Otago Regional Council

Document Id:

MEMORANDUM

To: **Dolina Lee Policy**

From: **Mark Crawford Land and Soil Scientist**

Date: **6/11/2023**

Re: **Winter Grazing and Sacrifice paddocks**

Name	Role	Date Completed
Dean Olsen	Reviewer 1	17th November 2023
Ross Monaghan	Reviewer 2	10th June 2024

Purpose

Greater intensification on both sheep and beef plus dairy farms has led to an increase in stocking rates (1) increased winter fodder cropping (2), increases in imported feed and irrigated land (3) (4) (5) plus some reliance on off-paddock facilities (6).

A key adverse effect arising from the intensification of land use is the effect on soil quality and the resulting higher concentrations and loads of nutrients, sediment and pathogens and the potential for these to be lost to surface water or groundwater through runoff or leaching (7) (8). This is no different for winter grazing activities as a subset of land intensification.

The purpose of this memo was a request by the policy team to describe and advise on the level of risks associated with the various winter grazing activities as proposed within the proposed Land and Water Regional Plan (pLWRP) for the Otago Regional Council (ORC). These risks would include the following winter grazing activities,

- feed pads,
- wintering pads,
- intensive winter grazing on forage crops,
- sacrifice paddocks and
- pasture based (winter bale and all-grass rotation) winter grazing.

The advice will be used to guide amendments to the Draft Land and Water Plan for Otago.

Approach

The rules in the partially operative Southland Water and Land Regional Plan (poSWLRP) on sacrifice paddocks and pasture-based (both bale-based wintering and all-grass wintering) winter grazing by cattle were considered by reading both the section 42a report and reply to their proposed Water and Land Plan. It was noted that these relied on guidance from DairyNZ and Ross Monaghan. Further information was supplied by Policy with respect to the Environment Court decisions with respect to the poSWLRP. Further referenced research papers were also accessed.

To describe the risks associated with these winter grazing activities, this memo starts by looking at the broader farming systems currently used in general in Otago and what winter grazing as an activity involves before focussing on the risks associated with the various winter grazing activities identified.

Discussion

Farm systems:

Farm systems generally conform to the seasonal pattern of pasture production which follows that of the humid temperate regions of the world. Within New Zealand there are distinct regional differences and can be generalised within four temperature/moisture categories of pasture production: warm moist, warm dry, cold moist and cold dry (9).These patterns of pasture production have a strong influence on the type of livestock production practiced and leads to a strong seasonal pattern of production as livestock systems were manipulated to fit the underlying pattern of pastoral growth (10).

Historically in dairying systems calving would be timed to maximise potential milk production with expected grass growth. Any surplus growth was harvested as silage and/or baleage/hay and fed to the herd when grass growth was slow during the summer or saved for winter feeding. Herds were then dried off as pregnancy advanced and grass growth slowed. Very few herds were winter milked for town supply. On these winter milk farms, calving cows in autumn coincided with declining grass growth with shortfalls made up with conserved pasture. The losses and inefficiencies associated with pasture conservation were largely responsible for the lower stocking carried and the lower production from the farm (11).

As milk value increased, and improved animal reproduction plus breeding meant higher milk production per cow, the increased use of nitrogen was advocated to increase pasture production. This and the comparative profit advantage meant more land was converted to dairying. Farmers were encouraged to milk longer and calve earlier (12).

In the sheep and beef sector, farming systems are more diverse, and traditionally the type of farm system and their level of intensity were classed accordingly on their topographical and climate limitations. These high, hill and down land sheep and beef farms were further classified according to their pastoral productivity based on whether they were within dry/wet and cool/humid climates. The pastoral productivity potential of these farms was based on these factors plus the level of soil fertility and the pasture species grown.

Like dairying, in the moist cool and/or humid environments, the aim was to winter sufficient capital stock to be able to utilise the higher levels of pasture production in spring and summer. Weaning stock were either finished to freezing works or sold store (sold unfinished off farm or

through sale yards to be finished elsewhere) depending upon summer and autumn growth. Livestock numbers were adjusted to ensure sufficient feed was available and capital stock liveweights and/or condition were adequate prior to winter. Winter feed was then rationed over the slower growing period to transfer a pasture mass for breeding stock to give birth and lactate on in spring. The use of supplementary feed such as hay, baleage or silage was made from excess spring summer surpluses and helped with the rationing of pasture.

