I have and it's sort of peripheral, would we be affected by changes in legislation in between now and then, there's so much moving at the moment with all sorts of wintering, like we sort of put back by nearly a year, it will be affected by the changes that happen in the meantime.

Durand We're not sure when those documents are going to be released. If you're looking at the week of 30th of October I could say probably not, or more likely than not, it looks to me like it's going to be late in the year or maybe next year. I think there's going to be a series of opportunities for submissions to be made and various other things.

de Wolde (OVERTOP) Yea but Nicol Horrell rung me and said stuff was coming out of central government we should be very afraid of, there seems to be a monster coming our way that ??? around for. Is it going to affect me because it's going to be bump back, bump back, bump back, out of my control. I'll be very sad at the end of the day if I would sort of get hammered. Will I be affected by legislation or will my case be considered under current legislation?

Freeman Nobody can give you an absolute guarantee Abe.

de Wolde That's why I would really suggest getting to it as soon as possible.

Freeman Yes.

de Wolde I think I deserve that. Cause it's my risk at the end of the day and the risk of all the people and the cows in my possession.

Freeman If it's any consolation Abe, my understanding is generally, central government, the jargon that they use is, it's, quote, repugnant to drop new rules and have them applied retrospectively, but it's not repugnant to have new rules applied immediately. So, they won't backdate things and if I had $5 I'd put it on the table that said what will probably come out will be rules that effectively apply probably something very similar to your own standard rules for intensive winter grazing and say those are the minimum standards for the whole country.

de Wolde …the right thing but I think it would be really frustrating and painful if I will be worse off because every time ??? pump for three years I end up intensive winter grazing, my facilities fall to bits because we can't make the improvements and then at the end I'm hammered by legislation that changes in the meantime.

Freeman To me it sounds, I get a sense of de ja vous like water metering. All the regional councils used to bicker about what was appropriate water metering rules and eventually central government came in and said stop bickering, these are the minimum rules, you will have to comply with them, end of story. To me it sounds like the same sort of thing coming.

Durand We don't really know. We know that there are going to be announcements this side of Christmas, we're pretty sure of that, but what is meant by announcement we don't know, like it might be here's a draft for consultation, it might be here's the rule and it commences immediately.

de Wolde The ??? said August, that's not happening.

Durand These things seem to usually slip out of central government. But, Dave Parker's been saying this year is the year of action, next year is the election.

de Wolde I don't really feel, I really think as soon as possible.

Durand So that week, the 30th of October, that is possible.

Legg 30th of September.

Durand Sorry 30th of September to 4th of October.

Legg Yes, Cain can be here on the Monday and the 7th of October. He's available Thursday, Friday.

McMurdo Do we need to phone Cain?

Freeman So I suppose it raises another question which I was going to raise later, but, in terms of communicating back to the commissioners, obviously the want advice sooner rather than later, otherwise they're going to order us all to a teleconference…

Grant Today I think is their direction.

Freeman So, if we agree in principle on those dates with a preference, at least from our perspective, earlier than later.

McMurdo So preference 1 is obviously the earliest 1, 2, 3 just in the order of the dates.

Freeman Yes. Council?

Grant I can make that work.

Durand So let's just look at the pre-circulation dates and go backwards from there. Let's say it's the 30th of September, let's say for arguments sake, which means that the submitters evidence is the 23rd of September, which means that applicants evidence is the 16th of September and council's report is the 9th of September. We talked before about our desire to have a revised assessment of effects to us so that we can update our 42A report, so that gives us a bit more. So we've got to have our report done, circulated on the 9th.

Freeman On that scenario my suggestion would be as we discussed earlier but an updated but focused on the actual AEE, part of the AEE by about the 26th and that would give you two weeks.

Grant I'm fine with the updated AEE, yep, those timeframes are achievable.

Legg So by what date?

Durand 23rd. End of the day Friday the 23rd and then council has two weeks.

Freeman Now you've screwed up my Monday's. Monday, Monday, Monday and Monday.

Grant That's when my thesis is due, a week before my thesis, but that's fine.

Durand Well maybe, Mike and Nessa how much work is that going to be?

Legg It's just Section 7, part of the AEE. I think we would need that time because we need to look at Woldwide runoff and that may take a bit more time, the AEE part.

Durand I'm not sure if it's equitable, but it's equal, right, that gives you two weeks and that gives us two weeks.

Legg Yes, that's fair.

Durand Does that work for you Aurora?

Grant No it doesn't but I'll make it work.

Durand What about then if it wasn't the 30th of September but the 7th of October so that shifts the whole thing by a week.

Freeman No, I think from Abe's perspective he needs things to start earlier if it absolutely makes it work better then I think the onus should more be on Nessa and me to get an updated AEE to you earlier. Because otherwise we'd be preparing our evidence to be ready by the 2nd of September anyway, on the old schedule.

Durand Also, I guess for your information, say the hearing was held that first week…

de Wolde The 7th of October?

Durand No sorry, the 30th of September to the 4th of October and say the commissioners closed the hearing at the end, like literally say thanks we've got everything we need, so close the hearing on the 4th, that's going to be the 25th of October before you get your decision, and then you've got three weeks of appeal period. You can't exercise the consent until…

de Wolde As I said before, it puts my cows into another year of intensive winter grazing.

Durand So you're looking at 15th November before you can be sure what the decision is, and if somebody appeals then you can't exercise it until the appeal settles.

de Wolde That's as we said before, the week of the 16th was the last week that it could possibly have made it work.

Freeman Just to clarify you've got no absolute guarantee that they'd take 15 working days. They might grant themselves an extension presumably.

Durand That's true.

de Wolde They can't put off sunny days, they can't put off sunshine.

Durand No but just for the interests of transparency we're focusing on the week of the hearing but you won't get an answer until…

de Wolde I have calculated….

Durand Sure.

de Wolde Full clarity around what the outcome is for me to decide whether to put fodder beet in the ground or grass, that's the guts of it.

