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Resource Consent Application to Environment Southland

Prepared for Titipua Limited Partnership

Prepared For

Titipua Limited Partnership

Prepared By

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QUALITY INFORMATION

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1. INTRODUCTION

1.1 Overview of Proposal

Titipua Limited Partnership (the applicant) own a dairy farm located at Hedghope, consented to milk 600 cows. Currently they are undergoing the process of applying to expand their diary platform onto a neighbouring block of land, the 'Schrama Block', purchased by the applicants in mid-2020. Application reference APP-20211092.

As part of the application process, the applicants have decided to increase the environmental outcomes of the proposal, and in addition to constructing a wetland, a herd home will be incorporated into the farm system. The herd home will be used to feed grass silage for the whole herd in the shoulders of the milking season, during adverse weather conditions, and by a proportion of the herd during winter. Effluent will be captured in the herd home bunkers, preventing nutrient loss and ensuring nutrients can be captured and utilised. The use of the herd home during winter will provide an alternative to wintering outside on winter crop, resulting in positive environmental and animal welfare benefits, and a significant reduction in contaminants lost during the winter months.

The applicants have experience in managing herd homes and believe that they result in a greater utilisation of nutrients as effluent is captured in the herd home bunkers.

In summary, in addition to the consents sought in the original application, the applicant is seeking the additional resource consents for the following:

- Land use consent to use land for a Herd Home on the property with capacity for up to 490 cows, and be used year-round including for housing dairy cows during winter, summer feeding, calving, and during other periods of adverse weather conditions;
- Land use consent for an effluent holding facility (herd home bunker)

1.2 The Applicant

Applicant: Titipua Limited Partnership

Address for Service: C/- Landpro Limited
PO Box 302
Cromwell 9342

1.3 Purpose of Documentation

Under Section 88 of the Resource Management Act 1991 (the RMA), this report provides an assessment of the activities effects on the environment as required by Schedule 4 of the RMA.

2. DETAILS OF PROPOSAL

2.1 Location

The farm is located along Hedgehope Block Road, Hedgehop. The farm is situation in the Titipua Stream catchment. The farm, as well as the Schrama Block is shown in the figure below.

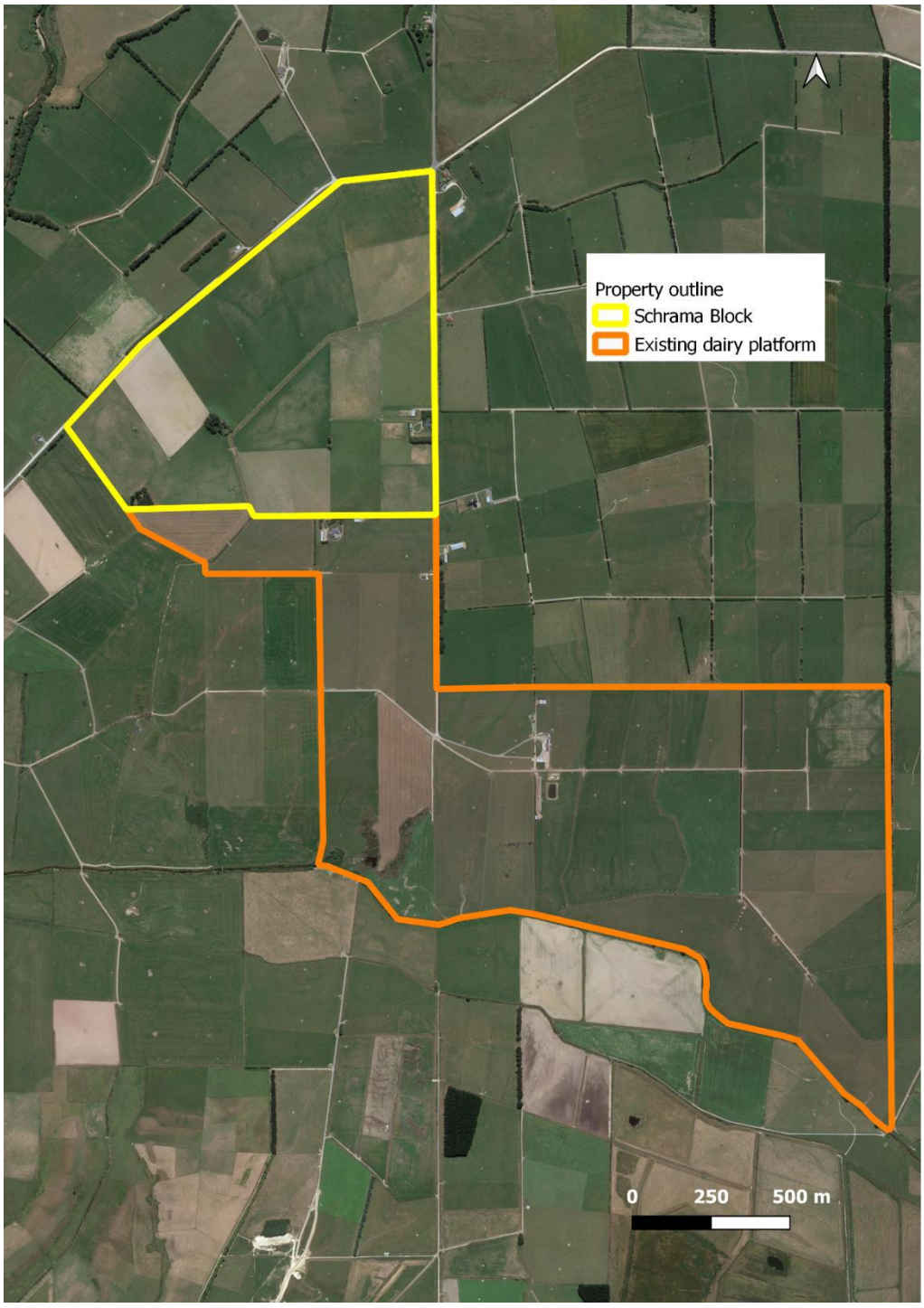

Figure 1: Map showing the locations of the dairy platform and the Schrama Block.

2.2 Farm Overview and Details of Proposal

The proposed dairy farm is 265 ha in total (181 ha dairy platform + 84ha Schrama Block). The applicant operates a conventional dairy farm milking 600 cows. As part of the proposal, the number of milking cows is not proposed to change.

Table 1: Farm Details

Property Details	
Property address	354 Hedgehope Block Road.
Property owner(s)	Titipua Limited Partnership
Legal Description	Lot 2 DP 420431, Lot 1 DP 470872, Lot 3 DP 1494, Lot 2 DP 386399, Lot 2 DP 4406, Lot 1 DP 386399, Lot 1 DP 4406
Property area (ha)	265
Freshwater Management Unit	Oreti

2.2.1 Proposed Herd Home

As part of this application, the applicant proposes to build a Herd Home, and is seeking a land use consent for the use of this as a feedpad/lot under Rule 35A of the pSWLP.

The Herd Home has been designed to house up to 490 animals and will be used in winter to house 200 cows for 24 hours/day, and be used for summer feeding, calving, and during adverse weather conditions for up to 490 cows.

The Herd Home will be located close to the dairy shed (Figure 2) and constructed as per the plan as attached in Appendix A.

The Herd Home will be 66 m in length with an overall footprint of 100m (including concrete area surrounding Herd Home)10.9m wide with an overall footprint of 18m. The Herd Home will occupy 720m^2. There are 3 containment bunkers which are 3.4m wide x 1.5m deep located beneath the Herd Home which gives a storage capacity of 834 m^3 for solids collected. The floor of the herd home is slatted so that solids fall to the bunker. Liquids evaporate, and solids remain. See herd home design in Appendix A for further details.

The herd home is located near the existing dairy shed (Figure 2), at or about NZTM2000 1257658E 4869494N.

The calving pad location adheres to the following buffers and is not located within:

- 50 metres of the nearest sub-surface drain, lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, natural wetland, or another feed pad/lot on the same landholding; or
- within a microbial health protection zone of a drinking water supply site identified in Appendix J, or

where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J of the pSWLP; or

- within 200 metres of a place of general assembly or dwelling not located on the same landholding, or
- within 20 metres of the boundary of any other landholding; or
- within a critical source area.

Figure 2: Proposed located of herd home (white)

The discharge to land of any solid material collected from the herd home is a permitted activity in accordance with Rule 38 of the PSWLP.

2.2.2 Effluent from herd home

Solid effluent from the Herd Home is collected and stored in the concrete bunker that forms the base of the Herd Home and is spread annually with a slurry tanker or slurry cart.

The DESC calculation submitted with the original application has not been updated include the effluent

generated from the herd home. It is not expected that any solids or liquids will drain to the pond, unless it is in a contingency manor in which only liquid would be pumped to the pond. The amount of liquid would be negligible. The herd home is not proposed to be hooked up to the effluent system, and if needed a slurry tanker would be brought in to transfer liquid to the pond. Due to the nature of the herd home, this is very unlikely to happen.

3. ACTIVITY CLASSIFICATION

3.1 Consents Required - Summary

The following resource Consents are required under the Regional Water Plan for Southland, 2010 (RWPS), Proposed Southland Water and Land Plan, 2018 (PSWLP), and National Environmental Standard for Freshwater (NESF).

Table 2: Consents required and applicable rules.

Consent	Plan	Rule	Activity Status
Regional Rules			
Land use consent – to use land for herd home	RWPS	NA	NA
	PSWLP	35A(b)	Discretionary
Land Use Consent – to construct an agricultural effluent storage facility *Herd Home Solids Bunkers*	RWPS	49(a)	Restricted Discretionary
	PSWLP	32B(d)	Controlled Activity
RWPS – Regional Water Plan PSWLP – Proposed Southland Water and Land Plan NESF – National Environmental Standard Freshwater			

Bundling

Overall, the proposal is 'bundled' to be treated as a **discretionary activity**.

3.1.1 Regional Plans

Land Use Consent – Herd Home

The applicant proposes to construct a herd home to house cows in winter and for use as a feed pad/standoff pad, and therefore the activity is considered a **discretionary activity** under Rule 35A(b) that applies to feed pads and lots. There is no relevant provision in the RWPS for feed pads and lots.

Land Use Consent – Herd Home Solids Bunker

The proposed construction, maintenance and use of the new solids' bunkers located beneath the herd home is a restricted discretionary activity under the RWP and a controlled activity under the under PSWLP as the structures hold >35 m^3.

3.1.2 National Environmental Standards for Freshwater

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (referred to here as the NESF). The NESF regulates activities that pose risk to the health of freshwater and freshwater ecosystems.

The NESF came into force on 3 September 2020, although clauses relating to intensive winter grazing, stocking holding areas other than feedlots and application of synthetic nitrogen fertiliser to pastoral land come into force in mid-2022.

Assessment of the NESF indicates that consent is not needed for the herd home as the definition of 'feed pad' excludes wintering barns.

3.2 Consents Not Required

In accordance with Schedule 4 of the RMA, an application must describe and demonstrate compliance with any permitted activity that is part of the proposal to which the application relates (see Table 3).

Table 3: Activities for which Consent is Not Required.

Activity	Compliance with the relevant permitted activity rules.
Intensive Winter Grazing under the NES-FW	A Land Use Consent for Intensive Winter Grazing under the NES-FW is determined to not be needed. The Intensive Winter Grazing that does occur meets the permitted activity thresholds and was conducted during the reference period.
Use of land for the maintenance and use of an existing agricultural effluent storage facility (Rule 32D of the pSWLP)	The use of land for the maintenance and use of an existing agricultural storage facility (includes ponds, weeping walls, sumps and stone traps etc) that was authorised before 4 April 2018 is a permitted activity providing the construction of the facility was authorised by a resource consent).
Incidental discharges from farming (Rule 24 pSWLP)	The land use associated with this discharge is or will be authorised under Rule 20, 25 or 70.
Fertiliser (Rule 10 RWPS & Rule 14 pSWLP)	All practicable measures will be taken to minimise fertiliser drift beyond the target areas. Fertiliser will be applied to selected areas of the farms in accordance with nutrient budget recommendations, and soil tests to avoid excess leaching of nutrients to groundwater. Fertiliser will be applied when a soil water deficit exists, and all waterways will have riparian margins with stock excluded.
Silage storage and silage leachate (Rule 51 of the RWPS, and Rules 40, & 41 of the pSWLP).	All silage storage facilities are located away from sensitive receiving environments, in accordance with permitted rule setbacks and no direct discharge of silage leachate to any waterbody is proposed. The silage pad is not hooked up to the effluent system, and therefore silage leachate is discharged to land in accordance with the rules listed in the column to the left.

Sludge (Rule 38 of the pSWLP)	Solid sludge effluent collected from the stone trap and sludge beds will be dried as much as reasonably practical before applying to land when conditions are suitable, observing appropriate separation distances, and there will be no disposal of solids to any waterway.
Cleanfill, Farm Landfills and Offal Holes (Rules 53, 54 & 55 of the RWPS, and Rule 42 & 43 of the pSWLP).	No more than 500 m^3 of material will be discharged within cleanfill sites. Stormwater will be directed away from fill areas and no unauthorised material will be placed into proposed fill areas. No naturally formed limestone rock is known to reside within the property. Excavation of fill holes do not intercept springs and are not below the seasonal mean groundwater level in that location. Sensitive areas can be easily avoided when undertaking these associated activities. Offal sites are to be covered and the surfaces to be restored to a similar state as surrounding land upon closing.
Stock exclusion from waterbodies (Rule 70 PSWLP)	All water bodies are fenced, and crossings are bridged over unnamed tributaries. Bed disturbance from stock is thus avoided and dairy cattle on the dairy platform are excluded from water bodies.
Drainage of Land (Rule 9 RWPS & Rule 13 pSWLP)	It is not anticipated that any discharge from subsurface drains would result in a conspicuous change to the colour and/or clarity of the receiving waters at a distance of 20 metres from the point of discharge. The proposed good management practices will significantly reduce the likelihood of any contaminants reaching the subsurface drains.
Wetlands (Rule 74 PSWLP)	In future, once the applicant has constructed a wetland on farm, the continued use of that land as a wetland will be a permitted activity as: The wetland will be maintained or enhanced once constructed, no indigenous vegetation is destroyed or removed, no neighbouring land is flooded, and all endeavours will be undertaken to ensure that no pest species are established.

4. DESCRIPTION OF EXISTING ENVIRONMENT

4.1 Land Use, Topography and Climate

To avoid duplication, the existing environment has only been summarised here. Please refer to the original application for full details regarding the existing environment.

The property currently operates as a dairy farm with a 181.5ha dairy platform and using an 84.2ha adjacent block as a support block. The proposed dairy platform will be made up of the existing 181.5ha dairy platform and 84.2ha support block as part of the dairy platform, a total 265.7 ha dairy platform. Currently the support block is used for growing winter crop. This has been undertaken during the NES reference period of 1 July 2014 to 30 June 2019. However, the applicant also wishes to use this land for dairy support which it has not previously been used for in the reference period.

4.2 Water Resources

4.2.1 Surface Water

Three unnamed tributaries of the Titipua Stream run through the property and the Titipua Stream forms the southern boundary of the farm. The tributaries predominantly run in a north-south direction with the Titipua Stream running from east to west. All waterways on the existing dairy platform are fenced and have grassed buffers. There are no regionally significant wetlands or sensitive water bodies in the immediate vicinity of the farm.

4.2.2 Groundwater

The property is located within the Makarewa groundwater management zone. Data from Environment Southland's Beacon shows that the estimated total oxidised nitrogen (TON) concertation under the property varies between 3.1 and 5.0 mg/l. The TON estimates are higher at the west and south of the property and lowest in the east and north.

4.2.3 Estuary

The Makarewa River joins the Oreti River which discharges into the New River Estuary approximately 30km downstream of the property boundary. This estuary drains several coastal catchments including the Makarewa Catchment.

Section 3.11 in the Regional Coastal Plan describes the key values for the New River Estuary. In summary, the key values are the exceptional bird and waterfowl habitat, recreational, shellfish gathering and heritage values which can be adversely affected by excessive levels of microbes, sediment and nutrients. The New River Estuary is listed in Appendix Q of the PSWLP as a sensitive waterbody.