The drier environments were more likely to have strategies to significantly reduce stock demand over summer and were less suitable for breeding cattle given the lactation demand over summer (13).

Livestock numbers on these differing farm systems within New Zealand and regionally was based upon the availability of such land plus the relative returns from milk, meat and wool (10) (14).

The better class of land in New Zealand has led to the higher value farming enterprises and more intensive farm production being carried out on this land (14). With the better dairy returns a large area of sheep and beef farmland has been converted to dairying, with some of this land being of lower class as defined by the land use classification system. The limitations to these blocks of land have by and large been overcome with additional nitrogen, drainage, and irrigation, along with added infrastructure (15) (16). This can mean a degree of intensity on lower class soils with a corresponding increase in environmental risks to soil and water quality.

In Otago, the region's farmland, when compared to other New Zealand regions, is dominated by less highly productive versatile land (Sheep and Beef Land classes 1 and 2), with a similar proportion of moderate productive land (Sheep and Beef land classes 3 and 4) and a higher proportion (60%) of lower class less productive farmland and steep land, some of which is only suitable for native and exotic vegetation (Sheep and Beef land classes 6 to 8) (14) (17).

Of its primary production area, the Otago region has more dry stock land use, less dairy land, and more forestry land than New Zealand proportionally (18). Thus, sheep and beef farming is the predominant land use in Otago, covering 70 % of developed land in the region – which is often land that has few alternative land uses. It also is the most diverse region for sheep and beef farming in New Zealand – ranging from high country stations, of which Otago has the most of any region, to coastal properties (19). Thus, the land use change has generally occurred on less versatile and lower class less productive land in the main.

These farm systems in Otago over the last 20 years have increased stocking rates and have got larger in size plus improved productivity per hectare. They also have increased their winter grazed crop areas and in the case of dairying have increased the use of imported supplementary feed (19)

Winter Grazing

The original aim of grazing during the winter period was to ration the feed supply, mostly autumn saved pasture, by rotationally grazing the farm area (less any set aside for a specific purpose), with regrowth providing the main basis for the feed covers at the start of spring.

In the 1970s and 80s there was a move for this to be done without any winter fodder cropping. This all-grass farming concept practiced in the past, and still practiced currently, was practiced when farming was less intensive with fewer farming inputs (20) (21) (22). In dairying, several farms were self-contained, with not only milking cows but also the replacement stock being

managed on farm all year round as well, with famers able to produce pasture-based feed at 3 to 4 cents per kg of dry matter (DM) (23).

Reasons for winter cropping are varied but, in the past, have been a function of pasture renewal, with the added benefit of filling a winter feed deficit period, as pasture production was unable to match feed supply for an extended period over the winter months (24). It was this ability to fill this feed gap over the winter period with high quality feed at a reasonable cost which was the main reason for growing the crop in southern parts of New Zealand and in particular in Otago and Southland (25) (26).

However, as yields increased, they have also been used to intensify further by enabling the farmer to milk longer or finish stock later, rather than saving grass in autumn to transfer into the winter. The late 1990s and 2000s saw a push to grow higher yielding crops and to increase milk production. This and the higher feed value of winter forage crops has led to a reliance on winter crops to enable the current stock intensification within some regions of New Zealand. The reliance on pasture as the predominant forage feed has reduced in these later years, especially in the Dairy Industry (27) (28). The issue with higher yielding crops are that they are grazed with high stocking rates and subsequently may result in high rates of N leaching (29) (30) and sediment loss (31) (32).

With such higher stocking intensities, challenges arose with the increasing risks of stock treading and pugging (33) (34). Research has shown that poor land management practices degrade soil physical quality, and the largest challenge found is when intensive overgrazing of pastures during wet conditions compromises soil health (35) (36). This is especially so for steeper hill slopes (37) (38) and naturally poorly drained soils that can remain wet throughout winter (32) (31).

On hill country landscapes, areas where stock are fed supplements and congregate are other areas where increased risks of contaminant losses can happen from surface runoff from poorer draining soil types and cattle treading (39).