Grant Just on timeframe extensions as well, the statutory timeframe is 30th of August, so we've got two options, we can either do a timeframe extension special circumstances or we can do an agreed one. It's very easy to do one with the applicants agreement otherwise there's more administration time to write one up for special circumstances. So if you guys can have a think about that, whether you agree to a timeframe extension until the hearing date that would be helpful too. Again I'm just thinking cost and time.

Durand Just so we can give the commissioners a couple of options, we've got the 30th of September and 4th of October, which is tight for council but we could do it, especially if you could get your revised documents to us sooner rather than later. 7th to the 11th is the second option. Not sure of the second preference but that is another option, 7th to the 11th of October and by reckoning we've also got the 28th October to the 1st of November. Is that right? That's another one. Those are the three soonest.

Freeman Yes but obviously from the applicant's perspective we were saying that our strong preference would be earlier, as early as possible.

Durand Yes of course. I guess what don't want to do is convene like this, focus on that one date then go back to them and they say no, we can't do it. Then we have to reconvene.

McMurdo I don't know how the commission works but do we need November dates or is this…

Grant While we are all here should we look at it just in case the commissioners say well actually we're in Tahiti that whole time.

Freeman Do you want to say anything more?

Durand No, no thanks you. Thanks for your patience in working through this.

(*Michael Durand left at this time*)

Freeman Thanks.

Legg The week of the 18th of November is….

Freeman Yes although to be frank from my perspective if the currently appointed commissioners can't make any of those dates I'd almost be suggesting we talk to Hans about asking for different commissioners.

de Wolde No I don't think I want to do that.

Freeman No?

de Wolde No, I think I like the way they handled the Adams case and I think I've got faith in the way they handle it and I'm quite happy with this choice.

Legg So that's the 18th of November as a very very last resort.

Grant Ok.

Legg We don't want that week but…

Grant I understand.

Freeman So, 1, 2, 3, 4. It may then pay to just to outline that we, for their information as much as anything else but then we've got it in writing as references to us all in terms of what we talked about saying right, an updated AE part of the AEE two weeks before your 42A report is required. So whatever that schedule ends up being we know that that would be "the schedule".

Grant So if you guys are in agreeance, what I can do after this meeting is put down what we've discussed, obviously it will take a wee while to get the transcript, but if I just put the main points down because we need to get back to the commissioners today. And, I will send a draft email through to you to check that you are in agreeance with what we've come up with today. If you could check that before I send a request through to them.

Freeman Sounds good. In terms of the notes I had as a draft agenda, there's still a couple of items there and then you wanted to cover a couple of other as well.

Grant No, have a discussion on where I'm at with my 42 report.

McMurdo Ok so we're happy with the dates obviously and we're going to move on to the next point.

Freeman Happy's not the right word. Yep. So, I suppose from my perspective in terms of any additional mitigation measures the key things that stood out for me was are we all clear whether there was any or those proposed mitigations would either trigger the need for an additional consent or change the activity status of anything.

Erceg So the culverts will need to be assessed against the culvert rule. There's not enough in here to determine whether they do meet that permitted activity requirement.

de Wolde Today…

Legg At the runoff.

Erceg There's 1, 2, so the changes to the widening of the culverts and so they just wanted to check against the, should the consent be required, they're generally a controlled activity.

de Wolde What culvert were we going to widen?

Freeman Off the top of my head I can't…

Erceg The one by the, there's one where one of your paddocks and dairy lanes has flooded, can flood, and you mentioned that it's due to the culvert not being wide enough.

Grant Yeah yeah, it's page, critical source area.

Freeman Where's this?

Grant 14/15.

Erceg 1 and 2.

Grant It says that it's recommended the culvert size be enlarged.

de Wolde Oh yeah but that is actually, it was blocked I pulled the weeds out, it's between 14 and 15. It is a 90cm culvert and it's as big as all the other ones so it does not need to be enlarged.

Erceg So you're not enlarging it?

de Wolde We're not enlarging it no.

Erceg Ok.

de Wolde It's been unblocked and there's no requirement to enlarge it.

Erceg Ok. It's just implied that that was going to be a mitigation but that's alright, we'll take that out.

Legg I'll confirm that was cleaned.

Grant If we could, cause the option of the wording in this is should and suggests so just, if you're putting this forward, expect us to write conditions on what's in here.

Erceg So where they say could or should it would be better to clarify that these are or are not happening instead of like, this could be done because it sounds like, putting this forward makes it sound like it will be done but the wording kind of suggests that it may not be.

Grant And there's a couple of different options in there right so ones just like maintain riparian margin and the other one says it will be planted out in native species. So decide which one you're going to go for and if you could put that forward in the updated document that would be much appreciated. Because the last thing we want is the close of hearing being put off because of draft consent conditions that we've pulled out of this, but the wording is suggested. I'm just trying to think of streamlining ways.

Freeman Ok, good point.

Erceg It will be likely that everything mentioned in these will be a specific consent condition as they were proposed after the application.

de Wolde We'll check them, it was two culverts that were enlarged you said or it'll make things longer.

Erceg No I think the rest are just to do with the culvert crossing run…

de Wolde ??? consent does it?

Erceg No. If possible can we have GPS coordinates for all of these? All the critical source areas and stuff.

de Wolde Can't you do it on the map?

Erceg Yep it will show up on the map we just need something to show exactly where they are.

de Wolde There's farm maps included anyway.

Grant Yes but if you could just mark on…

Erceg Cause when we, if a consent condition is written it will need to have an exact location otherwise if we just used t make the GPS coordinates and compliance comes out, and the actual GPS is different then that could result in non-compliances.

de Wolde So does compliance not have the map, they can't read maps. What's wrong with maps when compliance…

Erceg It doesn't show exactly, like that's a very zoomed out high scale…

de Wolde It's A4, what's the problem.

Erceg I'm just trying to…

de Wolde Is it a requirement for us to have GPS coordinates, I mean cause it's easy like you can palm more and more information off.

Erceg I'm just trying to avoid any future compliance issues so…

de Wolde We'll give them a map with the numbers on and that should be fine.

Erceg Ok.

Freeman We can talk to Cain as well, he may already have that.

de Wolde It's so easy, like one hiccup and another person racing around doing this and this and this and the other thing adds costs. A map should be fine.