4.3 Soils and Physiographic Zone

4.3.1 Soils

Environment Southland's Beacon indicated that there Pukemutu, Makarewa and Titipua soils on the dairy platform. The neighbouring Schrama Block has been mapped as Pukemutu, Woodlands and Waikiwi soils.

Table 4: Soil type summary on the dairy platform with vulnerability factors (Source: S-Map).

Soil Characteristics			
	Vulnerability Factors		
Soil type	**Structural compaction**	**Nutrient Leaching**	**Waterlogging**
Pukuemutu	Severe	Slight	Severe
Makarewa	Moderate	Slight	Severe
Titipua	Minimal	Slight	Severe

Figure 3: Soil types on the dairy platform and support block.

4.3.2 Physiographic Zones

The proposed dairy farming and effluent discharge activities occur within the Gleyed, Lignite/Marine Terraces and the Peat Wetlands Physiographic Zones.

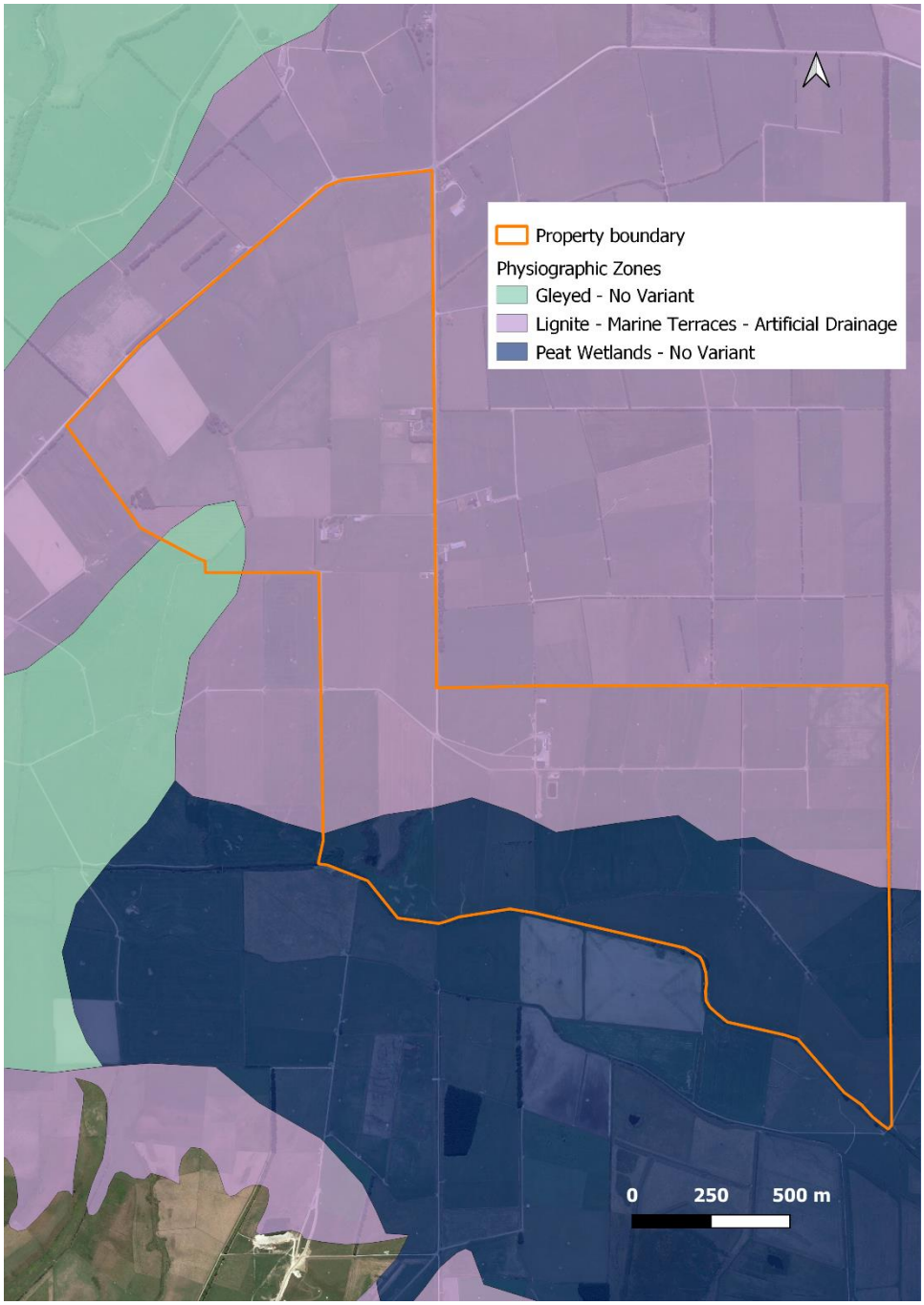

Figure 4: Physiographic zones present on the property

5. NON-NOTIFICATION & CONSULTATION

A consent authority has the discretion whether to publicly notify an application unless a rule or National Environmental Standard (NES) precludes public notification (in which case the consent authority must not publicly notify) or section 95A(2) applies.

6. ASSESSMENT OF ENVIRONMENTAL EFFECTS

In addition to the application being made in the prescribed forms and manner, Section 88 of the RMA also requires that every application for consent includes an assessment of the effects of the activity on the environment as set out in Schedule 4 of the RMA.

6.1 Assessment of Alternatives

Schedule 4 of the RMA requires that an assessment of environmental effects must include a description of any possible alternative locations or methods for undertaking the activity if it is likely that the activity will result in any significant adverse effect on the environment and/or if the activity includes the discharge of contaminants. None of the activities described in this report are expected to result in significant adverse effects on the environment.

Herd Home / Wintering Barn

The applicant is proposing to build a Herd Home to house a proportion of the dairy herd during winter, and to use this during adverse weather conditions, calving, and for summer feeding. This provides opportunity to protect soil structure for soils are vulnerable and provides for animal welfare benefits.

Housing cows in a barn over winter and deferring the solid effluent produced to storage keeps cows off vulnerable soils in winter and other periods of adverse weather conditions and allows for the barn effluent to be disposed to land when soil conditions are most suitable.

Several studies have been completed that discuss the benefits of housing animals in wintering barns over the winter period, when the effects of animals being grazed on brassica wintering crops are greatest. These studies provide an opportunity for overall reduction in nutrient outputs that occur as a result of housing cows in the barn over winter and deferring effluent irrigation until suitable soil conditions allow disposal. There are many cases for the benefits of animal confinement in comparison to IWG that ensures the proposed scenario is likely to have better long-term outcomes than the alternative grazing scenario.

6.1.1 Storage

Herd Home Storage Bunkers

The herd home is built with bunkers beneath the barn that collect and hold solid effluent. All liquid evaporates. There are 3 containment bunkers which are 3.4 m wide x 1.5 m deep located beneath the Herd Home. This gives a storage capacity of 834 m^3 for solids collected beneath the Herd Home. The floor of the Herd Home is slotted so that solids fall to the bunker.

The bunkers under the Herd Home will be emptied at least once per season.

Engineering NZ Practice Note 27 outlines the volume of storage, for the solids component only, as being:

FDE Solids Volume Generated:

$V_{FDE} = M \times P_{Ret} \times T$

Where:

V_{FDE} = FDE Solids Volume (litres/cow/day)

M = Whole manure volume per hour (*3.4 litres/cow/hour)

P_{Ret} = Percentage of manure retained in sludge bed (*20%)

T = Hours per cow each day (hours/cow/day) on FDE contained surface

* estimated (default) values

In this case: V = 3.4 x 20% x 24 = 16.32 litres/cow/day of solids storage.

16.32 x 200 x 1 = 3,246 litres of solids produced each day in the herd home when in use for 24 hours and for up to 200 cows, therefore 3.24 m^3 of solids storage is required for each day of use.

Therefore, the bunkers that are 834 m^3 provide 257 days storage of solids at the herd home for up to 200 cows.

Liquids (if there are any after evaporation) can be pumped to the main effluent system as a contingency measure although it is anticipated that this is very likely. In reality, liquids are evaporated over their residence time in the herd home bunkers and the solids remain. The herd home will be plumbed into the effluent system to allow for liquid transfer if necessary.

6.2 Land Use Consent – Herd Home Solids Bunkers

6.2.1 Continued Operation of Effluent Management System

Prior to use of the Herd Home, the applicant will update their current operational management plan to include details related to the Herd Home, this will include matters related to regular inspections to ensure capacity of the bunkers is managed. The proposed bunkers are purpose built for the Herd Home and form part of the Herd Home structure being concrete lined bunkers located beneath the barn where all effluent falls through slots in the base of the home to the bunkers. This storage system is effective for managing effluent generated in the structure, the design allows for all liquids to evaporate, so only solids remain which are emptied at the end of the season.

The existing discharge permit restricts effluent application rates, methods and a discharge area which has already been assessed to be suitable and unlikely to result in adverse effects on the receiving environment, particularly on water quality. As a result of this proposal, adverse effects on the environment should be able to be adequately mitigated and avoided by ensuring effluent is still able to be applied as per the restrictions on the existing discharge permit and only applied to land when a suitable soil moisture deficit occurs.

6.2.2 Storage During Construction

No storage is required during construction of the Herd Home bunkers, as the Herd Home will not be

operational until all works are complete, including the bunkers which form the base of the structure.

6.2.3 Design and Construction

The applicant proposes to construct the solids bunkers at or about NZTM2000: 1257658E 4869494N which is beneath the barn.

There are 3 containment bunkers which are 3.4 m wide x 1.5 m deep located beneath the herd home. This gives a storage capacity of 834 m^3 for solids collected beneath the herd home.

Designs (Appendix A) are consistent with IPENZ Practice Note 21. The construction of the bunkers must be supervised by a suitably qualified person. Upon completion, and before effluent is stored in the bunkers, the following will be provided:

- confirmation the bunkers have been designed and constructed in accordance with the conditions of the consent and the "IPENZ Practice Note 21 "Farm Dairy Effluent Ponds" 2017;
- Producer statement;
- Results from compaction testing undertaken following completion of the earthworks; and
- Reports and photographs from each installation progress inspection undertaken by the suitably qualified person, or by any other supervising person acting on their behalf.

6.2.4 Embankments

The bunkers have no embankments.

6.2.5 Construction, Maintenance, Use Effects on Water

The Herd Home and bunkers are located at a suitable distance from the property boundaries and nearest dwellings to avoid potential odour affecting anyone beyond the property boundary.

Effects on water quality from the ongoing use and maintenance of the bunkers will be adequately mitigated and avoided.

The herd home and bunkers are located to ensure the following buffers observed which ensures that adverse effects on water quality from effluent leakage and/or overflow are mitigated as far as reasonably practical:

- 50 metres from any surface water body, artificial watercourse or coastal marine area;
- 200 metres from any dwelling not on the same property;
- 50 metres from the boundary of any other property; and
- 100 metres from any water abstraction point.

The potential for effluent to reach surface waterways via overflow or leakage is mitigated by the separation distances on site.

There are no registered drinking water sites nearby. Furthermore, the herd home is located far enough away from any known domestic bores.

There are no heritage sites or hazards in the vicinity of the proposed herd home site and therefore effects on these matters will be nil.

Overall, the effects of the initial construction, and the ongoing use and maintenance of the structure will not adversely affect any water sources for the reasons outlined above.

6.2.6 Distance from Landholdings and Road Boundaries

The new solids bunkers as part of the herd home will be located approximately 290 m from the northern property boundary, 480 m from the southern boundary, and 600m from the western boundary. These separation distances avoid potential odour effects beyond the property boundary.

The nearest residential dwelling not on the property, will be 1800 m away from proposed location. The siting of the Herd Home with solids bunkers is well within the applicant's property and ensures no neighbours or public places will be adversely impacted by odour effects.

6.2.7 Operational Management Plan

An operational management plan includes the Collected Agricultural Effluent Management Plan (CAEMP) and addresses operational procedures, emergency responses, monitoring and reporting requirements for the effluent system.

6.2.8 Monitoring

The new solids bunkers will be subject to regular visual inspections, including visual observations. Frequent inspection will reveal any signs of damage and/or leakage, in which case any observed damage will be immediately repaired using appropriate repair methods and experienced installers/repairers, although the risk of leakages occurring should be minimal given the proposed construction methods. These monitoring requirements are commensurate to the scope and scale of the activity.

The applicant will have the final construction signed off by the engineer, to ensure that the construction is compliant with any conditions of consent granted, i.e., it is constructed to the specified dimensions and standards as applied for as part of this resource consent application.

6.3 Land Use Consent for Herd Home

The activity to use land for feed pads and lots is classified as a discretionary activity by Rule 35A(b) of the PSWLP. The below assessment therefore follows the matters referred to in Rule 35A of the PSWLP. I note the activity is permitted under the RWPS as no rules apply to feed pads and lots.

The Herd Home will be 66 m in total length and 10.9 m wide, occupying 720m^2. There are 3 containment bunkers which are 3.4 m wide x 1.5 m deep located beneath the Herd Home.

The Herd Home shelter includes a very low maintenance slatted floor over the effluent bunkers to collect

solid waste. The structure itself is a large open sheltered area and means there is flexibility of potential uses, such as a feed pad, stand-off pad, calving and for splitting herds, or isolating sick stock. This provides the consent holder the flexibility to use the structure for all proposed purposes.

The Herd Home has 3 bunkers below the slatted floor which provide more than enough solids storage and therefore increases effluent storage capacity. The slatted floor has animal welfare benefits, including stock being cleaner due to the reduction of solid concrete areas. Effluent generation figures have been considered. As the bunkers collect solids only, and liquids evaporate, the solids remaining will be emptied at least once per year and disposed of in accordance with Rule 38 of the PSWLP as a permitted activity.

The Herd Home will be constructed as to comply with the setbacks listed in Rule 35 of the PSWLP namely, the feed pad/lot will not be located:

- Within 50 meters from the nearest sub-surface drain, lake, river, artificial watercourse, modified watercourse, natural wetland or another feed pad
- Within a microbial health protection zone of a drinking water supply site or within 250 meters of a drinking water supply
- Within 200 meters of a place of general assembly or dwelling not on the same property
- Within 20 meters of the boundary
- Within a critical source area

The Herd Homes have a slatted floor to allow effluent to fall to bunkers beneath the barn, the surfaces are concrete, and the system is sealed so that animal effluent is collected in a sealed animal effluent storage system. Overland flow of stormwater or surface runoff from surrounding land is prevented from entering the Herd Home.

6.3.1 Herd Home and Water Quality

Several studies have been completed that discuss the benefits of housing animals in barns/shelters over the winter period, when the effects of animals being grazed on annual forage crops, or pasture, are greatest. These studies provide a best case for the likely overall reduction in nutrient outputs that can occur because of housing stock in a shelter. The benefits of animal confinement in comparison to IWG, or winter pasture grazing systems, discussed below, will ensure that the proposed farm system has less environmental impact than an IWG scenario, and that the effluent produced on-site will be better managed than an alternative grazing situation would allow.

Nitrogen

Nitrogen losses are greatest in crop wintering systems due to relatively large amounts of nitrogen that remain in the soil for longer periods increasing risk of leaching, and the deposition of animal waste onto crops

in winter when plant uptake is considerably low[1]. This gives rise to a longer period when nitrogen can be leached from the system. In the wintering barn scenario, animals are housed for 24 hours, and all effluent is captured and deferred to storage ponds and is spread to land as a slurry mix with the liquid FDE from the dairy shed when pasture is actively growing and taking up nitrogen. In a farm system where animals were housed on a stand-off pad every night from May to August, the reduction in nitrate leaching was 27%[2]. For animals housed for 24 hrs a day.

Furthermore, animal confinement is likely to be 15 – 30% effective at mitigating nitrogen loses.[5]

The inclusion of a wintering shed within the farm system is one of the most effective and significant mitigation measures available for NZ dairy farms for reducing nitrogen leaching beyond the root zone through to groundwater and surface water receiving bodies. The wintering barn allows the applicant to remove cows from pasture and hold them inside during high-risk drainage periods. In doing so, nitrogen deposited via urine and dung patches is collected within the effluent system and can be redistributed to pasture evenly, at a lower rate and timed to avoid high risk drainage periods. This significantly reduces the risk of nitrogen leaching through the soil profile as it is preferentially used in the root zone.