Intensive stocking on winter forage crops happens at times when soil conditions are not ideal, with periods of wet weather and lower evapotranspiration rates leading to prolonged periods of high soil water content. (40). Hoof treading damage reduces the soil's water infiltration rates due to disruptions to soil macropore continuity and reductions in soil aggregate strength (41) (42). Soil surface deformation is also usually quite pronounced. This in turn leads to increasing risk of surface runoff and increased contaminant loss in this runoff. Soil treading damage and bare ground from intensive winter grazing are key drivers of sediment and nutrient runoff which are higher in winter (38) and under cattle treading when compared to sheep and deer (41).

To protect soils during these wet cold conditions and reduce stress on stock, especially for dairy cows, the development of off-paddock facilities to feed animals over winter has increased. They have reduced nutrient losses from overland flow, lowered nitrate leaching (43) and lowered pasture damage with subsequent increases in pasture production, feed utilisation and improved animal welfare (44) (45).

Thus, much of Otago is on rolling Pallic soils or hill and high country Brown soils on steeper slopes, with little flat land (46), with pastoral grasslands generally more erodible than the North Island (35). Activities which lead to bare ground, reduced pastoral covers and stock treading are activities creating a higher risk of sediment and P losses (37) (42) (47). As well, Otago along with Southland is one of the regions with most winter forage cropping in New

Zealand (48). Given all this, Otago Regional Council has a right to be concerned about winter grazing activities and the results of such activities within the region.

Current Winter Grazing terminology:

The practices over winter and the various activities have become more intensive and more diverse, with the greater use of winter forage cropping as farming intensity and productivity has increased as outlined above.

Winter grazing activities can be either categorised as;

1. Pastoral (paddock) based or
2. Forage crop (paddock) based or
3. Off-paddock based.

One way of further classifying winter feeding activities is seen below in Figure 1.

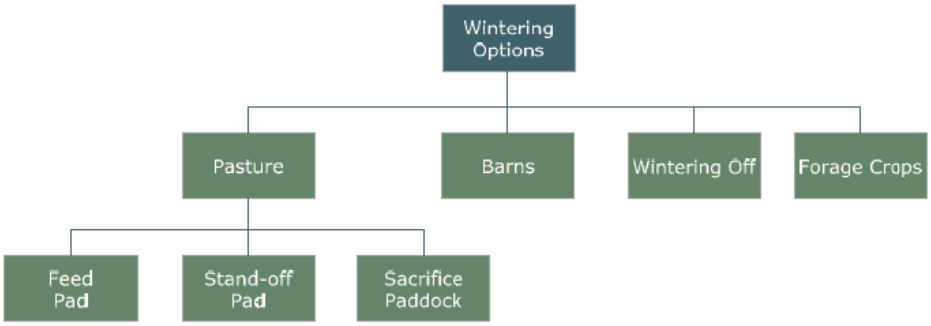

Figure 1 New Zealand wintering systems (from Monaghan and Longhurst, 2007)

Figure 1 shows that feed and standoff pads are a subset of pastoral-based feeding, where the length of time pads are used is weather dependant with the remaining time spent on pasture. Wintering off farm also has the same wintering options. Another option is all-grass (rotational) wintering. Bale-based winter grazing is also a new category arising out of the reaction to Intensive Winter Grazing (IWG) rules within Southland.

A brief description of each activity follows and is adapted from Longhurst (44)

- **Feed pad**: Either a concreted or rocked area (impervious surface) feeding platform where cows are held for short periods of time (~2 hours/day) and are fed supplements. Can be used at other times than in winter and can be used in conjunction with other options. Primarily used to reduce wastage of offered supplementary feeds.
- **Stand-off pads**: Can be known as loafing pads. A soft surface area for holding cows for extended periods (2-20 hours/day). Not initially used for feeding supplementary feed. Has either carbon-rich material such as wood chips, bark or sawdust, or baled straw as bedding material for cow comfort. Should be drained with a humped and hollowed base with sub-surface drains to contain and capture the effluent. Laneways can sometimes be used as temporary stand-off areas although their hard surface provides little comfort for livestock to rest upon.
- **Winter pads**: A stand off area which is combined with a feed pad or has a separate feed pad area. The pads can be built side-by-side or constructed as a self-feeding silage stack on the concrete pad with an adjacent soft surface loafing area or pastoral area in some cases. Can be used 24 hr a day, 7 days a week (24/7) if necessary.