Legg I could get the GPS coordinates from Cain's map just on the desktop. He actually may well have them already.

de Wolde Maybe but I'm not promising anything. If there's no GPS coordinates we should ask the compliance office just to read the maps.

Freeman But as a standard, these are Fonterra templates aren't they so is there a bigger issue possibly to talk to Fonterra and Ravensdown and Balance about their template needs GPS coordinates.

Grant …address that but I'd prefer not to do that on Abe's money.

Erceg The other thing is the mitigations on the lease runoff block, um, just some type of agreement to show that these can actually go ahead since that property's not owned by the applicant.

Legg Yes.

Erceg We need to actually be sure that you can legally go ahead and do all the fencing and riparian planting on that block.

Freeman But if there is a consent condition that requires it, isn't it almost a bit irrelevant to you as to what agreements may I not be hovering around here.

Erceg We can't grant a consent for something that he can't actually do and is automatically non-compliant with it. If he's got no legal obligation to go and fence waterways on a property he doesn't own and we issue a consent saying you must fence this waterway…

Freeman It still has to be done.

Erceg Yep but then either he breaches the lease agreement he's got with the owner, the person who owns that block of land or Abe is then non-compliant with his consent because he can't do the fencing and the riparian planting.

Freeman But what level of detail would you expect to see, do you want the signed lease agreement with all the financial detail in there?

Erceg Just confirmation from the owner of that block, that Abe can go ahead with these mitigations that have been proposed to occur on that piece of land.

Grant So some people just give us the lease agreement and redact out any financial stuff, I don't care about that, if that's the easiest way to do it or if it's easier to get a signed statement for the leasee.

Freeman Are you happy with that?

de Wolde Yeah yeah I think it's just very funny because they're sort of saying landholding because it's the same ownership structure like how do you manage that, like it's a big nonsense but if like we have to do that I'll have to. This actually contradicts the whole ownership argument, the whole landholding argument really in my mind.

Grant …anything else?

Erceg And just that email I sent last night about the overseer budgets, get confirmation of that cause at the moment…

Legg It will just be one nutrient budget though because…

Erceg We will need, to compare the effectiveness of these mitigations all the previous nutrient budgets need to go into Overseer.

Legg So the previous nutrient budgets are all exactly the same because they are pre-expansion so it's only the proposed nutrient budget from the March application, it's the only one that's actually changed.

Erceg Yep but when it goes into the new Overseer the losses…

Legg So it's just one that you need to see.

Erceg …the losses can change from, they can be different.

Legg They're already there so the 13/14, 14/15, 15/16, they're already there in FM, and they're the same as you know, nothing has changed, it's just the proposed nutrient budget for Woldwide 1 and 2 has been changed slightly, so I'll get the one from March and get it put into FM, so that's the only one, the slightly new version.

Erceg Yep.

Legg Ok.

Grant Just the other point that I had Nessa in 1, is that one of those mitigations says the reconfiguration of Woldwide 1 platform, the application doesn't discuss that at all. What, because that potentially, is quite a major change. I consider it would still be in the scope but it would just be helpful if that was addressed.

Legg I need to follow up on that, yeah.

Grant Because our understanding was that the two farms would be run operationally so there was going to be no changes with land between the two. So I've either missed something completely but I looked right through the application last night and couldn't find anything.

Legg Could you just say that again?

Grant On page 17, the phosphorus mitigation plan, the reconfiguration of the farm will result in a number of these paddocks being assigned to the Woldwide 1 dairy platform.

Legg Yes.

Grant That's not in the application.

Legg I guess the application treats it all as one though.

Grant It does but….

de Wolde We might just rephrase that and change the cow flow.

Legg Yes it's just that there are no reconfigure, major reconfigurations for either unit but just…

Grant Like, we obviously assess all effects and losses.

Erceg So, operationally, how do you propose to operate the dairy platforms 1 and 2? Are they being combined and they'll be operated as one platform?

Legg No, they're still two units.

de Wolde We put the wording like something like a difference in cow, changes in cow flow and cow traffic in the new scenario sort of thing if the consent would be granted blah, blah, blah, something like that. Wold that be acceptable.

Grant It's good to know what you're doing on the ground.

de Wolde So basically this means that the cow, there's not as many cows walking along the creek if we get the consent going forward.

Grant Ok, well this is probably a good time to head into my issues, like what I think of…

Freeman Go for it.

Grant Is that ok?

Freeman Yeah, yeah, go for it.

Grant So just on that, the landholding, where I've arrived at in ??? as it currently stands, is that I've treated the two applications as separate application because that's what has been put in front of me but I was not able to treat the farms as separate landholdings. So I've arrived at the conclusion that your entire operation is one landholding. So I just want to make that very clear that is in my report and it does bring Woldwide 3 into the mix. I can explain my thinking a little bit more behind that if that would be helpful.

de Wolde What would the implications of that be.

Grant Because you, as I dug into it and I processed and wrote my report, there were so many transfers of effects between property's that it was impossible for me to not consider them when looking at the definition of landholding as one entire farm operation. And, then, I realised that Woldwide 1 and 2 have combined into one landholding even though they are being treated still, as operationally different, but 4 and 5 are still being treated at different farms and you're telling me that they are separate landholdings, there's a complete contradiction there. So in my professional opinion through the ??? that actually it's all one landholding. I do know that Cain came to the same conclusion with the Horner block being in the landholding for 1 and 2 for its nutrient budgets and that's been removed, that's fine, but just note that the farming permit or 2 does include the Horner block as part of the landholding and that was proposed. So where I've arrived at, I tried to write it as they were all separate landholdings and I couldn't do it.

de Wolde What if you would go way back to 2016 when the whole thing started, our very first application, Woldwide 1 and Woldwide 2, Environment Southland muddled it all up ,they got separated and then you said let's combine it to make it easier so there's the reason 1 and 2 are combined.

Grant I did go right back.

de Wolde Yeah but that's the reason they are combined, that's the only reason because you guys muddled the original one, they were separate, you guys couldn't understand that and then it had to be re-lodged again.