Phosphorus

Phosphorus is not readily leached from soil, and losses rather are caused by overland flow, typically in animal waste during winter when overland flow is more likely, and as soil derived phosphate eroded with other sediments primarily occurring as runoff from laneways and via critical source areas. Wintering animals on crops has a detrimental effect on soil physical properties through pugging and compaction and can increase potential for overland flow[3, 4]. Such an increase in overland flow mobilises more phosphorus as it is washed off with sediments and effluent. Housing animals in a wintering barn removes animals from being on wet vulnerable soils and reduces soil damage and the effects of overland flow. As for nitrogen, the phosphorus collected in deferred storage is then applied to growing pastures when soil conditions are suitable[7]. It is reasonable to assume that under a wintering barn scenario the nutrient losses of phosphorus are expected to be less than those in a wintering scenario. In a scenario where wintering barn effluent was accommodated by upgrading the effluent management system to a more efficient system (like proposed by the applicant by means of providing more storage and disposal via efficient umbilical) phosphorus losses reduced by 32% [7].

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[1] de Wolde, A. (2006). An alternative wintering system for Southland. A comparison of wintering cows outside on brassica crops versus inside, in a free stall barn in Southland New Zealand. Dissertation, Lincoln University, New Zealand.

[2] McDowell, R.W., Wilcock, B., and Hamilton, D.P. (2013). Assessment of strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Freshwater. Report prepared for MfE.

[3] McDowell, R.W., Wilcock, B., and Hamilton, D.P. (2013). Assessment of strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Freshwater. Report prepared for MfE.

[4] McDowell, R.W., Drewry, J.J., Muirhead, R.W., and Paton, R.J. (2003). Cattle treading and phosphorus and sediment loss in overland flow from grazed cropland. *Australian Journal of Soil Research, 41,* 1521 – 1532.

Furthermore, animal confinement is expected to be 10 - 20% effective at mitigating phosphorus loses.[5]

6.3.2 Overseer Modelling

Further nutrient modelling has been conducted by Mo Topham in addition to the original modelling. This updated modelling shows the inclusion of the herd home as well as updates to the wetland calculations based on feedback from council as part of the original application.

Please refer to the File note for more details regarding the nutrient modelling updates by Mo Topham (Appendix B). A brief summary is outlined below:

- Use of a herd home over the winter months, shoulder seasons and during adverse weather
- Reduction in crop to adjust for the use of the herd home
- Small increase in imported supplements to adjust for the use of the herd home
- Outside of Overseer calculations for phosphorus losses with grass baleage wintering
- Updated wetland calculations based on feedback from council and cooler climatic conditions
- Updated version of Overseer (6.4.1)

Updated calculations are as follows. Please note that these calculations include outside of Overseer calculations, i.e., grass baleage wintering adjustment and the construction of a wetland. For more details see file note by Mo Topham.

Table 5: Summary of Overseer N and P loss estimates outputs for the proposed model.

Land Use	Total existing environment	Proposed scenario	Difference	% change
Total Farm N loss Kg N/yr	12,034	11,180 (11,075 modelled plus 581 baleage grass wintering minus 476 wetlands calculation outside Overseer)	854 kg	7.1% decrease
N kg/ha/yr	45	42		
Kg P/yr	649	579 (623 modelled minus 5 baleage grass wintering minus 39 wetlands calculated outside Overseer)	70 kg	10.8% decrease
Kg P/ha/yr	2.4	2.2		

6.3.3 Updated wetland calculations

As part of the original application the applicants proposed to construct a wetland as a mitigation contributing

[5] Journeauz, P., and Newman, M. (2015). Economic and Environmental Analysis of Dairy Farms with Barn. DairyNZ Limited Report.

to a reduction in contaminant losses to water. Calculations outside of Overseer were completed to quantify the effectiveness of the wetland as a mitigation.

These calculations have been updated in the File Note prepared by Mo Topham and peer reviewed by Andrea Richardson. These calculations utilise performance estimates from guidelines published by NIWA and Diary NZ[6].

The file note outlines that provided that the wetland is constructed according to the guidelines outlined by NIWA, it is expected that the wetland will mitigate 38% of the nitrogen and 48% of the phosphorus losses from the catchment area. As 77% of the catchment is within the applicant's property, the wetland is expected to reduce nutrient losses from the applicants activities, by 475.9kg N and 38.7 kg P. It is important to note, that whilst it does not form part of this application, the 23% of the catchment that is not on the applicant's property, will still filter through the wetland and mitigate losses, having an improvement to water quality additional to what has been described above. This is an example of how actions by one individual property will contribute to improvements beyond just their property and benefit the catchment as a whole.

The applicants are happy to provide wetland planting plans as a resource consent conditions. We do not see the need to provide these at this stage, to avoid unnecessary cost. This will also allow the applicants time to find a wetland solution that works for them. Provided the wetland is constructed to the guidelines, council can be confident in the mitigation effectiveness described.

6.4 Accidental Discovery Protocol

The applicant promotes the following condition of consent with regards to the accidental discovery protocol, and requests this be included on the land use consent to construct the herd home:

> *"In the event of a discovery, or suspected discovery, of a site of cultural importance (Waahi Taonga/Tapu) during the effluent pond construction, the consent holder shall immediately cease operations in that location and inform the local iwi authority (Te Ao Marama Inc, phone 03 929 6032). Operations may recommence at a time as agreed upon in writing with the Consent Authority. The discovery of Koiwi (human skeletal remains) or Taonga or artefact material (e.g. pounamu/greenstone) would indicate a site of cultural importance. Appendix A to this consent outlines the process that is to be followed in the event of such a discovery."*

6.5 Cumulative Effects

The Herd Home will reduce the impacts of wintering cows on-paddock or off farm and mitigates the effects

[6] "Constructed wetlands to reduce contaminant loss from pastoral farms" https://niwa.co.nz/sites/niwa.co.nz/files/Summary%20of%20Constructed%20Wetland%20Guidelines%202020%20v2.pdf

of IWG.

Improvements made under the proposal in isolation from other farms will only have an extremely small impact on long-term water quality. This highlights the importance of catchment wide implementation in water quality mitigation measures that will give certainty that water quality will be improved in the long term. The overall effects of the herd home and wetland construction will be positive and make a contribution to improving water quality at the local and catchment scale.

6.6 Operational Management Plan

The applicant has an effluent management plan which includes specific GMPs and matters linked to the operation of the effluent system on farm.

6.7 Positive effects

The continuation of dairy farming will contribute significantly to the social and economic wellbeing of the local and regional community.

The proposal is to build a Herd Home on farm to use during winter, calving, summer feeding and during adverse weather, and in turn will result in an improvement in water quality.

6.8 Other Assessment Matters

In accordance with Clause 7 of Schedule 4 of the RMA the following provides an assessment of the activity's effects on the environment:

a) *any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects*

The effects of the proposal already form part of the existing environment. Throughout the duration of the existing consents, there have been no known complaints from neighbours, which indicates that the potential adverse effects on the neighbourhood are less than minor.

The proposal will result in net positive benefits to the neighbourhood as there will be capacity to provide for the social and economic benefits with the employment of staff, as well as contractors and consultants, and the farm is serviced by local schools and many businesses that would not benefit if the activities were unable to occur.

The proposal is considered to be wholly consistent with the relevant policies of the Iwi Management Plan (Te Tangi a Tairua), and therefore the effects on cultural values are less than minor.

b) any physical effect on the locality, including any landscape and visual effects

In terms of landscape and visual effects, the presence of effluent irrigation, other farming equipment and cows is expected within the rural locality. Animal structures are now a common occurrence across Southland. The proposal will not have any significant physical effects on the locality over and above that currently experienced.

c) *any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity*

The dairy farm is located within a highly modified ecological landscape and the proposal will not have any significant adverse effects on ecosystems above that which has been occurring for many decades.

d) *any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations*

It is not considered that the activities will have any effect on aesthetic values, as the existing dairy platform is established and in keeping with the general rural nature of the area. The land in this area is historically known for farming activity, and the presence of a dairy operation on this property does not result in any effect contrary to the historical values associated with the natural and physical resources in the vicinity.

The waterways around the dairy platform are non-navigable and public access would be by permission of the applicant only. There is no evidence to suggest popular recreation fishing spots nearby which may be affected by the proposal. The effects on any cultural values are assessed below.

e) *any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants*

Effluent is proposed to continue to be treated and discharged to land as described earlier in this report. The assessment of alternatives provided in this report has concluded that this is the preferred solution for managing FDE generated at the property. The activity is in keeping with the rural nature of the area, therefore it is not considered there will be any unreasonable emission of noise or odour.

f) *any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations*

All hazardous materials carried and used onsite will comply with the relevant rules of the Part operative Southland District Plan 2012, and the Hazardous Substances and New Organisms Act 1996. As such, there will be no risk to the neighbourhood, wider community or the environment due to natural hazards or the use of hazardous substances or hazardous installations.

7. STATUTORY CONSIDERATIONS

Schedule 4 of the RMA requires that an assessment of the activity against the matters set out in Part 2 and

any relevant provisions of a document referred to in Section 104 of the RMA is provided when applying for a resource consent for any activity. These matters are assessed as follows.

7.1 Part 2 of the RMA

The proposal is consistent with the purpose and principles of the RMA, as outlined in Section 5. The proposal will have less than minor effect on local water resources and the ability to meet the reasonably foreseeable needs of future generations, or on the life-supporting capacity and any ecosystems associated with them. The proposal ensures that adverse effects on the environment are avoided or mitigated.

There are no matters of national importance under Section 6 of the RMA that will be affected by the proposal. The proposal is also consistent with the requirements of Section 7 of the RMA, with particular regard given to kaitiakitanga, and efficient use and development of natural and physical resources. Regarding Section 8, the proposed activity is not inconsistent with the principles of the Treaty of Waitangi.

Overall, the activity is considered to be consistent with Part 2 of the RMA, given the minor nature of the activities and the proposed mitigation.

7.2 Section 104(1)(b) of the RMA

In accordance with Schedule 4 of the RMA, an assessment of the activity against the relevant provisions of a document referred to in 104(1)(b) of the RMA must be included in an application for resource consent. Documentation in this section are noted as being:

(i) a National Environmental Standard;
(ii) other regulations;
(iii) a National Policy Statement;
(iv) a New Zealand Coastal Policy Statement;
(v) a Regional Policy Statement or Proposed Regional Policy Statement;
(vi) a plan or proposed plan.

Under the RMA, regional plans need to give effect to NPSs, NESs and RPSs. For an application of this scale, an assessment of the application against the regional plan is often adequate as these plans ultimately give effect to the higher order statutory instruments. As such, no individual assessment has been made against the National Environmental Standard for Sources of Human Drinking Water. An assessment has been made against the recently released National Environmental Standard for Freshwater (2020) and National Policy Statement for Freshwater Management (2020) as these contain the most up to date national policy directions that need to be considered.

Relevant policies from the RWPS, and the PSWLP are considered relevant to this application and are assessed below. The rules and policies in PSWLP have legal effect from the date of notification and weight must be given to the policies contained in PSWLP alongside the existing policies in the RWPS.

7.2.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management 2020 (NPS-FM) recently came into force on 3 September 2020. This document is a national direction for managing freshwater in New Zealand and has been introduced alongside some relevant National Environmental Standards for Freshwater. A detailed assessment of this application against each of the NPS-FM policies is not considered necessary. However, because both the RWPS and PSWLP were given legal effect prior to the NPS-FM coming into effect it is considered appropriate to undertake a brief assessment of the proposal against the objectives and policies of the NPS-FM (2020).

The policies of particular relevance to this application for resource consent are outlined below. The proposal has been carefully considered against Te Mana o te Wai, the objective and all relevant policies listed below and in the context of the detailed assessment of effects is strongly considered to be consistent with all the relevant provisions of the NPS-FM.

The fundamental concept underpinning the NPS-FM (2020) is Te Mana o te Wai, that is recognising the fundamental importance of water and the health of water in protecting the health and well-being of the wider environment. Within the context of the NPS-FM this encompasses 6 principles relating to the roles of tangata whenua and New Zealand in the management of freshwater and the implementation of the NPS-FM.

The NPS-FM (2020) also sets out a hierarchy of obligations and an objective for Te Mana o Te Wai that prioritises first the health and wellbeing of water bodies and freshwater ecosystems over second the health needs of people, and third, the ability of people and communities to provide for their social, economic, and cultural well-being.

A number of the principles set out for Te Mana o te Wai are directly relevant to Councils in giving effect to the NPSFM (for example through plan making processes), as they focus on tangata whenua's authority and responsibility and actions, as well as governance by the council. Many of the principles are more difficult for an applicant to give effect to. The two principles that stand out as relevant are the following:

> *"(e) Stewardship: the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generation."*
>
> *"(f) Care and respect: the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation."*

This proposal has been carefully considered against *Te Mana o te Wai,* the objective and all relevant policies, and in the context of the detailed assessment of effects is strongly considered to be consistent with all the relevant provisions of the NPS-FM. For the reasons given in the assessment of effects above in Section 6, this balance has been found by the applicant's proposal to construct a Herd Home on farm to house animals when soils are vulnerable, and for promoting good animal welfare, the barn is not proposed as a mitigation as there is no increase in dairy land or cow numbers proposed, but will have a positive benefit on wider water quality and achievement of catchment objectives in future and over time.

Further discussion of relevant policies within the NPS-FM (2020) is provided in the table below.

Table 6: Applicable policies from the NPS-FM (2020).

Policy	Wording	Comment
1	Freshwater is managed in a way that gives effect to *Te Mana o te Wai*.	See above discussion. The proposal includes mitigations on the dairy farm to ensure the health and wellbeing of water bodies are provided for.
2	*Tangata whenua* are actively involved in freshwater management (including decision making processes) and Māori freshwater values are identified and provided for.	See above discussion.
3	Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.	The use of a Herd Home on farm will contribute to an improvement in water quality by reducing the effects on soils when soils can be most vulnerable and prevent the overland flow of nutrient, sediment and microbial contaminants. The health and well-being of the receiving environments is predicted to improve as a result of the proposal as described. Section 6.4 of this report details the relationship between the wherd home and expected improvement in water quality.
4	Freshwater is managed as part of New Zealand's integrated response to climate change.	Same as for Policy 3.
5	Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.	Same as for Policy 3.
12	The national target (as set out in Appendix 3) for water quality improvement is achieved.	Same as for Policy 3.
13	The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.	Environment Southland is responsible for monitoring local water quality.
15	Communities are enabled to provide for their social, economic, and cultural	The Herd Home provides greater opportunities for the local economy in terms of jobs and supports local

	wellbeing in a way that is consistent with this National Policy Statement."	schools and communities. Positive economic, social, and cultural well-being should result.

7.2.2 Regional Plan(s)

Policies from the RWPS, and the PSWLP considered relevant to this application are assessed below. The rules and policies in PSWLP have legal effect from the date of notification and weight must be given to the policies contained in PSWLP alongside the existing policies in the RWPS. Consideration of the National Environmental Standard for Freshwater water 2020 and Iwi Management Plan – Te Tangi a Tauira are also included below.

7.2.2.1 Discharge of Effluent

Planning Document	Particularly relevant sections
Southland Regional Policy Statement	Objective: RURAL.1, 2, Policies: Rural 1, 2, 4, 5
Regional Water Plan for Southland	Objectives: 9A, 9B, 9C Polices: 7, 31A, 31C, 31D, 41, 42, 42A, 43
Proposed Southland Water and Land Plan	Objectives: 13, 13A, 13B Policies: 13, 14, 17, 40, 41
Te Tangi a Tauira	Section: 3.5.1

Objective RURAL.1 enables the sustainable management of Southland's rural land resource. The proposal includes limits on effluent application, in order to maintain the life supporting capacity of soils (RURAL.2).