- **Wintering barn**: Covered shelter for housing cows for extended periods, 24/7 if necessary. Many different types of construction, usually have metal roofs, but can have hard and/or soft surfaces. Herd homes and composting barns are a subset, where the cattle have an underfloor manure bunker with effluent minimised as the greater amount of liquid is contained in the carbon rich material.
- **Sacrifice paddock**: Defined by the stock holding guidelines, it is an area on which:
    - cattle are repeatedly, but temporarily, contained (typically during extended periods of wet weather); and
    - the resulting damage caused to the soil by pugging is so severe as to require resowing with another pasture or crop.

  This is a practice that can also be used with other stock types such as sheep and beef cattle and can also be associated with a winter fodder crop paddock where the adjacent paddock is used as a runoff[1] during severe weather events to provide both soil and animal relief. This paddock invariably becomes the next year's winter forage crop area. It is also used more likely on farms with greater likelihood of pugging and waterlogging (49) as the aim is to sacrifice an area for the greater good of the other areas.

- **Forage crops**: Forage crop cultivated and grown specifically for over wintering of stock. Grazed either by break fencing (daily to weekly) or set stocked (uncommon), with supplementary feed often fed out.
- **Pasture bale grazing**: This practice evolved from the IWG regulations in Southland. Farmers circumvented consent costs by pasture-based wintering, using a similar pastoral area to that they had of winter crop but supplementing a wedge of saved pasture with large quantities of supplement[2].
- **All grass rotational grazing**: The animals (stock) are set areas over most if not all the farm area; differing stock classes have differing set areas according to the animals and farmers needs and the area is then rationed accordingly to the length of the winter. Supplementary feed is used to support the rationing.

Winter Grazing activities and risk:

Risk is about the likelihood of harm. Risk is a function of the probability of an outcome and the magnitude of the outcome. It involves uncertainty which manifests into subjective risk assessments based on value judgements on uncertain outcomes. (50). This is more so with environmental risk given it is a biological system which is highly variable and complex and the limited data available as noted already. Risk can be simplified by using a continuum of least to greatest risk without any measurement index. This was used here to categorise winter grazing risk.

The current winter grazing practices and their associated risk can be represented in the following diagram. The risk posed by wintering activities can be described by their stocking

[1] During wet weather stock can be shifted off the crop paddock to a grass paddock, this paddock becomes the runoff area. It can also be a pre-determined grassed area of the crop paddock. If the adverse weather conditions are prolonged these can become sacrifice paddocks.

[2] A definition from Environment Southland focuses on the break feeding of cattle over winter (defined as 1 May to 30 September inclusive) where supplementary feed offered is more than 10,000 kgDM/ha.

densities/intensity and the residual vegetation cover[3] that remains after grazing, as these two factors are key factors that determine soil loss risk (35) (51) and the likelihood of N uptake by vegetation that survives winter defoliation.

<table>
<tr><td colspan="5">Winter Grazing Activities</td></tr>
<tr><td colspan="3">Pastoral Grazing Activities</td><td colspan="2">Off pasture-built facilities</td></tr>
<tr><td><u>Pasture-based Activities</u></td><td><u>Stocking Intensity</u></td><td><u>Risk profile</u></td><td><u>Winter built Infrastructure</u></td><td><u>Risk Profile</u></td></tr>
<tr><td>Winter Forage cropping (IWG)</td><td>Highest intensity, residual pasture cover nil, bare ground</td><td rowspan="8">Increasing stock density and reducing residual pasture cover with increased risk of soil treading and pugging.</td><td>Feed pad, stock holding area, Loafing pad, Winter pad and Winter barns (Effluent uncontained)</td><td rowspan="8">Worst case (if uncontained)
Increasing as stocking intensity and animal liveweight increases and period of use lengthens and resulting contaminant loads increase, with increasing dependence on the storage and application systems.
Least case (if contained)</td></tr>
<tr><td>Sacrifice area</td><td>High, Bare ground</td><td rowspan="5"></td></tr>
<tr><td>Bale based wintering (cattle)</td><td>Some bare ground, some residual cover (depends on pasture covers and supplement amounts)</td></tr>
<tr><td>Cattle/Deer all grass wintering</td><td>Moderate to High Residual pasture covers 800-1000 kg DM/ha</td></tr>
<tr><td>Sheep all grass wintering</td><td>Moderate to High Residual pasture covers 600-700 kg DM/ha</td></tr>
<tr><td>Runoff paddocks (Plan B) for IWG</td><td>Moderate</td></tr>
<tr><td>Young stock wintering (cattle/deer/sheep)</td><td>Lowest intensity, Residual pasture covers 1000-1200 kg DM/ha</td><td>Feed pad, stock holding area, Loafing pad, Winter pad and Winter barns (Effluent contained)</td></tr>
</table>