Grant So I've just, this is just me trying to be helpful and letting you know what's going to be in my evidence so you can address it and do some further thinking, I'm not going to debate it here sorry.

de Wolde But my question to you is what in your mind are the implications of Woldwide 3.

Grant So for me, this comes on to my second point that is a key issue for me in my 42A, is that currently as we discussed on the site visit your intensive winter grazing on the new Cochrane's block currently, from what we understand, what we were told at the site visit, is not in line iwht the permitted activity rules, it's illegal currently. And that means that Woldwide 3 no longer has Section 20(a) rights because those cows now ??? rule 20.

de Wolde What is Section 20 anyway?

Grant Mike would you like to explain?

Freeman 20(a) is just the Resource Management Act that says basically if something was legally authorised either for a rule ??? effect, it can carry on doing what it was legally authorised to do even though a rule might require it to do something different, it can carry on doing what it was doing until 6 months after that rule finally becomes operative. So, even if a rule comes in that says, think about it in this respect, if it said that portable water troughs are required, if portable water troughs weren't required beforehand you can carry on without them until the rule becomes operative.

Grant So because Cochrane's block was a sheep block and then by putting 3000 cows, I think you said at the start, on that block, there's a definite change, so there's a thing in case law that says the scale, scope or intensity and the intensity of that land use has definitely changed so you don't have Section 20(a) rights. There's something else that came out of the Adams decision was that actually, council needs to recognise that somebody does have Section 20(a) rights and you haven't got that permission from council so currently you're winter grazing on there illegally. So, that pulls Woldwide 3 into the mix and they need a consent for farming.

de Wolde Woldwide 3 does not winter the Cochrane block.

Grant You've got cows from 3 on there, you told me at the site visit.

de Wolde As like a ??? yes so I can graze Woldwide 3's cows somewhere else.

Grant You would need a farming consent for that unless they went to…

de Wolde To graze them off? I could send them to Wanaka or McKenzie Basin.

Grant You absolutely could, I really don't recommend that.

de Wolde Why not?

Grant I just want to let you know what my issues are without getting into a debate so if we could just…

de Wolde	Ok but what I'm saying if you're pulling Woldwide 3 in because we went to the Woldwide 3 cows on the ???, I said that's fine I won't do that again, that's fine. Because the cows were just there because there was more crop than we needed.

Grant	But it's been done now so there's a breach ??? for consent. And also, that's not the only reason why I consider that Woldwide 3 is part of your entire landholding. That's one factor, I'm going to tell you the other ones because the last thing I want to do is for my report to come out and there be, and you have to have further delays because you need to address what I put in. So what I tell you now is for transparency just to say this is what I'm thinking about it. And at the moment, I've done a lot of thinking about it and that's where I've arrived at. I'm not into debating it but I want to give you guys a fair chance to address it just cause this thing is so big and I don't think that it's fair for you to only have a week once my report comes out.

Freeman	Can we go back one step just so I'm clear on what you're saying, that clearly anybody could have a specific issue as you say if they are undertaking say new intensive winter grazing in a location where it wasn't carried out previously and then not complying with the provisions specified in Rule 20, they could be doing something that is not authorised. Ok, so that could happen anywhere. What I'm just struggling with, almost park that, there's the potential for someone to be undertaking intensive winter grazing that is not authorised. Then we've got the issue about landholding. what I'm just trying to be clear about in my mind is are both those things absolutely intricately connected or is there a distinction between intensive winter grazing that may not be authorised that either needs to stop and be authorised and the definition of landholding.

Grant	There is, it is connected but can be treated separately as well. I'm not sure I completely understand your question sorry.

Freeman	Well I'm just trying to, I can understand and certainly I can see…

Grant	Should I discuss maybe the other reasons why I think Woldwide 3 is part of the landholding?

Freeman	Yeah that might help because in my mind I'm thinking, like with any client, ok, need to ensure that whatever you're doing is properly authorised, now how do we understand the definition of landholding.

Grant	Ok. So the definition of landholding is set out in the plan.

Freeman	Yes and I've got a copy of it in front of me now.

Grant	That's great. So the other reasons that it is all, that I have arrived at the position of treating it all as one landholding is that what wasn't identified when the original legal opinion on landholding came out is that Woldwide 2's farming consent includes the Horner block in its entirety as part of use for farming there and I'm sorry I'm explaining this in kind of a cleaners language but I'll just get it out and we can explore a little bit, and Woldwide 3 puts effluent on Woldwide, on the Horner block so on Woldwide 2 and on 5, this is all from memory, and effluent goes onto 5. So 5 uses nutrients from 3 to grow the grass needed for the cows there and it's all connected. That's where I've arrived at. And the ownership structure is something that I couldn't escape either.

de Wolde	Yeah but you're just weaving all that of so many complications because the reason that Woldwide 5's application area is Woldwide 3 is because Environment Southland couldn't deal to making the changes, we tried 3 times to get it removed and we could not. Like Tania has been trying twice to get it removed. So the reason that Woldwide 5 is linked to Woldwide 3 is because Environment Southland could not handle making the changes.

Grant I'm sorry there is no…

de Wolde I can dig it out, I can dig up the email train, you can ask Tania, we tried twice to get Woldwide 5 removed from Woldwide 3 because initially we bought it as a slurry block, then we bought more land and we converted it into a dairy farm and on two occasions we tried to change that. So don't throw it back in our face now and say it's linked, don't try to change that. It's the same with the bore on Woldwide 5, I think it's Environment Southland's muck up and we pay the price. If you use the fact that Woldwide 5 and 3 are linked that is not fair because Woldwide 5 and 3 are linked because Environment Southland could not handle to make the changes that were needed. Nowhere ever has any slurry gone from Woldwide3 to Woldwide 5. We said we'll just leave it at nil.

Grant So it's been budgeted as that occurring in your budgets.

de Wolde Because you guys could not change to make the difference. We tried that, seriously. Ask Tania, we'll dig it up. We've bene trying to make the changes but you could not deal with it.