The Herd Home includes 3 solids bunkers that collect, treat, and store effluent generated at the barn. Liquids evaporate, and solids remain. The solids collected in the bunkers are disposed of to land when conditions permit under Rule 38 of the PSWLP as a permitted activity.

7.2.2.2 Use of Feed pad

The below applies to the proposed Herd Home.

Please note, consent is sought for the Herd Home under Rule 32A in the PSWLP.

Planning Document	Particularly relevant sections
Southland Regional Policy Statement	Objectives: RURAL.1 Policies: RURAL. 2, 5
Proposed Southland Water and Land Plan	Objectives: Policies: 13, 16, 40, 41
National Environmental Standard for Freshwater.	Part 2, Regulations 12 to 14.
Te Tangi a Tauira	Section: 3.5.1

Objective RURAL.1 enables the sustainable management of Southland's rural land resource. The proposed use of the Herd Home ensures that the life supporting capacity of soils (RURAL.2) when they are vulnerable is not degraded, by allowing cows off-paddock during winter and adverse weather conditions, during calving, and use during summer for supplementary feeding.

The proposal is consistent with the PSWLP and use of the Herd Home allows discharges of effluent to land when conditions are most suitable by taking cows off paddock during adverse weather conditions and during winter. This contributes to improving water quality and limits damage to soils when they can be vulnerable. The use of the Herd Home is consistent with Policy 16.

7.2.2.3 Water Quality

Planning Document	Particularly relevant sections
Southland Regional Policy Statement	Objectives: WQUAL.1, WQUAL.2 Policies: WQUAL 1, 2, 5, 7, 8, and 9. RURAL.5
Regional Water Plan for Southland	Objectives: 2, 3, 4 Policies: 1A, A4, 1, 3, 6, 7,
Proposed Southland Water and Land Plan	Objectives: 6 and 8, 13B, 18 Policies: 6, 10, A4, 13, 14, 15B, 16, 18, and 39A
Te Tangi a Tauira	Section: 3.5.11, 3.5.13, 3.5.16, 3.5.17, 3.5.19, 3.5.20

Objective WQUAL.1 is of significant relevance to the proposal as it sets the water quality framework for the management of water quality in Southland. The objective requires four primary things:

- The life supporting capacity of water and related ecosystems is safeguarded;
- The health of people and communities is safeguarded;
- Water quality is maintained or improved in accordance with the National Policy Statement for Freshwater Management 2020;
- Freshwater quality is managed to meet the reasonably foreseeable social, economic and cultural needs of future generations.

Part of the 'maintain or improve' requirement ensures that any decline is halted, and an improvement occurs across lowland water bodies. This proposal demonstrates that an improvement in water quality in the receiving environment will likely occur over time, as the herd home captures nutrient.

In contrast, IWG which is the alternative, involves grazing animals on soils when they are typically most vulnerable and unable to uptake the applied nutrients from cow effluent and urine increasing the risk of nutrient concentrations increasing in drainage waters as without sufficient assimilation this encourages overland flow transport of nutrients and other contaminants. Housing animals in a barn during adverse weather conditions, like winter, avoids this risk and this proposal ensures that water quality is enhanced and as a result indigenous biodiversity is likely to be enhanced along with the mauri of water.

Policy 16 requires the minimising of adverse environmental effects from farming activities. This proposal

includes an increase in the land area that comprises the dairy platform. Therefore, with the inclusion of a Herd Home on farm, this proposal provides opportunity to mitigate any adverse effects from farming, including cumulatively, on the quality of groundwater, water in lakes, rivers, artificial watercourses, modified watercourses, wetlands, tidal estuaries and salt marshes. The proposal is consistent with Policy 16 as the assessment here demonstrates the GMPs and mitigations that will be applied will minimise adverse environmental effects on the downstream sensitive receiving environments.

Policy 16(1)(b)(iii) likely applies as it is our assumption that no lowland surface water body in Southland meets the Appendix E water quality standards. However, in the context of demonstrating that there will be some improvement in water quality over time as a consequence of the herd home proposal proposed to be used, it is considered that the 'generally' component of the policy applies and Policy 15B and the higher objectives would provide an appropriate approach that would support granting applications that have been able to demonstrate that they would result in an improvement in water quality.

Policy 15B requires improvement of water quality where it does not meet Appendix E standards and this proposal is consistent with this policy. The proposal to build a herd home, construct a wetland and provide more than enough deferred storage either avoid or further mitigate against adverse effects on water quality.

Section 6.4 of this report details the relationship between animal confinement and expected improvement in water quality.

Addressing issues identified in Te Tangi a Tauira the run-off of agricultural contaminants, e.g., nitrates and phosphates, in water bodies through accelerated soil erosion are avoided where practicable by appropriate GMPs and mitigation. As a result of these GMPs and the proposed Herd Home, the water quality of waterways in the receiving environment will be improved, albeit very small and likely immeasurable based on the scale of property in the wider catchment.

7.2.2.4 Tangata Whenua

Iwi planning documents are not statutory instruments, but they do have statutory weight under the RMA in relation to the plan preparation process.

Planning Document	Particularly relevant sections
Southland Regional Policy Statement	Policies: TW.3
Regional Water Plan for Southland	Polices: 1A
Proposed Southland Water and Land Plan	Objective: 3, 4, 5, 15, Policies: 1, 2, 3, 44,
Te Tangi a Tauira	Section 3.5.1, 3.5.11, 3.5.13, 3.5.14, 3.5.16, 3.5.17, 3.5.19, 3.5.20

The Southland Regional Policy Statement describes the resource management issues important to Ngai Tahu in the Southland region and includes ensuring tangata whenua is considered in decision making, iwi management plans are recognised, taonga and sites of special significance are protected and food gathering

resources are protected. Te Tangi a Tauira is the iwi management plan recognised by Ngai Tahu which encompasses the Southland region. Policies TW.3 and Policy 2 of the PSWLP require iwi management plans to be taken into account.

The application has considered the relevant iwi management plan (Te Tangi a Tauira) and is therefore consistent with Policy 1, 2, and 3 of the PSWLP.

The Ngāi Tahu ki Murikiku Natural Resource and Environmental Iwi Management Plan, 2008 (NREM, a.k.a. *Te Tangi a Tauira)* is the iwi management plan relevant to the Southland Region.

This proposal includes activities which are contained within the property boundaries and GMPs are in place that will ensure that the effects of the activities will not materially impact on tangata whenua values or compromise sites of special significance or food gathering sites. The cumulative effects assessment concludes that any effects felt outside the boundary of the property will not degrade water quality and not impact on cultural values such as mahinga kai. The use of the herd home avoid compromising water quality.

Regarding Policies 3.5.14.17 and 3.5.1.17, the consent periods proposed are less than 25 years.

7.3 Sections 105 and 107 of the RMA

In addition to the matters in Section 104(1) of the RMA, if an application is for a discharge permit a consent authority must have regard to the matters as specified in Section 105.

There are no matters under Section 107(1) of the RMA that would require the consent authority to decline this application.

There are no practicable alternatives (Section 105(1)) to the application of effluent on to land. The discharge of solid animal waste to land will not result in any of the effects listed in Section 107(1) (c)-(g).

8. Consent Duration, Review and Lapse

With regard to consent duration, special consideration has been given to Policies 14A and 43 of the RWPS and Policy 40 of the PSWLP, which have been grouped below for ease of assessment.

Certainty of the nature, scale, duration and frequency of effects

Potential effects of the proposed activities are understood reasonably well and these are to be managed as far as reasonably practicable. Whilst the potential adverse effects of this dairy farm are expected to be similar to those expected from an average dairy farm, it is noted that the level of understanding in this field is increasing. Council's level of knowledge regarding the underlying aquifer, the receiving soils and surface water management zone is also improving, with continued knowledge and research of Southland and the site being achieved in the form of the proposed physiographic units and future catchment specific studies.

Potential adverse effects have in the first instance been mitigated by appropriate management techniques

on farm followed by contingency planning, ongoing monitoring and reporting in an auditable format. Whilst the potential effects are reasonably well understood, the advances in research and development suggest that there is still a lot to be understood. It is because of this that a 35-year term is not proposed.

Matching consent duration to the level of risk of adverse effects

The extent and nature of the actual and potential adverse effects of the activities on the existing environment (which includes the current dairy farm) were assessed in this document and concluded to be no more than occurring historically in the existing environment, with potential for continued improvement with the implementation of the various tasks identified as requiring attention in the FEMP.

Relevant Tangata Whenua values and Ngai Tahu Indicators of Health

The application has been assessed as consistent with the relevant tangata whenua values as outlined in the iwi management plan, with particular regard to the proposed consent duration being less than 25 years.

Duration sought by the applicant and supporting information

A consent term of 15 years is sought by the applicant. This is requested on the basis that the current consents do not expire until 2023 and the applicant in good faith has prepared these consent renewals early as part of the proposal to include a Herd Home on farm.

The permanence and economic life of any investment

Significant investment has been required just to get to the point of making application with expenditure on professional services, including business feasibility studies, nutrient advice, effluent system review, water quality and policy and planning assessments.

Commodity market influence is always a factor in the permanence of individual dairying units, hence why effluent discharge activities are often considered to have semi-permanent economic life. The economic life of the farm is firstly dependent on the granting of the relevant consents. Should consents be granted, the permanence of the dairying operation and associated activities should be inter-generational. Furthermore, the permanence of the economic life of the activity requires resource consents be granted from the Council for a reasonable duration.

Common expiry date for permits that affect the same resource

A common expiration date for all the permits applied for is considered appropriate.

Applicant's compliance history

The applicant has demonstrated an overall good compliance history with the existing resource consents and there is no evidence to suggest that future compliance will not continue to be good, and water records will be provided to Council on time.

Timing and development of FMUs

It is considered that granting a longer consent duration (i.e., 15 years) will better enable implementation of any revised framework established in the FMU section of the PSWLP, as Council will be able to review all

consents in the catchment collectively, which will serve to better implement any limit setting process.

In conclusion, due to the low level of environmental risk of the proposed activities and a substantial value of investments on the property, 15-year consent durations are considered appropriate.

Review and Lapse

The applicant is happy for ES to impose standard review conditions in accordance with Sections 128 and 129 of the RMA. In accordance with Section 125 of the RMA, the applicant seeks a 5-year lapse period for these consents. These consents must not be exercised until any current consents for the same activity have been surrendered or have expired.

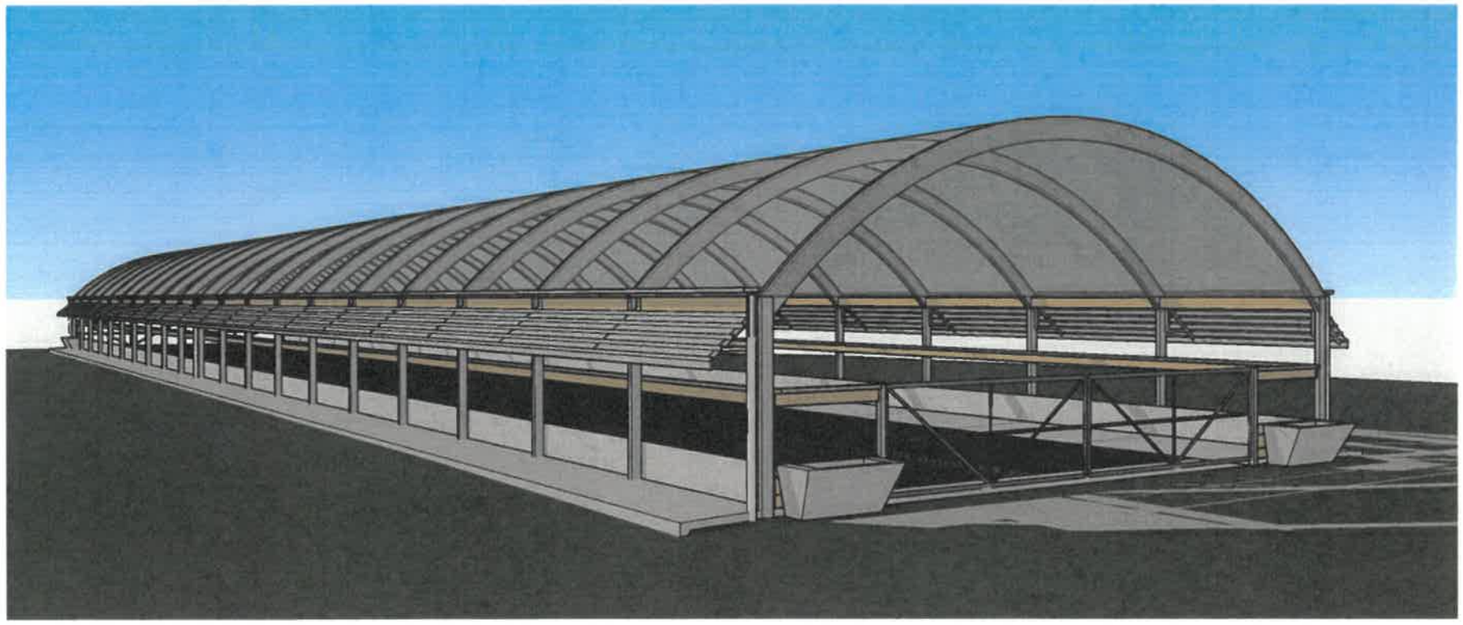
9. CONCLUSION

A decision to grant the resource consent application(s) under Section 104B is recommended on the basis that:

a) the adverse effects on the environment are virtually certain to be insignificant;
b) The proposal is consistent with the requirements of the RMA, relevant regional plan objectives and policies and other relevant matters.

Granting the resource consent application(s) will be consistent with the purpose of the RMA for the reasons explained within this report. The proposed activities are highly unlikely to result in further degradation of water quality and potential adverse effects will be avoided or mitigated as far as practicable.