Diagram 1. Diagrammatic representation of relative environmental risks associated with different animal wintering activities. Arrows in table show increasing levels of risk from bottom (lowest level) to top (highest level).

[3] Pasture mass or herbage mass is the total amount of herbage per unit of ground, usually measured above ground level but otherwise above a defined reference level which must be stated. (65). It describes the amount of above ground pasture plants, both living and dead parts, and is usually expressed as kg DM/ha. It is used as a predictor of likely pasture recovery and soil protection/cover in this instance.

Diagram 1 shows that all winter grazing activities/practices have a degree of risk due to their impacts upon the environment due to stocking intensities and degree of bare ground. This can mean increased soil treading damage and consequent losses of contaminants to water.

It highlights that younger stock and greater areas for the rotating animals (e.g. runoff paddocks) have a lower risk than heavier stock and higher stocking densities (e.g. pasture bale based wintering). The highest risk is associated with intensively stocked winter forage crops.

It also enables a diagrammatic representation for winter infrastructure and highlights that these structures have risks associated with both their containment and application systems and how effective they are.

All winter grazing activities should be addressed due to their associated risks given that the continuum between the two extremes in diagram 1 are activities which are evident on farms in Otago.

Wintering stock on crop has increasing risks to contaminant loads due to their impacts upon soil permeability and structure. A modelling paper suggested an order of magnitude of difference between untreaded pasture and differing winter crop forage types in terms of soil permeability and structural vulnerability. The modelled treading difference for Grass winter forage lay somewhere in between the above two states of ungrazed grassland and winter crop (brassicas and fodder beet) (35).

The risks of sediment and P loss are highly correlated to the magnitude of the run-off event and can be attributed to the lack of vegetation cover and reduced infiltration rate (52). Once ground cover is removed, slope and soil parent material have the next most significant influences on rate of soil loss and erosion (37) (35).

Diagram 1 illustrates this concept, where the level of stock intensity of the various wintering activities increases with reducing pastoral covers and the risk of bare soil and stock treading damage increases.

Donovan & Monaghan (2021) found that across all pastoral areas, grazing increased mean soil losses by approximately 85% compared to the ungrazed equivalent. In contrast, grazing on winter forage-crop paddocks increased mean annual soil losses by roughly 1200% compared to the same land being left in a typical pasture grazing scenario. It also concluded that although pastoral grazing increases soil erodibility, the risk is far greater for winter forage cropping. They also concluded that ***proactive decisions to reduce treading damage and avoid high-density grazing will far exceed reactive practices seeking to trap sediments lost from grazed lands.*** (emphasis added)" (35).

Capturing effluent with wintering infrastructure and discharging this at more appropriate times and the appropriate place can be an effective way of reducing whole farm contaminant loads (50). (45) Inadequate containment systems for wintering facilities can negate any benefit from having such a structure and could lead to increased whole farm losses by 35% (50).

These same principles can be used for sacrifice paddocks and winter forage crops, where effective containment of effluent is not possible. Contaminant losses can be reduced substantially (20% to 80% depending upon stock type and locality) (53) (42) (54) by adopting

good grazing management practices such as back fencing[4], grazing down the slope[5], leaving critical source areas[6] (CSAs) ungrazed and delaying grazing of higher risk areas (other than CSAs) until soil conditions improve. Restrictive grazing practices can be employed in conjunction with an effective standoff area to support some of these practices, particularly during adverse weather conditions.