Grant I'm really sorry and I understand how frustrating it is and I have gone back through and I've found all of that backwards and forwards, and I looked, and there is no variation to remove that that I can see. You were told that, that removing that would mean that you would need an application in and there's no application in the system. So if you can find something please out it forward and I'll consider it.

de Wolde And the Horner block is actually split in two 28 hectare blocks and ??? and that's not allocated to Woldwide 2. It's split up into allocated effluent areas, ignoring the fact that there's slurry and effluent and you guys cannot deal with the difference between effluent and slurry but it all has its individual areas allocated to the property so it's not that the slurry of Woldwide 3goes to Woldwide 2, no it goes to the Woldwide 3 allocated area of the Horner block.

Erceg The entire area of the Horner block though is included in our farming consent for Woldwide 2 so it's got nothing to do with the discharge of slurry it's to do with it being…

Legg That would've been under the previous version of the Water and Land Plan where there's no definition of a landholding.

Grant That's right.

Legg And that's something that we would need to look at. Because it is listed as you know, in the legal description but when that consent went through there was no definition of a landholding, so that's not, you know, one thing may not equal the other.

Grant But it was offered as almost an offset would balance the losses of what was occurring, so that's like a key part of that farming consent that's already in place.

Legg I guess that comes back to that legal opinion from Wynn Williams that said that's one activity in a much bigger…

Grant But unfortunately they didn't have all of the information at that time because it wasn't until I sat down and started, and I had them both, that was the difference, but I mean that will all be, there'll be legal submissions on that point. Just on Woldwide 2's farming permit as well, that farming permit obviously makes it part of the permitted base one to say that there's you know, there's cows allowed to be on there because it's permitted. But unfortunately the permit, the farming permit, they put forward a mitigation saying that there would be no more intensive winter grazing or cropping done on those land blocks, it's in the application for farming, but your nutrient budget relies on that winter cropping being removed so essentially you're doubling up for something that's not legally allowed to be there, so this is moving on to my second issue.

Legg But I guess what we have had to model the actual use of land and we can't get away from that. we have to provide nutrient budgets based on the actual use of that land and that's exactly what we've done.

Grant Yes except the likes of the Gladfield block which I understand has already been converted to a cut and carry block, that has been budgeted as proposed to be intensively winter grazed for several years to come until the winter barns are in place. The main issue I have here is the budgets are not aligning with what makes it with permitted or existing base lines at the moment because of those crossovers between farming consents. So those are the two key issues in my report that will, that I didn't want to surprise you with. On a different note though I can…

Legg Could we just go back to when you say the entire operation is one landholding, so what is that going to look like? How is that going to be in a land use consent permit?

Grant I don't think that's worth debating here.

Legg I think it's quite important, it's hugely important to Abe. In a general sense even, what are you proposing.

Freeman Well the implication as I understand it is that you're implying then that a lot of this information would be inadequate because you'd expect the whole Woldwide 3 would be included.

Grant So how I would approach that is I have, in my report I have a separate section on landholding but I've specifically said that I respect your right to apply for as you would lie your proposal to be, so I have assessed them separately, the landholding section is the same in both reports, and I've said that I consider, that from a planning opinion that the whole thing is one landholding. We've been playing with how conditions would look under that but I can't give you a ???

Freeman And just in terms of saying if you're right, whether you are right or not, it may be by the sounds of it advantageous to Abe for us to properly put an application in to change the discharge permits associated with WW3 and WW5 so that it's clear that WW# does not have authorisation to apply effluent on 5.

Grant It would have to be the Horner block as well, would need to be in that.

Freeman Ok but what you're saying from your perspective, if that were separated then presumably you wouldn't define…

Grant No because the Woldwide 3 still uses Woldwide runoff which I consider part of the landholding for the young stock and dry stock.

Freeman That's a stretch.

Erceg And Woldwide 1 owns Woldwide 3's dairy platform according to our system.

Freeman Owns it.

Erceg Yes so Woldwide 1 Limited, the company, is the owner of the land that Woldwide 3 Limited's dairy platform sits on, from what I can see.

de Wolde You guys still don't get it. I hope the commissioners can see through all this incompetence. I just, no, that is not true. That is not true.

Grant This is the Woldwide runoff and we got a bit of a decision from Adams on what's part of the landholding and I think that does apply in this case as well.

de Wolde Just to rectify this, Woldwide Farm is an independent limited company, Woldwide 1 is an independent limited company, 2 is, they are all independent limited companies. So Woldwide 1 owns the land that the farm is on.

Erceg What I can see on our system is that it appears that Woldwide 1 Limited, the company, also owns the land that Woldwide 3 Limited farms on.

de Wolde No this isn't correct.

Grant The rates are paid…

Erceg It does look like that on our system.

Freeman Mike just something else to mention as well, the budgets for the Collies block have essentially budgeted cows being on those blocks because it talks at length both in the old budget and the revised one, that there is a consent for that block, that's the one that was surrendered, so that's just another planning question mark over that that came up while I was doing my reports.

Freeman Sorry when you say it was surrendered…

Grant Yes 2016, the conversion permit for 5.

de Wolde Just taking a step back, and being conscious of the fact that you are aware of the anguish that you put us through, is there any way that we can backtrack so that we can sever the link between Woldwide 3 and the rest.

Grant No, not now.

de Wolde Because these cows are just there because there was crop left over like they could have been the cows of the neighbour or any other farm like they are just independent differnet companies, and it's not going to happen again.

Grant But Woldwide 3 relies on Woldwide runoff and that's what pulls it in. I know this is incredibly frustrating for you.

de Wolde So will it be like effluent ??? again and drop tests on the and all that again.

Grant For 3? If you choose to make an application for it today.

Freeman I think we probably need to have some discussion Abe I think it would be worth getting Hans' input in terms of whether that…

de Wolde It's got a 20 year consent of something I mean everything is tickety boo on that.

Grant If I can, look I've spoken to you about this, I would be happy, if it is helpful for you, to lift out my discussion on landholding that I've done because I don't think it's going to change anything in light of these changes, if you're wanting to get legal advice on it, but I'm happy to release that section to you early if I am able to and I'll take some advice on that.