Appendix A: Herd Home Design



Conceptual artistic impression only

PROPOSED NEW HERDHOMES® SHELTER WITH 3-BUNKER, 10.80m SHED DEVELOPMENT

DRAWING INDEX

Sheet No.	Sheet Name	Rev No.
CIVIL		
C01	SITE & LOCALITY PLAN	B1
C10	ROOF WATER DRAINAGE PLAN	B1
C11	ANTI-FLOTATION DRAINAGE PLAN	B1
C12	URINE COLLECTION DRAINAGE PLAN	B1
C13	PANEL SEALING DETAILS	B1
STRUCTURAL		
S01	FLOOR PLAN	B1
S02	ELEVATIONS	B1
S03	SECTIONS	B1
S04	FOUNDATION DETAIL	B1
S05	FOUNDATION DETAILS	B1
S06	FOUNDATION DETAILS	B1
S07	SETOUT & END DETAILS	B1
S08	PANEL A LAYOUT	B1
S09	WALL PANEL A	B1
S10	WALL PANEL A SIZES	B1
S11	WALL PANEL A SIZES	B1
S12	WALL PANEL A SIZES	B1
S13	WALL PANEL B	B1
S14	WALL PANEL C	B1
S15	MESH LAP DIAGRAM	B1
S16	RHS POST DETAIL	B1
S17	GATE POST AND RAILING DETAILS	B1

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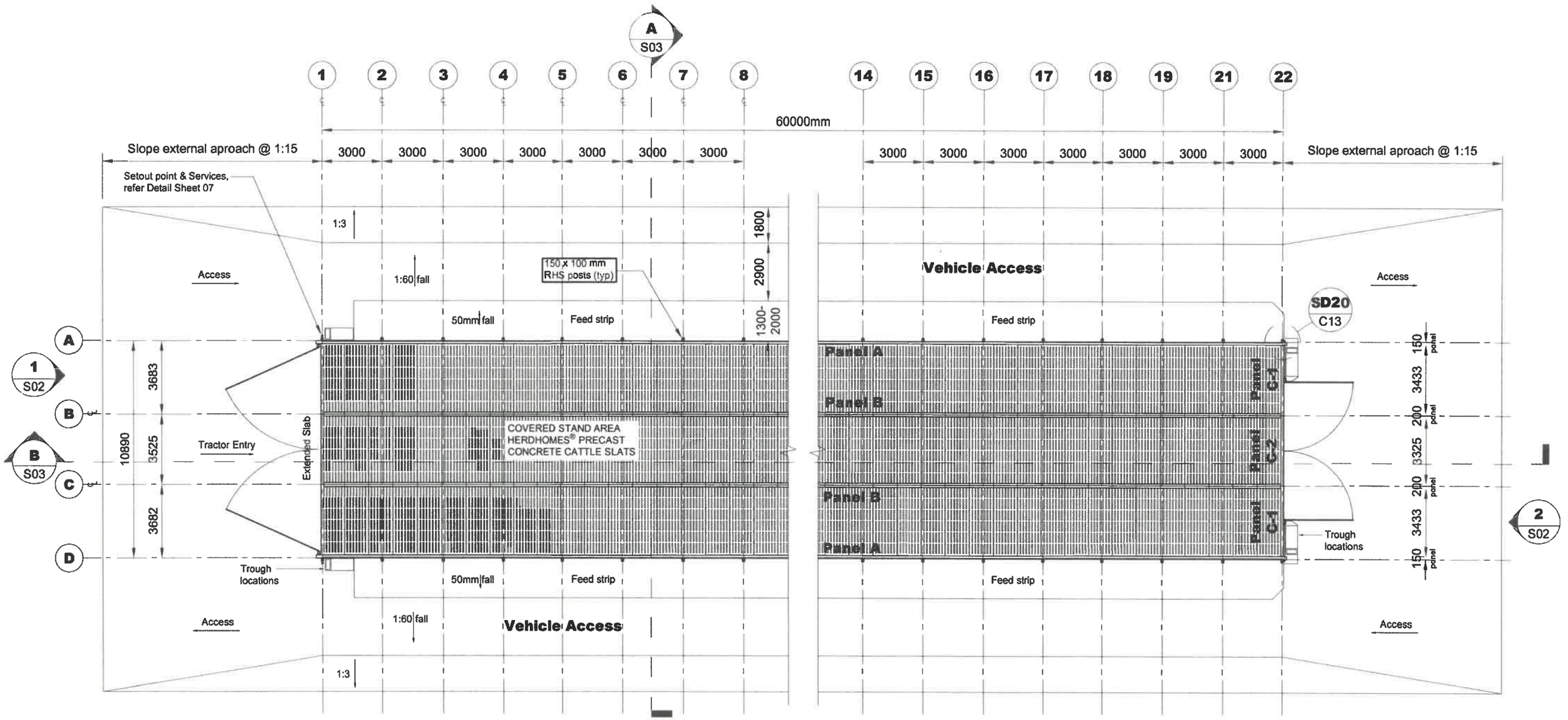
12365

2021 Set

HERD HOMES SYSTEMS LTD REF #

NOTE
HERD HOMES SLATS ARE DESIGNED FOR STOCK LOADS ONLY, STRICTLY NO VEHICULAR ACCESS ACROSS SLATS



PROPOSED PLAN

SCALE - 1:200

2021 Set

HERDHOMES® SYSTEMS LIMITED REF #

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CLIENT HERDHOMES® SYSTEMS LTD

PROJECT PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT

DRAWING PROPOSED FLOOR PLAN

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	20/04/21

DEVELOPED DESIGN

SCALE @ A3 AS SHOWN

DRAWN JV MAY 2021

CHECK

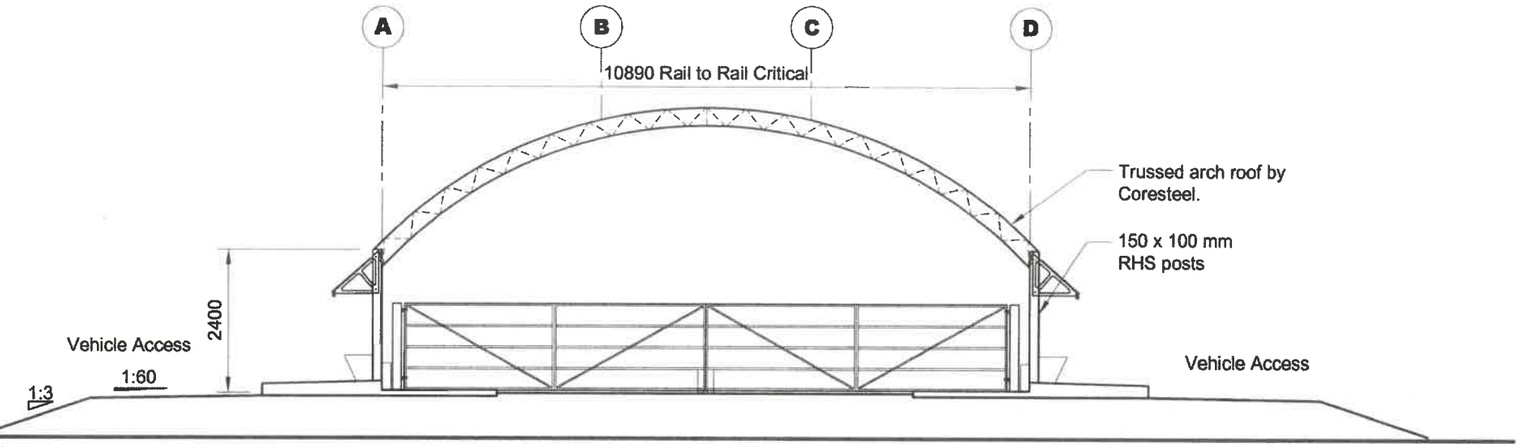
APPROVED PETER GEDDES

PROJECT No. 12365

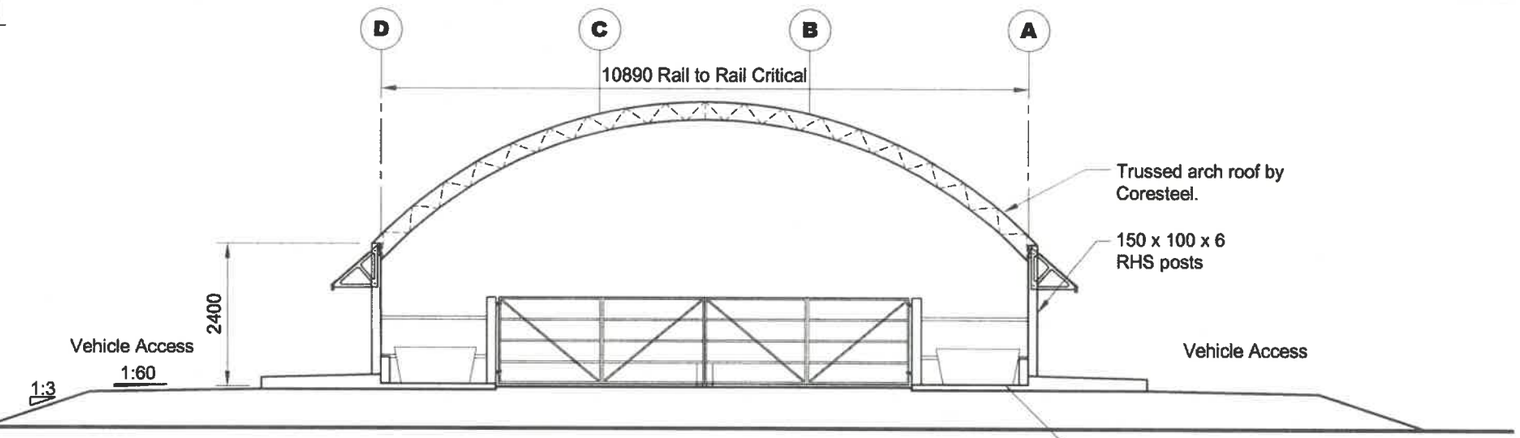
SHEET S01

REV. P1

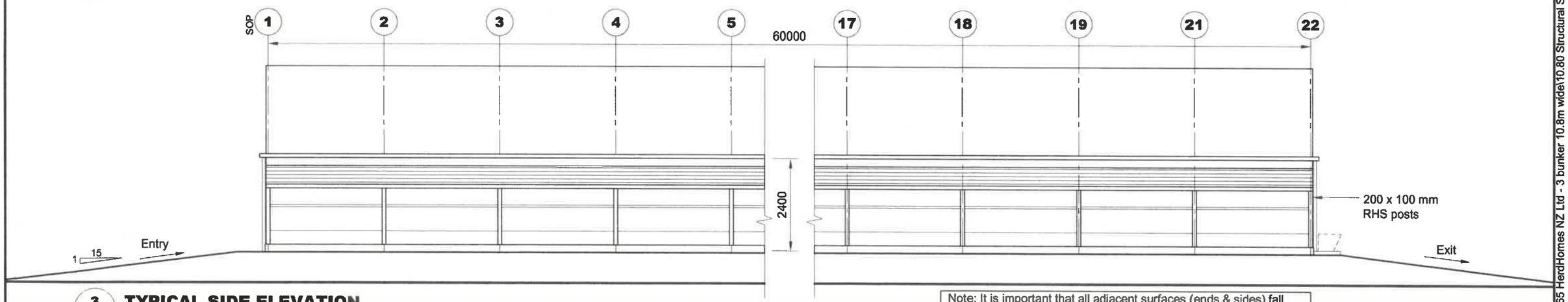
20/05/2021 4:31:17 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



1 ENTRANCE ELEVATION
S01 SCALE - 1:100 (RAMP END)



2 EXIT ELEVATION
S01 SCALE - 1:100 (NON-RAMP END)



3 TYPICAL SIDE ELEVATION
S01 SCALE - 1:100

Note: It is important that all adjacent surfaces (ends & sides) fall away from structure to adjacent gravity stormwater systems

2021 Set

HERDHOMES® SYSTEMS LIMITED REF #

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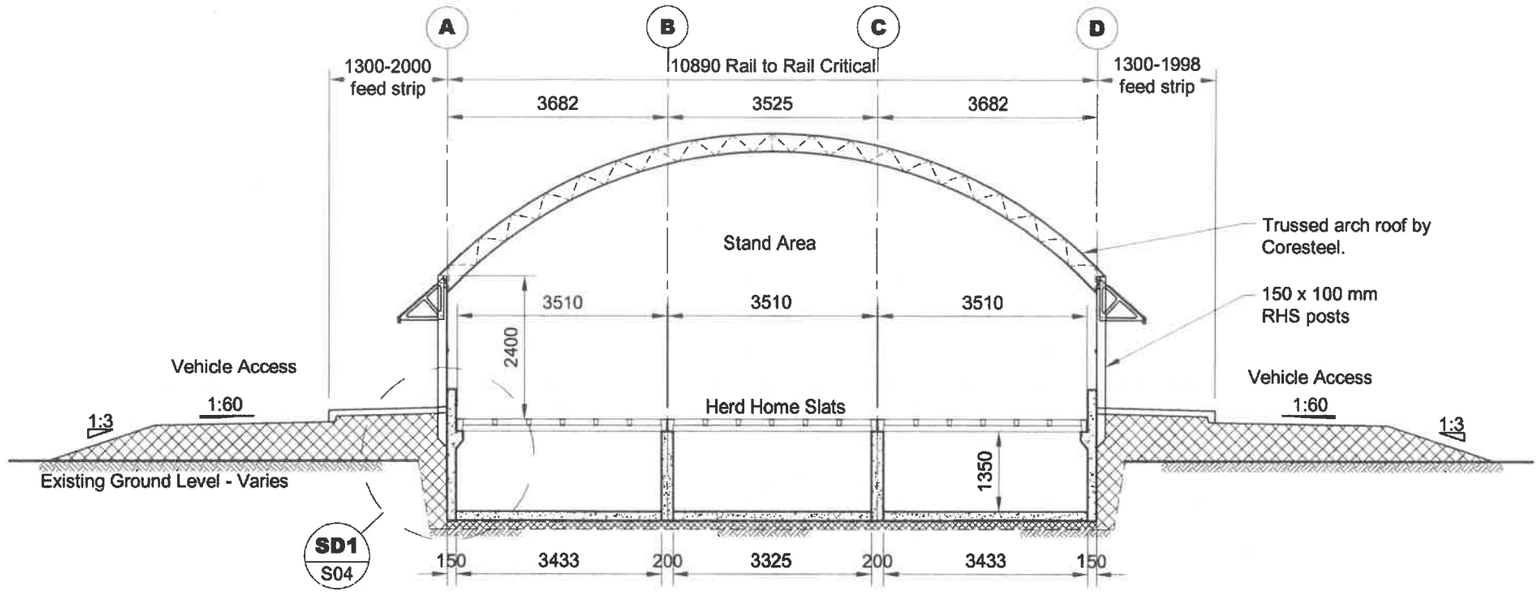
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **PROPOSED ELEVATION**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	23/04/21

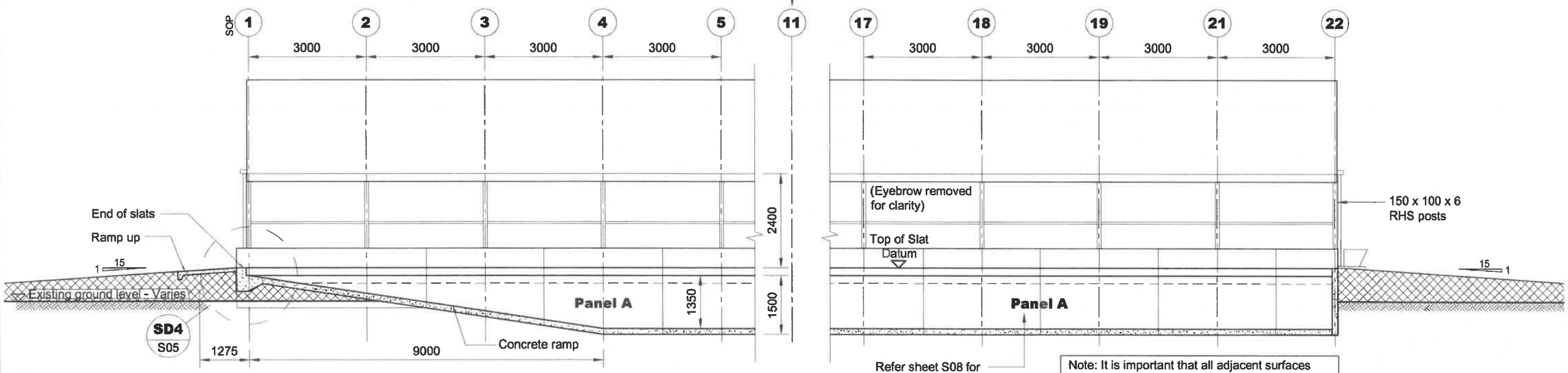
DEVELOPED DESIGN
SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S02
REV. P1

21/05/2021 2:30:28 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



A CROSS SECTION
S01 SCALE - 1:100

Truss bracket to mid pole of sheds is 100mm higher than at end poles to allow for fall in the S/W gutter; adjust bracket height evenly to suit.