Conclusion

As a region, Otago has a higher environmental risk due to management practices used to manage the winter feed gap that exists with grazed pastoral systems compared to much of the rest of New Zealand. This is due both to the greater extent of grazed hill country on steeper slopes and rolling downland overlaying Pallic soils plus the area of winter forage crop relative to other regions within New Zealand.

However, despite the importance of soils and terrain in soil losses, this can be overshadowed by impacts of poor grazing management and high stocking densities that degrade soil and remove ground cover (35). Thus, all winter activities are activities which are of higher risk to the environment, which may necessitate regulation.

Current good management practices (GMP) and research has identified retaining ground cover, avoiding steep hill country terrain and poorly drained soils plus deferred grazing[7] as mitigations. Much research effort on passive and active practices such as planting vegetation along adjacent hillslopes and gullies, grazing away from hill slopes, avoiding critical source areas (52), edge of field mitigations for hill country paddocks and reducing grazing during and after rainfall events are still being evaluated as mitigations for erosion and contaminant losses to water ways. These changing practices and the relative success of different management approaches can inform the regulatory approach.

A large amount of feedback to the draft LWRP was that, in addition to the current NES-IWG rule. that FWFPs were the instrument that would provide evidence that these practices were being followed (D Lee (ORC Policy Analyst), pers. comm.). The use of farm planning tools is critical in balancing the implementation of mitigations with farm system objectives to improve whole-system sustainability (38).

Council requires more oversight of winter grazing practices given the higher risk they pose to this region and its environment, and the availability of evolving practices and solutions required. Rather than providing a consenting pathway, one accepts that the farm plan pathway is more flexible, but Council is only able to access the certified actions of these plans. It is unable to access the context of these permitted activity FWFPs (55). They also lack the ability to enforce on the context, only the outcomes of the actions.

The purpose of this memo was to advise on the risk of winter grazing activities. Given the level of losses from winter forage crop grazing and the evidence of the scale of these losses from this

[4] Electric fencing behind the area that has been grazed by stock. Usually between from 1 to 7 days.

[5] As opposed to grazing up a slope (starting at base of slope).

[6] Areas of enriched nutrient or sediment sources and hydrological activity that occur in small parts of a catchment or farm, but contribute a disproportionately large amount of nutrient or sediment to the environment (e.g. steep hills, gullies or swales).

[7] Deferred grazing is where stock are stood off from the area under pastoral grazing or forage crop grazing for a period of time (usually 8 to 20 hours) and do not graze the area in situ for the entire 24-hour period. Usually done when conditions are wet and the risk of soil treading or pugging is high.

and other winter grazing activities, there is a need to prioritise to ensure all winter grazing practices follow established good farm practices as a minimum. These risks will likely become worse under climate change (56). Prioritising good farming practices for winter grazing practices and the associated risks, whole farm winter grazing plans, in addition to consent based winter grazing IWG plans (if required) would provide further context to meet the risks arising from winter grazing on the changing landscapes and climate.

Policy options for council may include.

- Include all winter grazing activities by controlled activity status. This gives Council greatest certainty; however, this does not provide flexibility for the farming community nor allows Council to keep rules relevant to improving technologies. It also increases the regulation on farm.
- A possible option is to encompass all winter grazing activities as a controlled activity, with a non-consenting alternative pathway of a certified winter grazing plan within the FWFP which are to be submitted as evidence of the GMPs that are being used to mitigate the unique risks for each farm. If the farm plan pathway is more flexible plus Council could access not only the certified actions of these plans but also the context of these permitted activity FWFP plans for winter grazing, then this will give Council the confidence that plans will have appropriate measures and an ability to enforce on those measures (context). Given the priority risk of winter grazing, whole farm winter grazing plans in addition to their consent-based winter grazing IWG plans (if required) would provide this context.
- Continue with the status quo, with the NES-FW IWG consent required based on slope (>10 degrees) and beyond 50 ha or 10% of farm area (whichever is the greater), with the rest of the winter grazing activity as permitted activity and winter grazing plans are assessed within the FWFP framework. This provides the least regulatory input for Council and is left in the hands of industry to control. It also means further rules around other practices considered highest risk, such as sacrifice paddocks and bale-based winter grazing and increases regulatory costs for both Council and the farming community.

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