Freeman That would be useful otherwise I can imagine going into the hearing and the commissioners are just getting…

Grant And that's exactly what I want to avoid. So, I'll take some advice on that and I consider that would be useful for you to see.

Freeman I suppose just as an aside, as I look at my definition, am I right, I assume I must be that the definition hasn't been appealed by anybody.

Grant I will check that.

Freeman It doesn't look like it, my copy of the appeals version and it's not greyed out so like a number of things about this plan, people don't seem to be too concerned about the detail, so nobody's even, none of the submitters have actually looked in detail at that definition.

Erceg Or they agreed with it.

Freeman Yes of course.

Grant I just want to put, if I do release part of my report, it's not something that's done normally and I am not releasing it for it to be picked apart. It's my opinion and that's what a hearing is for ok. It would be a heads up for you guys because I want to be as helpful as possible. So you can take what I've put and hopefully it explains it in a concise way but I'm really not open to having a debate about it before we get to the hearing.

de Wolde Is there any way we could have a constructive talk about the effluent pond and slurry.

Grant 2, or 3.

de Wolde Or 3, I mean that's going to be the next thing coming up, the rules across the new effluent pond – no it's slurry, no it should be effluent blah blah blah, it doesn't work. Like, we'll get the same issues there, like, I'm going to line it completely, proof pond like we did a drop test and it didn't drop. I'm going to line it out of the goodness of my own heart and it means that we have to spend another half million dollars to do another pond because your rules don't fit. Is there any way we can address this crust on the slurry ponds because slurry is thicker than effluent. Ok you can see this coming a mile away for Woldwide 3 now.

Freeman My understanding of that is people, Nessa you'll know better than I, is that people have got methods now to try and force slurry ponds to fit the dairy shed effluent pond requirements. Even if that means putting some sort of floating device on push the crust aside and measure levels of that instead of trying to measure levels of the crust or something.

Grant Alex is all over the farm ones.

Erceg No, it would have to be free from curst.

de Wolde That's not possible.

Erceg And it would have to be de-sludged within the last 12 months for it to meet Appendix P So, we're not worried about the fact that there's sludge being stored in the pond, when it comes to the testing of that pond it needs to be liquid.

de Wolde I mean that's the thing, it's 60 times as thick as effluent, like it is poos and piss, it's not effluent, it's different material. So your rules don't fit. Like, if Woldewide 3 is going to pulled into it the first thing we're going to come across is this effluent pond because it is a crust yes because it's slurry, it's not effluent, it's thicker and you guys won't handle it, and before I know it I'm relining another perfectly good pond because you're silly rules don't fit.

Erceg But obviously it's in the rule, we didn't write it, it was written by the Environment Court, they've put this out. It's going through the appeals process at the moment, the public has had the chance to appeal on it, these issues can be submitted on through the public process but now that it's a rule, we can't just go round in circles constantly arguing that your pond doesn't fit into the rule, the rule is there and it needs to fit that rule. We can't go round in circles and there's no point going round in circles because no one is going to get anywhere.

Freeman But operationally Alex, that means these types of ponds basically have to be emptied and filled with liquid to do the text.

Erceg Yes, the same as the sludge beds. And we've acknowledged that this rule is not the best and it's not functional and we have approached our planning team to change that, and it just hasn't been done yet and at the end of the day we have to live with that, you guys have to live with that.

de Wolde That's funny, what are you towards it.

Erceg We can't sit here and argue…

de Wolde We have to live with it, you have to live with it, what are you doing towards it.

Freeman Alex can only do so much.

de Wolde That's not a fair way to describe it.

Erceg We have to have this conversation with everyone every time, and we have tried to get through this. We've made attempts to make things simpler for people where we can but there's just no way that that pond can be filled with slurry during its testing.

de Wolde Stone silence.

Freeman I mean at least we know then that one approach if necessary is, and I don't know how practical it will be, to basically ensure it's empty, de-sludge, filled with liquid and then tested. Alternatively it's…

Legg …from the dairy sheds. Those steps would just take a hell of a lot of time to make happen. In a practical sense it's extremely challenging.

Erceg Yes we acknowledge that and we always have acknowledged that. And, this rule has been out for a while now so everyone is aware that that has been the case since this rule was released. Instead of just accepting that that's the rule and trying to do this stuff in advance we get to an application and we argue that we can't go and drop test it every time.

McMurdo Can we park that a wee while?

Freeman Yeah we probably need to. But it's all based I suppose, the concern about the extent to which WW3 might get pulled into all of this.

Grant Yes. Well as it stands and if we consider that every one of Abe's farms bar 1 and 2 which is one land-holding, like as per that got forward Woldewide 3 does currently need a retrospective resource consent for farming because of illegal intensive winter grazing on Cochrane's blick.

de Wolde So why is it illegal?

Grant It comes back to the scope issue and the fact that you've put 3000 cows on to land that was sheep farm and you don't have a permit for that, and you don't have protection to continue those operations because it's in your activity on that land.

Erceg And it wasn't done in accordance with this rule or the regional water plan.

Grant So there was no good management practices in place when we were out on site, so that's what we discussed at the site visit.

Freeman We should have a discussion separately about that and presumably you would only be expecting a retrospective consent for an activity that continues. Putting your old hat on.

Grant Putting my old hat on, that has been past compliance. So they'll be looking at it and how they approach it.

Freeman Just so you understand Abe, I think the point being discussed there is that, councils will often request, as council's can only request that applications be made for a retrospective activity but normally, this is my personal view, normally councils wouldn't expect a consent application to be made unless the activity is continuing. If the activity is ceased then generally council's aren't expecting consent applications, they might be taking some enforcement action about something that happened in the past, and that would be the difference. Council's might be both taking enforcement action and telling someone they should be applying for a retrospective consent.

Grant That's correct.

Freeman So we're on a similar page.

Grant Yes, you need to have the discussion on who that's going to look going forward.

de Wolde So we're going right back to where we started to I am not able to make my planning decisions because this date is going to be too late for me.