B LONG SECTION
S01 SCALE - 1:100

2021 Set

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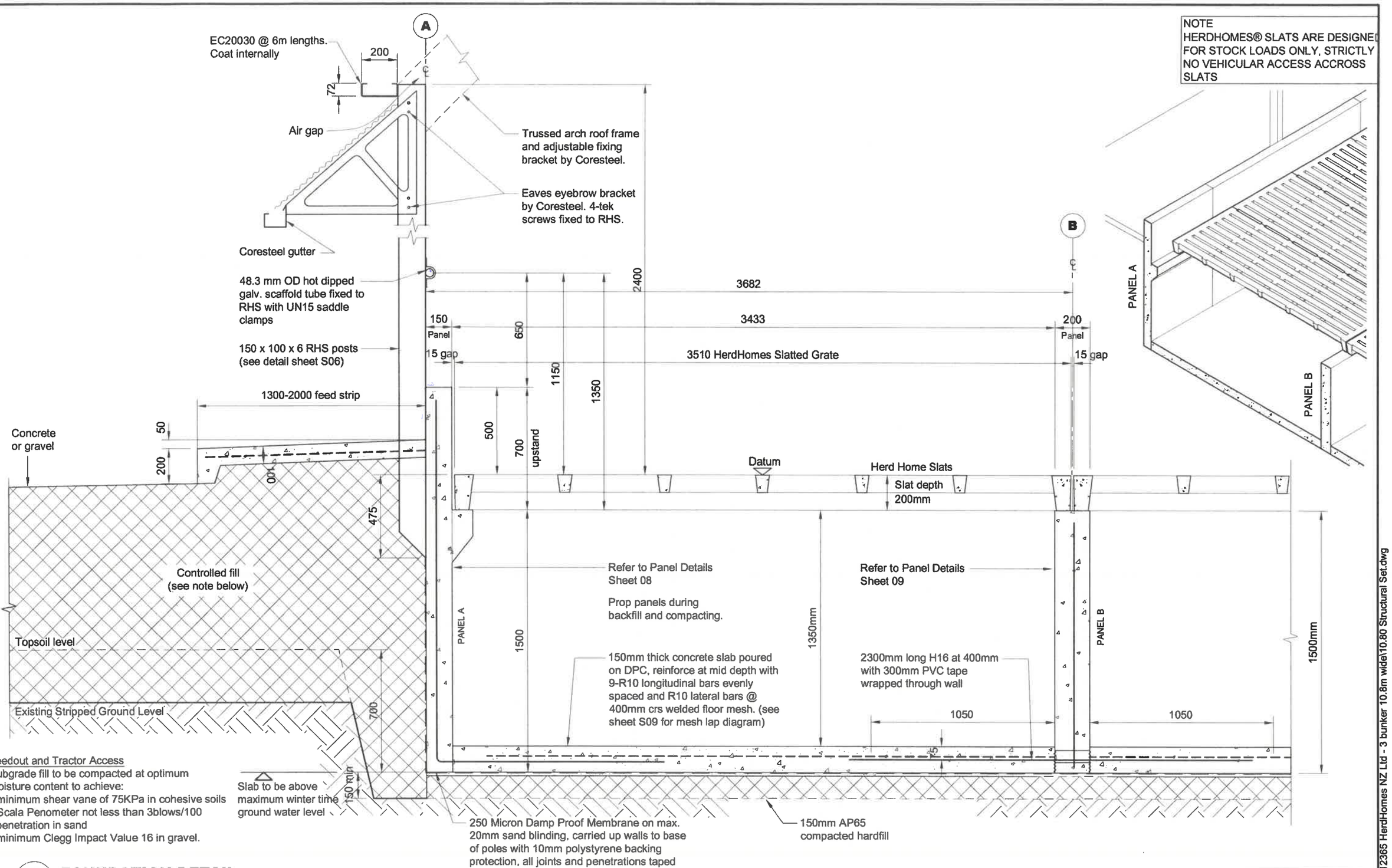
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **PROPOSED SECTION**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN SCALE @ A3 AS SHOWN

DRAWN	JV MAY 2021	PROJECT No. 12365
CHECK		
APPROVED	PETER GEDDES	SHEET S03 / REV. P1

21/05/2021 2:31:04 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



NOTE
HERDHOMES® SLATS ARE DESIGNED FOR STOCK LOADS ONLY, STRICTLY NO VEHICULAR ACCESS ACCROSS SLATS

SD1 FOUNDATION DETAIL
S03 SCALE - 1:20 (RAISED FEED BIN & LOWER TRACTOR TRACK)

2021 Set

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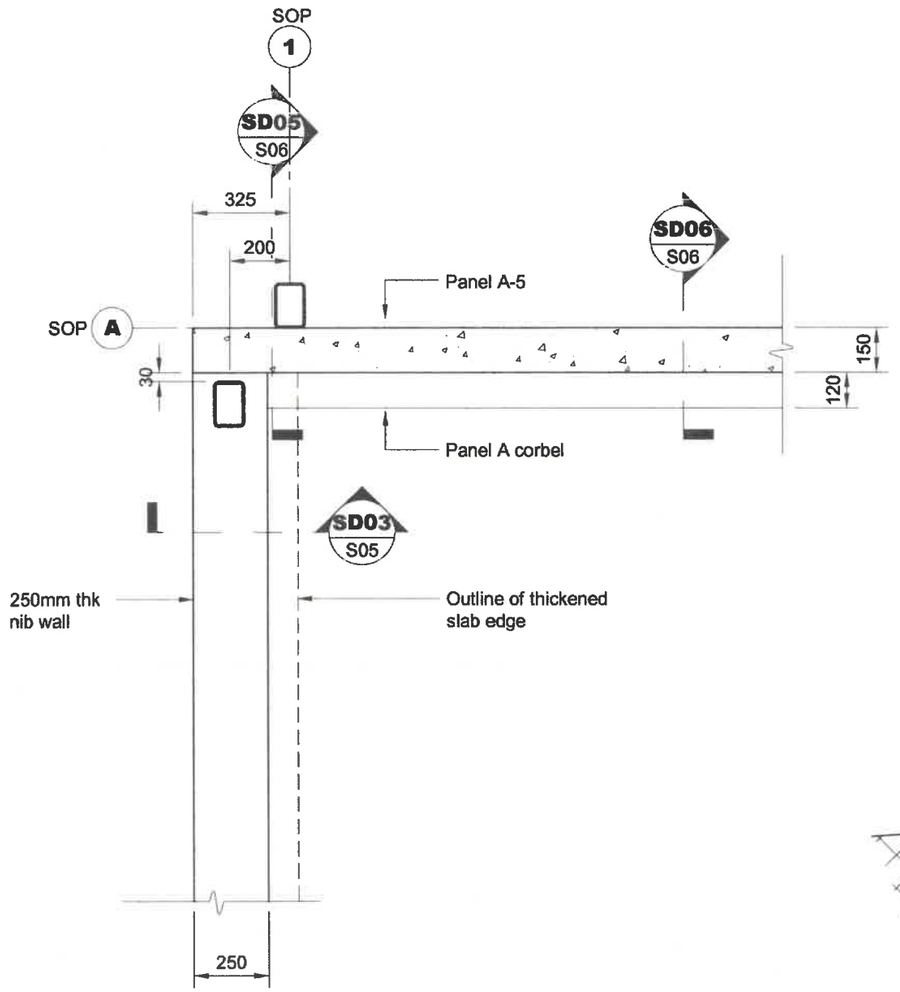
CLIENT HERDHOMES® SYSTEMS LTD
PROJECT PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT
DRAWING PROPOSED FOUNDATION DETAIL

REV	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

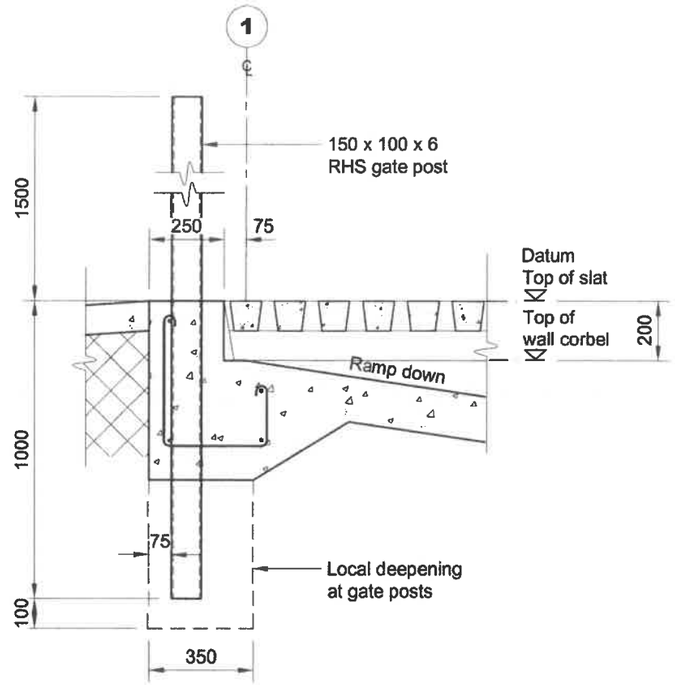
DEVELOPED DESIGN
SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S04
REV. P1

21/05/2021 2:31:22 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



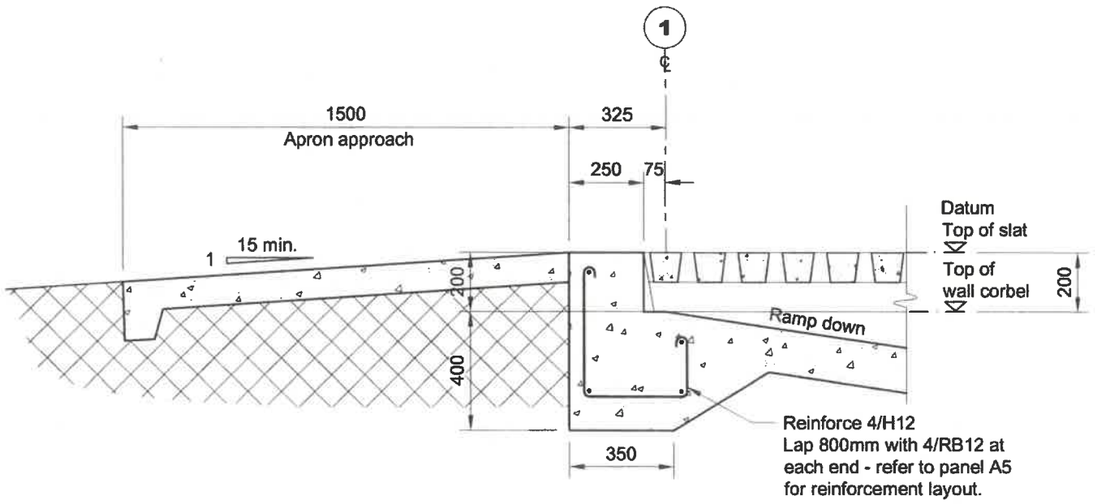
SD2 - **PLAN AT GRIDLINE A-1**

SCALE - 1:20



SD3 S05 **NIB AT GATE POST**

SCALE - 1:20



SD4 S03 **RAMP AND NIB DETAIL**

SCALE - 1:20

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **FOUNDATION DETAILS**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3 AS SHOWN

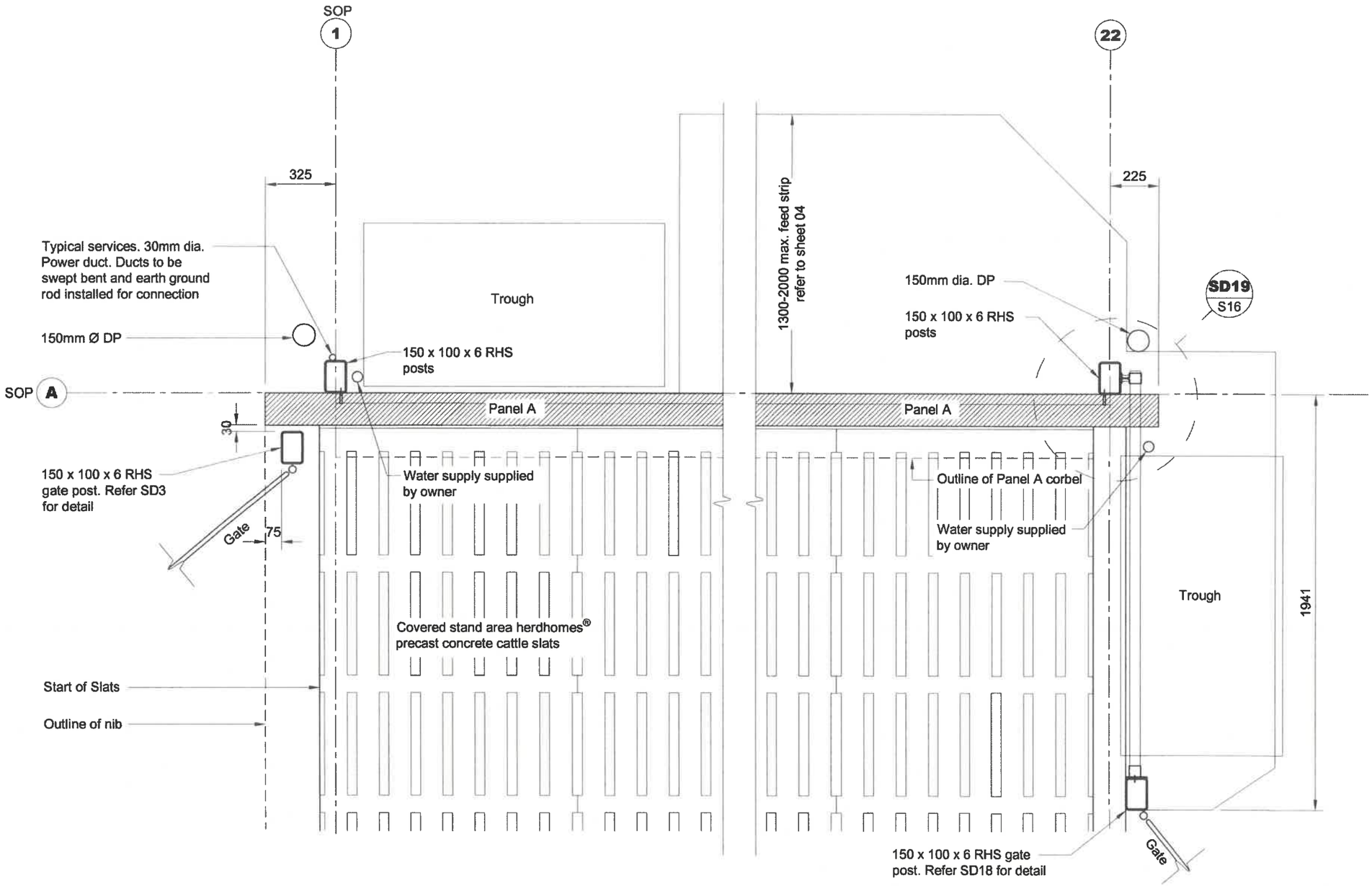
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES

PROJECT No. 12365

SHEET S05

REV. P1

21/05/2021 2:33:28 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



SD7 S01 SETOUT/GATE SUPPORT DETAIL

SCALE - 1:20

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT HERDHOMES® SYSTEMS LTD

PROJECT PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT

DRAWING SETOUT AND END DETAILS

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3 AS SHOWN

DRAWN JV MAY 2021

CHECK

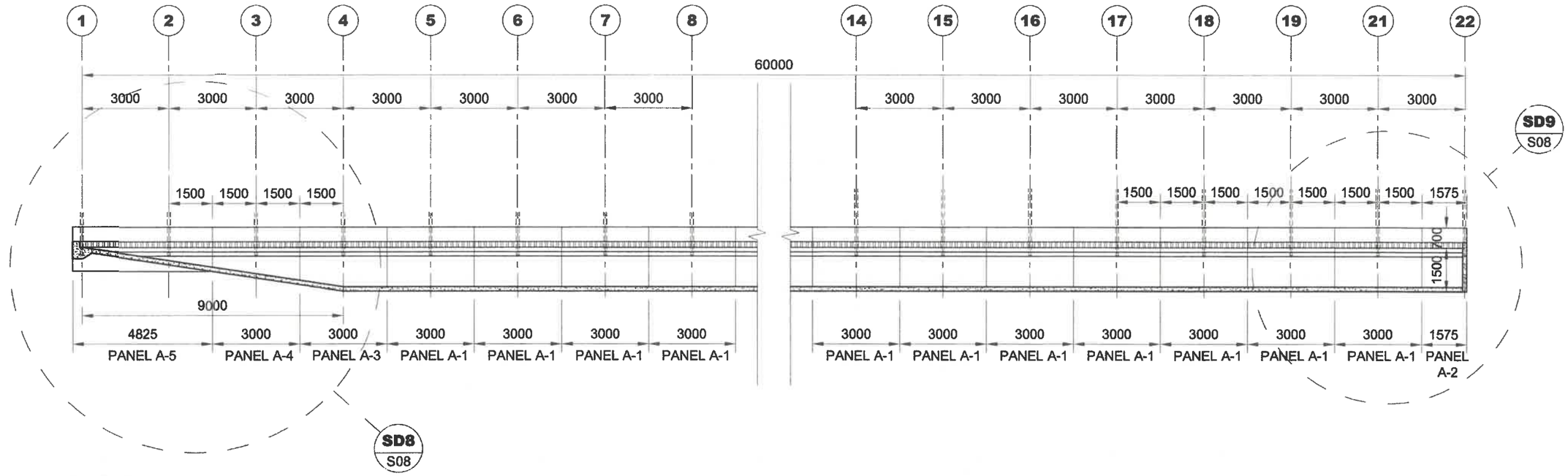
APPROVED PETER GEDDES

PROJECT No. 12365

SHEET S07

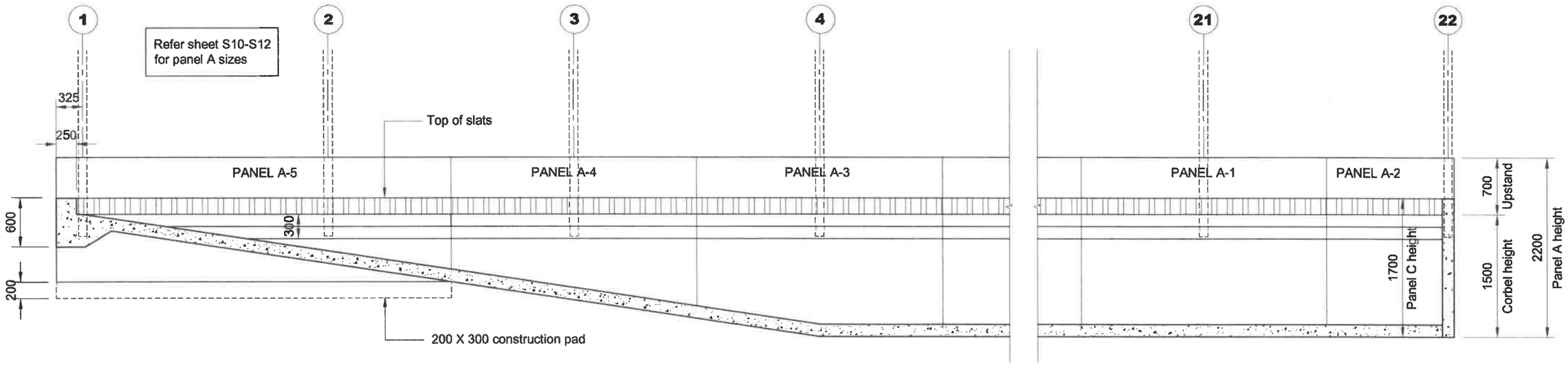
REV. P1

20/05/2021 4:34:23 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



PANEL A LAYOUT

SCALE - 1:150



SD8 PANEL A LAYOUT DETAIL 1

SCALE - 1:50

SD9 PANEL A LAYOUT DETAIL 2

SCALE - 1:50

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **PANEL A LAYOUT**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN | SCALE @ A3 AS SHOWN

DRAWN	JV	MAY 2021
CHECK		
APPROVED	PETER GEDDES	

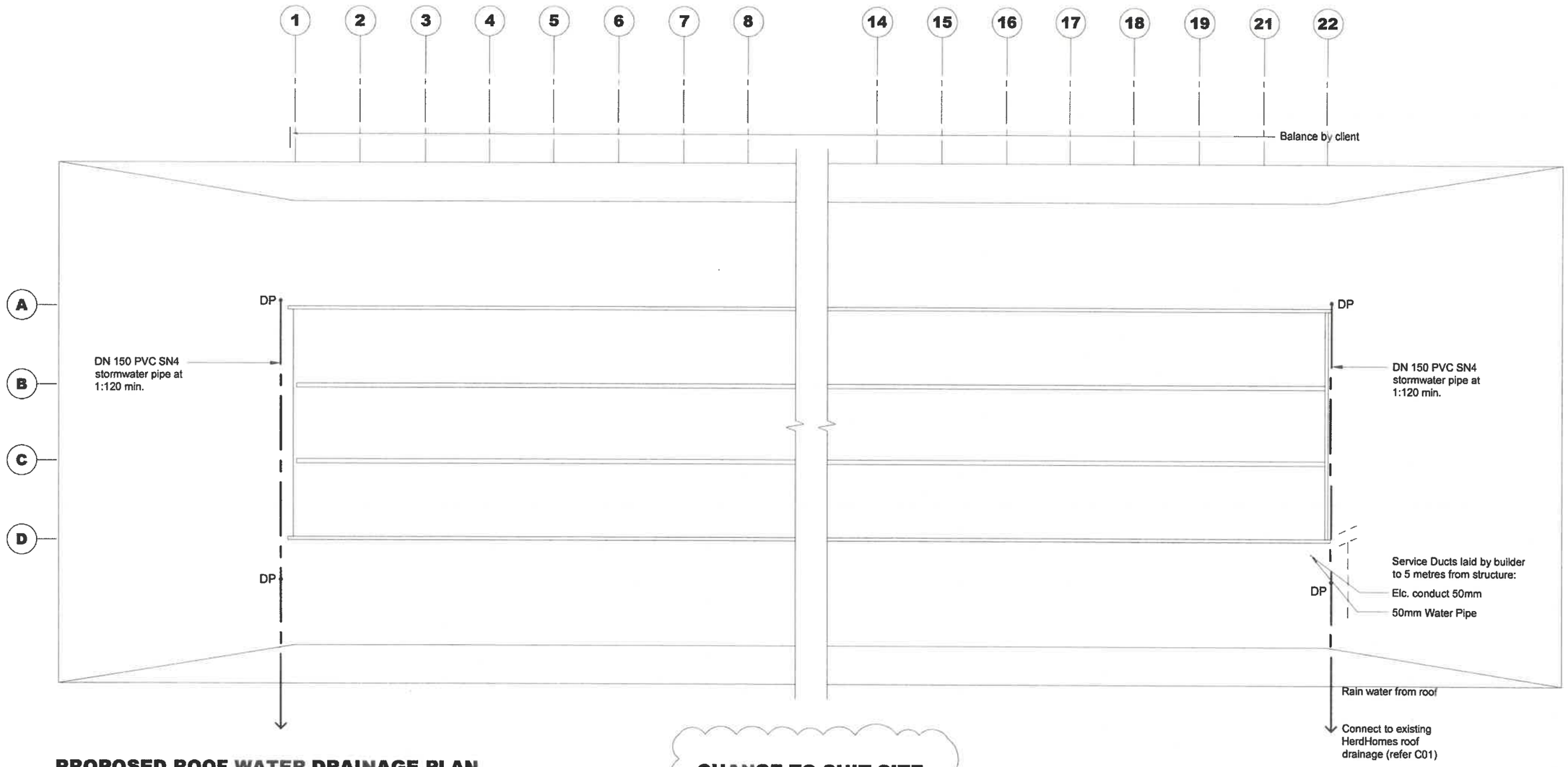
PROJECT No. **12365**

SHEET **S08** | REV. **P1**

20/05/2021 4:35:05 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg

Notes:
-Contractor supplies 5m of electrical duct, water duct & stormwater of contract Balance supplied by Client.

-All drain pipe joints and concrete penetrations to be sealed.



PROPOSED ROOF WATER DRAINAGE PLAN

SCALE - 1:200

CHANGE TO SUIT SITE

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT HERDHOMES® SYSTEMS LTD

PROJECT PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT

DRAWING ROOF WATER DRAINAGE PLAN

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3 AS SHOWN

DRAWN JV MAY 2021

CHECK

APPROVED PETER GEDDES

PROJECT No. 12365

SHEET C10

REV. B1

21/05/2021 2:34:34 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg

NOT REQUIRED

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **ANTI-FLOTATION DRAINAGE PLAN**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021
CHECK:
APPROVED: PETER GEDDES

PROJECT No.: **12365**

SHEET: **C11**

REV.: **B1**

20/05/2021 4:46:15 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg

NOT REQUIRED

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **URINE COLLECTION DRAINAGE PLAN**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021

CHECK:

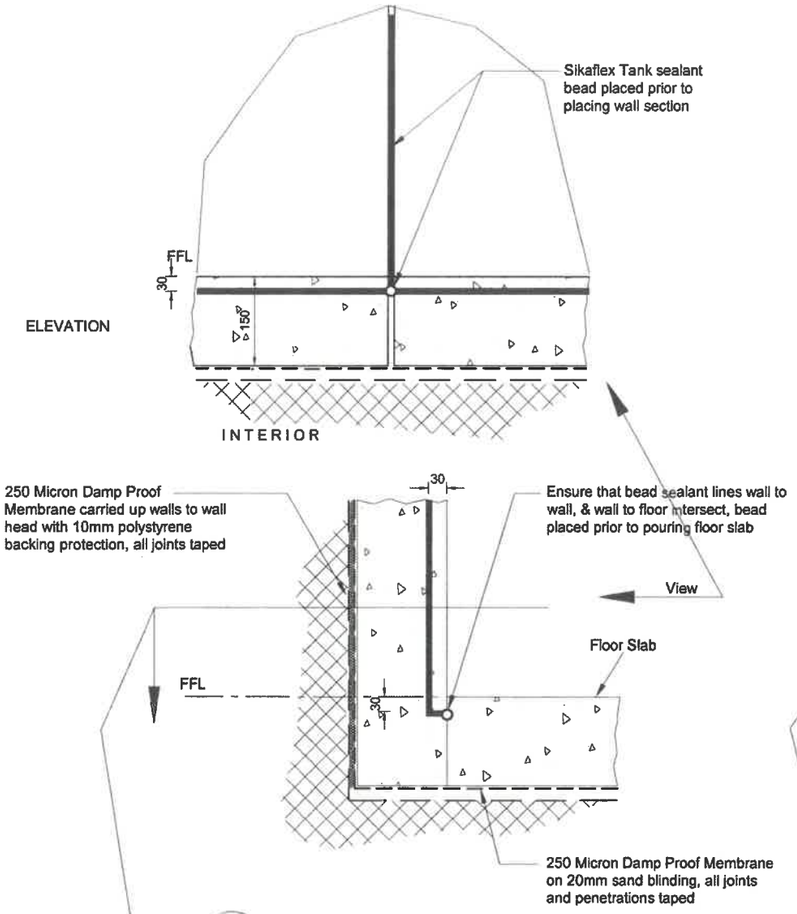
APPROVED: PETER GEDDES

PROJECT No.: 12365

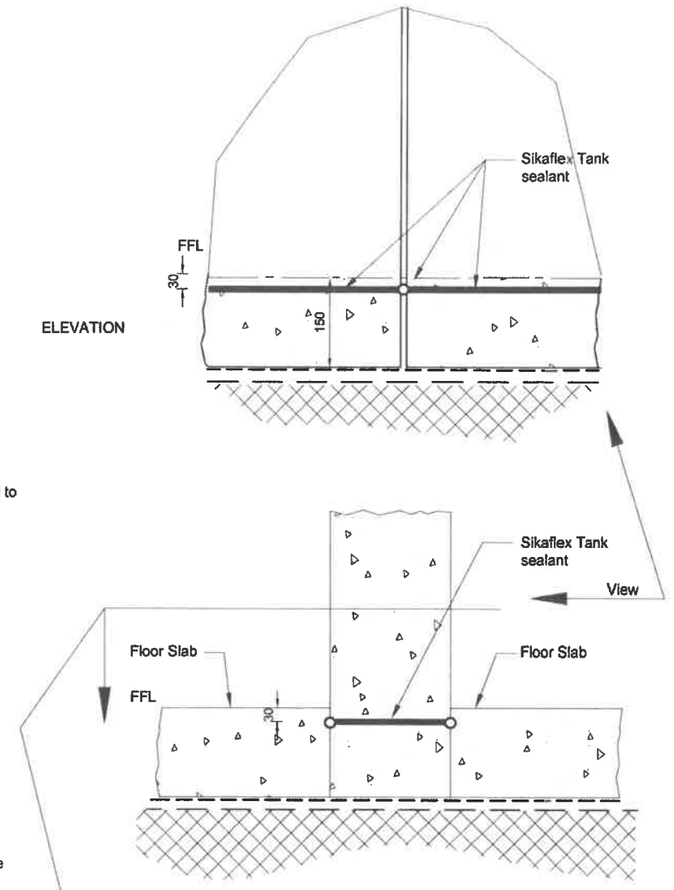
SHEET: C12

REV.: B1

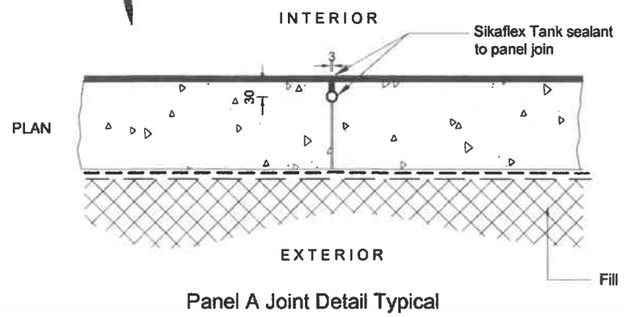
20/05/2021 4:46:40 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



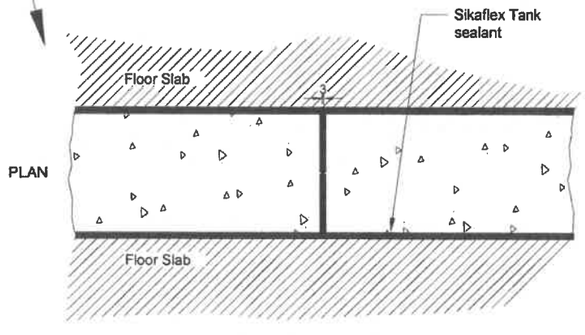
SD20 DETAIL
S01 1:5 A1/S04 (1:10 A3)



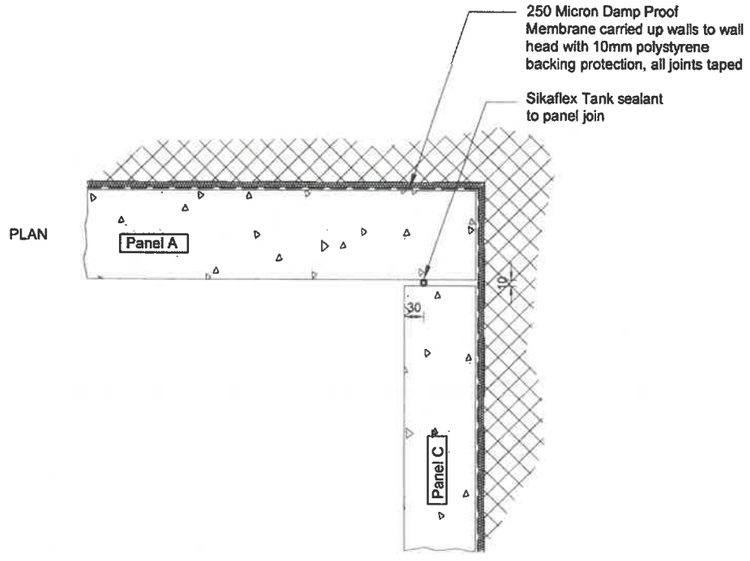
SD21 DETAIL
S01 1:5 A1/S04 (1:10 A3)



Panel A Joint Detail Typical



Panel B Joint Detail Typical



Panel A-C Joint Detail

SD22 DETAIL
S01 1:5 A1/S04 (1:10 A3)