Grant I appreciate that that is going to be a factor for operational but unfortunately the new information that has come through says you've already got the cows on the property. That's kind of like me building a house and going oh I should have probably talked to the council first.

de Wolde No, no, no, no, no, no, when we had a scoping meeting 2016 with Environment Southland people and they say go ahead with it, there's a new formality and we accept the 380 hectare lease, that was when the decision is made. I've got $700,000 worth of feed stored up and we did have the pre-scoping meeting and we did get the green light. And the lease agreement, 3 and a half of the 5 years are gone now. Lease land doesn't lie around so we did the right thing, we went to Environment Southland, they said it's easy, we went and accepted the lease for 380 hectares. So that's when the decision was made. 2016.

Grant Ok. And we appreciate we've had two variations, like we've had two versions of plans come out since then which has changed things for you.

de Wolde Is it two or three now.

Freeman Two, yeah.

de Wolde This is the third time, and half a million dollars and several hundred thousand dollars' worth of stacked up feed. But like, what do I do? So you lease 380 hectares of land, what do I do with it, it's just not practical. And I did the right thing, I did do pre-scoping thing and I did do the pre-coping thing for Woldwide 4 and 5 and then it was that unless the effects of intensification are fully mitigated blah, blah, blah, blah, blah. So we were made to believe then that if we mitigate the effects that we'd be fine. As a farmer I cannot run with that, I end up in a situation that I shouldn't be in because of indecisiveness and incompetence of Environment Southland people, and it's very frustrating.

Grant I'm sorry I know how frustrating it is.

de Wolde I tried to do the right thing and we had the pre-scoping meetings, what more could we have done.

Grant Yes and unfortunately this is just the rule framework that we work with, and I can't tell you what to do with your operations on the ground, but, and I'm sorry if there has been times that you've received bad advice from Environment Southland in the past, and I totally acknowledge that and I think I've been completely open and apologetic to you for that.

de Wolde On top of that we've added to our wintering sheds and they've been asked for, for two years in a row now.

Grant Yes and hey we can put through a consent variation very quickly and easily to put just want you've got on the ground and in the barns, you've already done the extension, so that is always an option but I just want to…

de Wolde But thing is like when we got this Cochrane block we always said like unless the effects are fully mitigated blah, blah, blah, so we were made to believe that if we mitigated the effects of the intensification on the sheep farm, on the rest of our operation, we will be fine.

Grant And that was what was acceptable at the rules, with the rules in the policy at that time but that's changed, and I understand that that's moving goalposts but this is just the environment that we are in at the moment with our regional rules. I totally understand how frustrating it is.

de Wolde But can you see that I as a farmer have done the right thing. So I end up in a situation now with like, so I got this Cochrane block, what can I do with it.

Grant I can't answer that I'm sorry but I do understand how frustrating it is for you. And I can see that you are trying to do the right thing.

de Wolde I really am. I really am.

McMurdo Just to keep pushing it forward.

Freeman You had one other issue didn't you Aurora, I thought you'd made a comment about the existing environment.

Grant So that's what I was talking about with the budget, what's been budgeted on, for Collies block where it's been, the application adds to the nutrient budget both consider that Collies block is allowed to be a dairy farm, so it's consented to be a dairy farm, but unfortunately, we did in 2016 so it doesn't make up part of the existing environment as cows on that block. Was there anything else?

de Wolde So that's the consented effluent area.

Grant No the conversion consent for 5.

de Wolde Yep.

Grant Remember we had the discussion.

de Wolde …sign it otherwise couldn't supply milk and that was….

Grant	Yes. One thing I did want to mention as well, I emailed about the activity status. So I've advised that currently with the intensive winter grazing being occurring, it does trigger Rule 24, but if consent was granted under Rule 20 then Rule 24 discharges become a permitted activity. I have discussed that at length but I've arrived back at the it's a discretionary activity, not considering Woldwide 2's pond and what's happening there. I needed to advise that in my report but it will depend on what happens…

Legg	Yeah that consent application is being finalised, it's with the chartered engineer at the moment, and so the application will be made under 32(b) part (ii) so it would be a controlled activity.

Grant	Ok, cool.

Legg	So it's not going to change.

Grant	So I can just say…

de Wolde	A practical question, if Woldwide 3 is going to be pulled into it, if you're successful in doing that, how are possibly going to provide all the information to the level of detail that you received on the other ones, it'll be a complete impossibility won't it?

Grant	It will be something for you to talk to your consultants about looking at what you've already got so hopefully you've already got a farm environmental management plan for that.\

de Wolde	You'll want drop tests and you'll want all that other drama.

Gratn	Again, putting it back on your consultants that would be for them to say, you know this is late in the piece, if that's the road you want to go down, it's completely up to you, this is late in the piece, we propose drop testing by x date. I would suggest that commissioners looking at that would consider that that would be a reasonable approach and I certainly wouldn't have an issue with that. I'm assuming that you do have nutrient budgets for that and FEMPs for that farm too.

Legg	But there won't be a nutrient budget for Woldwide 3, it would just be a new round of reporting nutrient budget, it's going to be nothing like the ??? standard which, you know, we don't have nutrient budgets on hand for Woldwide 3 that are done to a high level of detail. So would that matter? Would that matter?

Grant	It would be, it's hard to say without seeing…

Erceg	I guess it comes down to whether with the argument you guys are putting forward for the landholding, whether you decide to apply for that consent or not as well.

de Wolde	Yes but with this application we were denied access to the commission if we didn't adhere to the way we presented our landholding. Is it an option to say well Woldwide 3 actually will let commissioners decide what they think about it.

Grant	That's exactly how I've written my report, I've said in my opinion the whole thing needs to be considered as part of the landholding but I completely respect your right to apply as you have, and then I've assessed what I've got in front of me in terms of environmental effects.

Erceg And the applications are clear that you do disagree with our opinion as it stands and that that was an issue going forward to the commissioners anyway so there is already that discussion to be had with the commissioners about the landholding anyway, because the application is very clear that you disagree with our opinion.

Grant But just do be aware that the Adams decision did give us the steer on what is contained in the landholding with the additional cut and carry block, so because, yeah, the Horner block would be bought into that if you were using the same logic. I'm just trying to be helpful.

de Wolde Would we have the opportunity to say well you know what, let's, in the uncertainty what the commissioners decide on this whole landholding thing there'll be no additional information on Woldwide 3 If they decide it needs to be pulled in yes we'll provide it then.

Grant Yes and that might be quite simple right because some things ??? changing on 3.

Legg But surely you want to know everything about it.

de Wolde Yes!

Grant The RMA directs but you know, the applicants put forward an application that tells me about things, it would be helpful.

de wolde It's compliant farm and it's got a consent and everything. So could we say well if the commissioners rule that it is actually part of a landholding then we'll provide all the information.

Grant Yeah so obviously your consultants will be able to give you a better steer on this in the future.

de Wolde ???

Grant Yes I'm going to tell you that. At the moment Woldwide 3 has a permit to use groundwater and to discharge effluent but your cows on your paddock are currently illegal because you don't have Section 20(a) rights to be a farm, you don't have that protection anymore. So while some aspects of Woldwide 3 are permitted and all good and I don't have any issue about them and I think that they expire 2027, so they're a non-issue to me because we've already given you permission for those activities to occur. But unfortunately now your cows on paddock are not legal so you need a consent.

Legg Because otherwise you're grazing.

Grant Yes. So I need to know what the effects of that are. That's where my focus would be.

de Wolde And you said for the winter grazing, the young stock.

Grant Yes.

de Wolde That's two things.

Grant Yes I just simply put forward the number of factors that I think bring Woldwide 3 into the picture, and we've covered off a few of them, Woldwide runoff because 3 uses Woldwide runoff, there's a transfer of effects there so Adams did give us a steer on that transfer of effects between where intensive winter grazing is done and where support cows go and what not. The other factors being for 3 bringing it in, is that 3's effluent goes on to these two which has also bought it into the mix for me. But like I say I'm more than happy to take some advice on giving you my discussion on landholding. That could be helpful.

Freeman I mean it is very useful to get your perspectives, I think we need Hans' input into some of this or key parts of it, I wouldn't be at all surprised if Hans has a very different view and depending on the strength of his view then we have to decide about what approach to take.

de Wolde Thank you for making us aware of it.

Freeman May main perspective about the definition of the landholding, there's got to be a point at which it doesn't keep connecting, connecting, connecting. But where that point is and where that relationship is whether it's a company that's got similar ownership or a completely separate entity I don't know, I suspect we wouldn't be having this discussion if some of these areas of land were owned by completely separate legal entities but had the same relationships, I'm not sure whether you'd automatically assuming that it was a single landholding. But, you know, a lot of these things I'm sorry Abe, do end up with lawyers having to crawl all over them and then someone like a commissioner making a call at the end of the day between two lawyers sometimes with equally plausible arguments being put in front of them.

de Wolde A two way question, why me, is my question.

Grant This is a large operation you have and…

de Wolde No it's not a large operation.

McMurdo Where are we at people?

Grant I think that's, that's the key issues that I've got in my 40A, anything else major that isn't under, like I've obviously talked about in more detail in them but that's the crux of it.

Freeman It's appreciated, there's no point of anybody ambushing anybody at the eleventh hour at the hearings.

Grant No and I appreciate that, especially the landholding where I've arrived at. I have tried to keep the rest of the 42A quite separate from that and obviously what you've put in front of me, separately. But that is just a fact for you to be aware of and I do think that 3, it currently, requires a farming consent too, regardless of however you slice the cake, it either needs a separate one or it needs to be bought into the landholding global arch.

McMurdo Is there any information in relation to the proposed amendments that hasn't been covered? Anything else anyone wants to talk about?

Grant I think we've got until Monday to determine a scope.

Freeman Yep.

Grant Which is the only thing we haven't talked about from what I can see, there's no major thing and I don't think it will change the scope.

Legg I agree.

Grant So we don't need to go down that track, but is there any, obviously we've talked about the fertiliser use and management on farm but there's not, I just want to make doubly sure there's not an additional block of land.

Legg Just the dairy effluent reports change that's all.

Grant In my opinion so far from what I can see I wouldn't consider that there is a change of scope there. But it si something that the commissioners would want.

de Wolde So what about Woldwide 3, that's a lot of extra stuff that needs to come in isn't it, if we have to go down that track.

Grant How do you mean, oh if that comes into the scope.

de Wolde If you want to pull in Woldwide 3 as well. That will be a lot of extra information.

Grant It will be. I think that Adams also, sorry to keep referring back to that but it gave us a steer on scope and they were happy to bring the cut and carry block that came up at the hearing into it without it being a change of scope. I have no idea what they would consider without a farm being added. I mean, I'm really not too sure on how that will go. But again, that's why I've tried to keep it separate, I'll still consider that as two separate applications and that there's essentially a missing puzzle piece in the middle and I've tried to frame it up like that so it's not like this whole thing is in together.

Freeman Ok. We'll work on all that.

Grant A very interesting question bringing it up.

Freeman In terms of feeding back to the commissioners on the specific questions that they posed to us, it sounds like you're going to flick a draft round so that we might all basically, before the end of the day, be able to say yes we agree with you with that proposition if you like put to the commissioners.

Grant Yes, and if we could revisit, just to make sure given that I appreciate I've thrown some quite big things at you, are we still ok with that first stage? You don't want more time? I appreciate Hans is quite busy also.

Freeman I think some of that might depend on Hans' advice. If Hans's advice is strongly along the lines of essentially saying no, that's ridiculous, the definition couldn't possibly be extended that far and is very confident about his advice, then I'm sure we'd be pressing hard for that. Conversely if Hans comes back and says oh my god, you know, they've got us by the short and curlies, we're going to have to completely rethink, you know, if he comes back with something like that then I'm sure we'll be in touch.

Grant Yes and you do always have mechanisms under the Act you could use. Great. Ok, well I'll draft that up now and flick it around.

McMurdo Thanks for attending today everybody, we'll get this transcribed passed around by Wednesday.

Freeman I'll be hanging out for it. All 10 pages of it.

End.