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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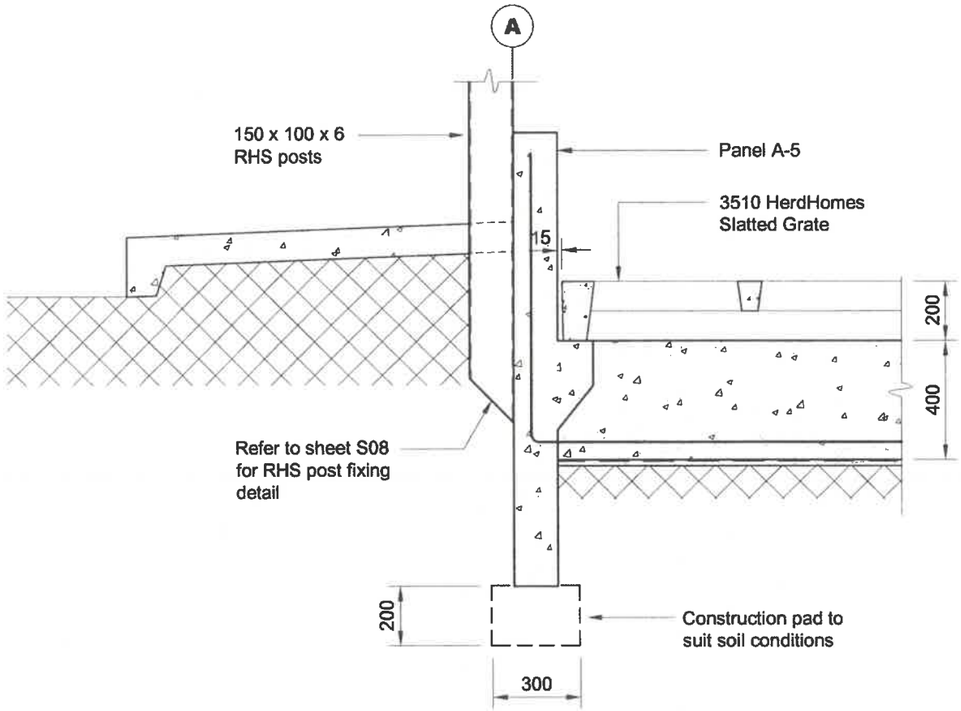
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **PANEL SEALING DETAILS**

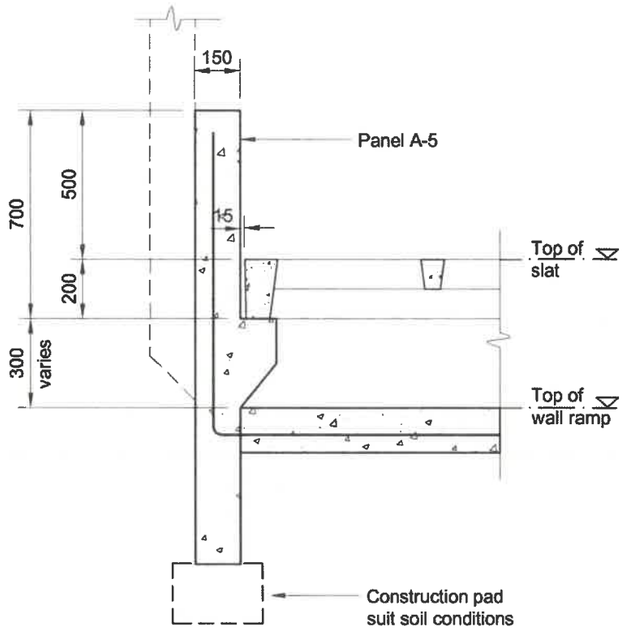
REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET C13
REV. B1

20/05/2021 4:43:25 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



SD05 **SECTION AT GRIDLINE A-1**
S05 SCALE - 1:20



SD06 **SECTION AT PANEL A-5**
S05 SCALE - 1:20

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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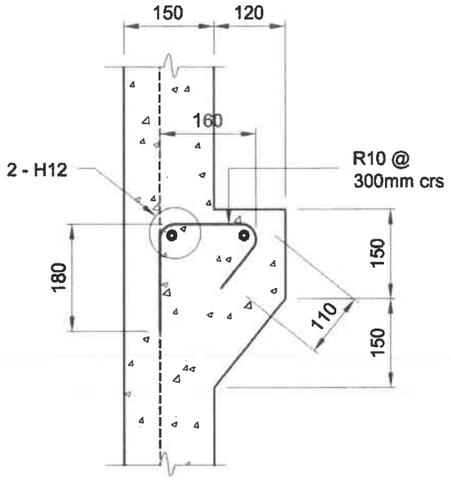
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **FOUNDATION DETAILS**

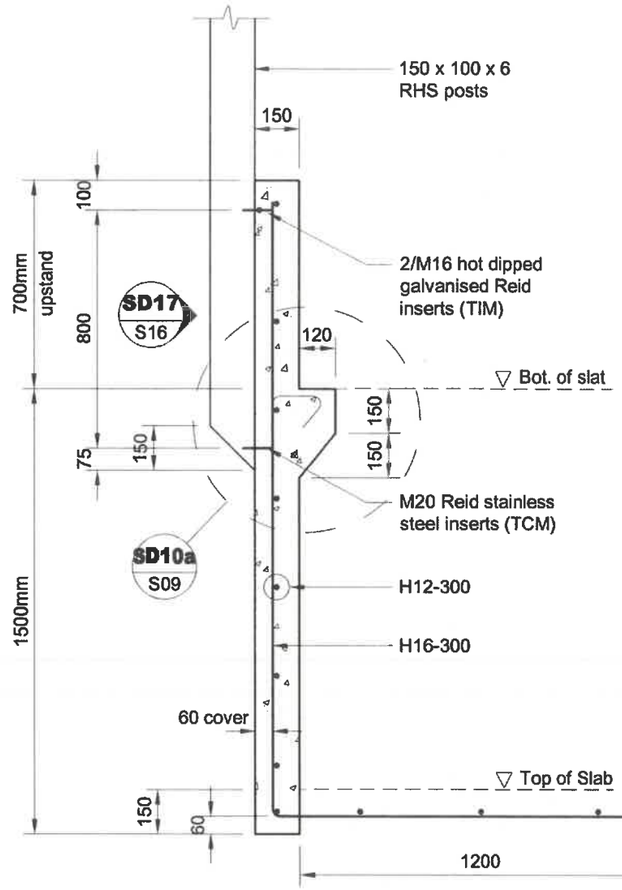
REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN
SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S06
REV. P1

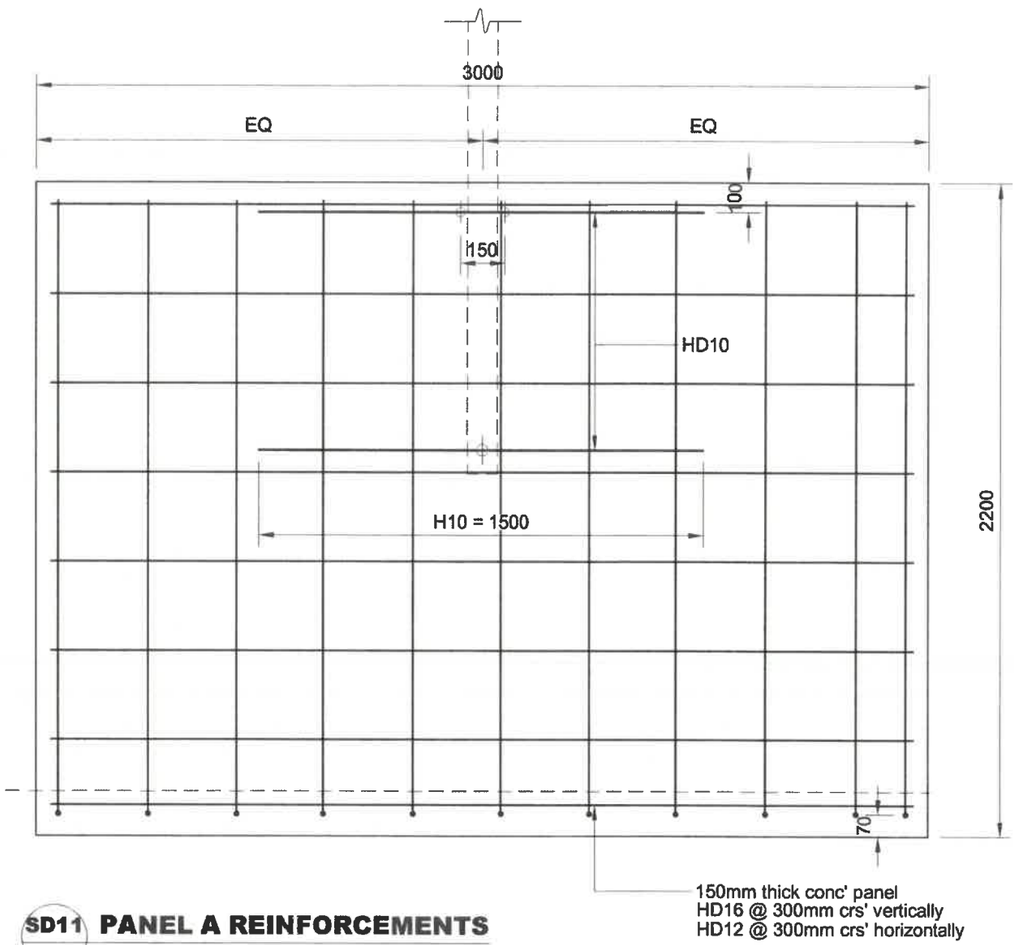
21/05/2021 2:33:39 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



SD10a CORBEL DETAIL
S09 SCALE - 1:10



SD10 PANEL A SECTION
S01 SCALE - 1:20



SD11 PANEL A REINFORCEMENTS
S01 SCALE - 1:20

HERDHOMES® SYSTEMS LIMITED REF #

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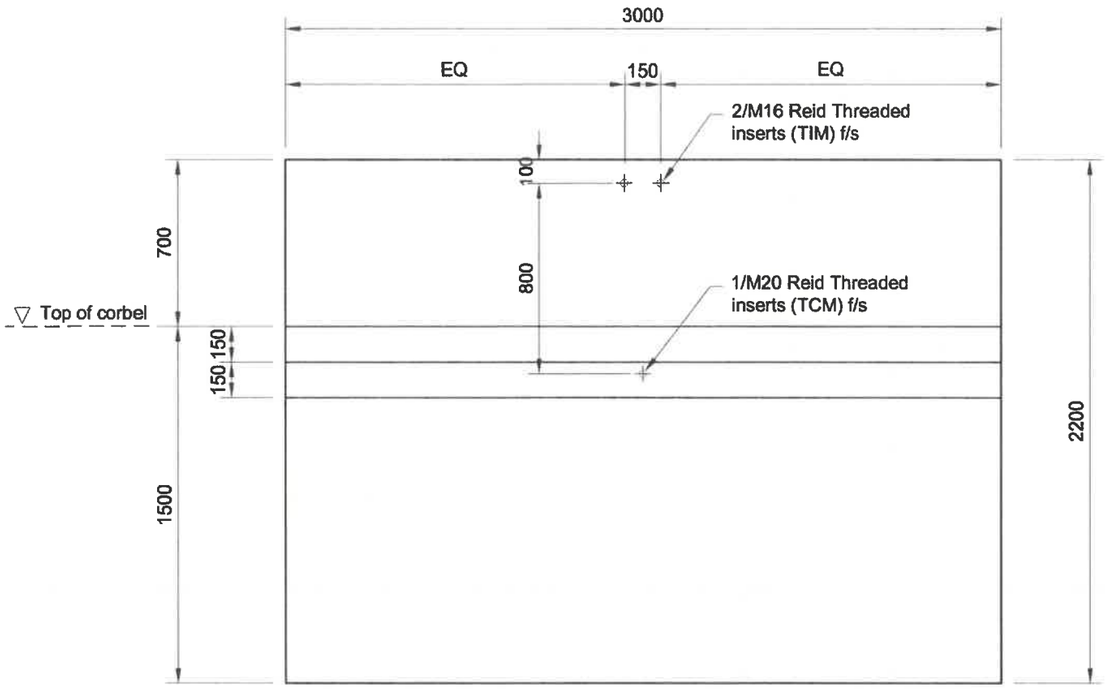
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **WALL PANEL A**

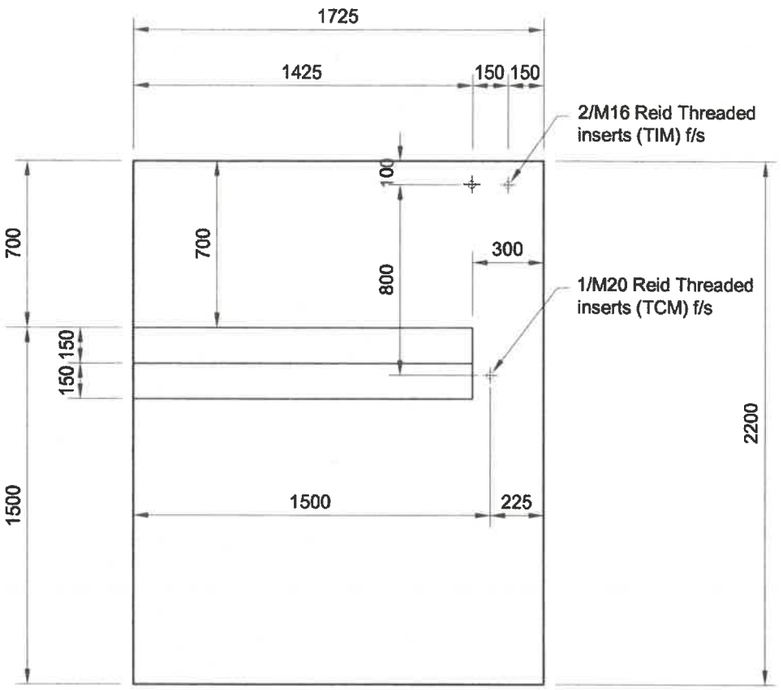
REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN
SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S09
REV. P1

21/05/2021 2:34:18 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



PANEL A-1
1:25



PANEL A-2
1:25

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **WALL PANEL A SIZES**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021
CHECK:
APPROVED: PETER GEDDES

PROJECT No.: **12365**

SHEET: **S10**

REV.: **P1**

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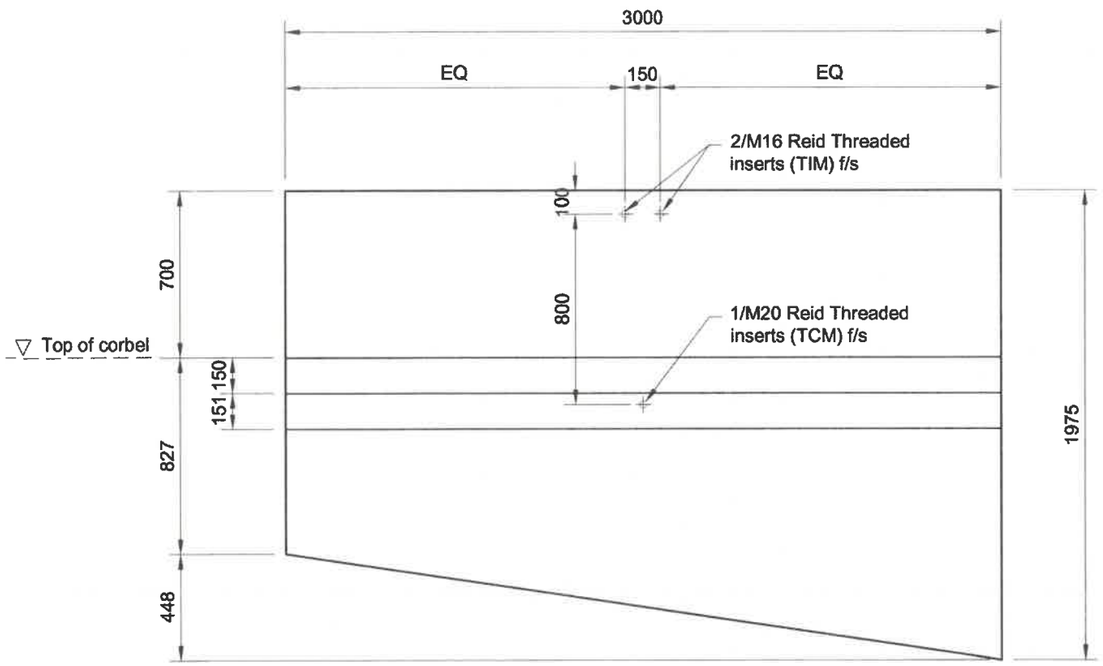
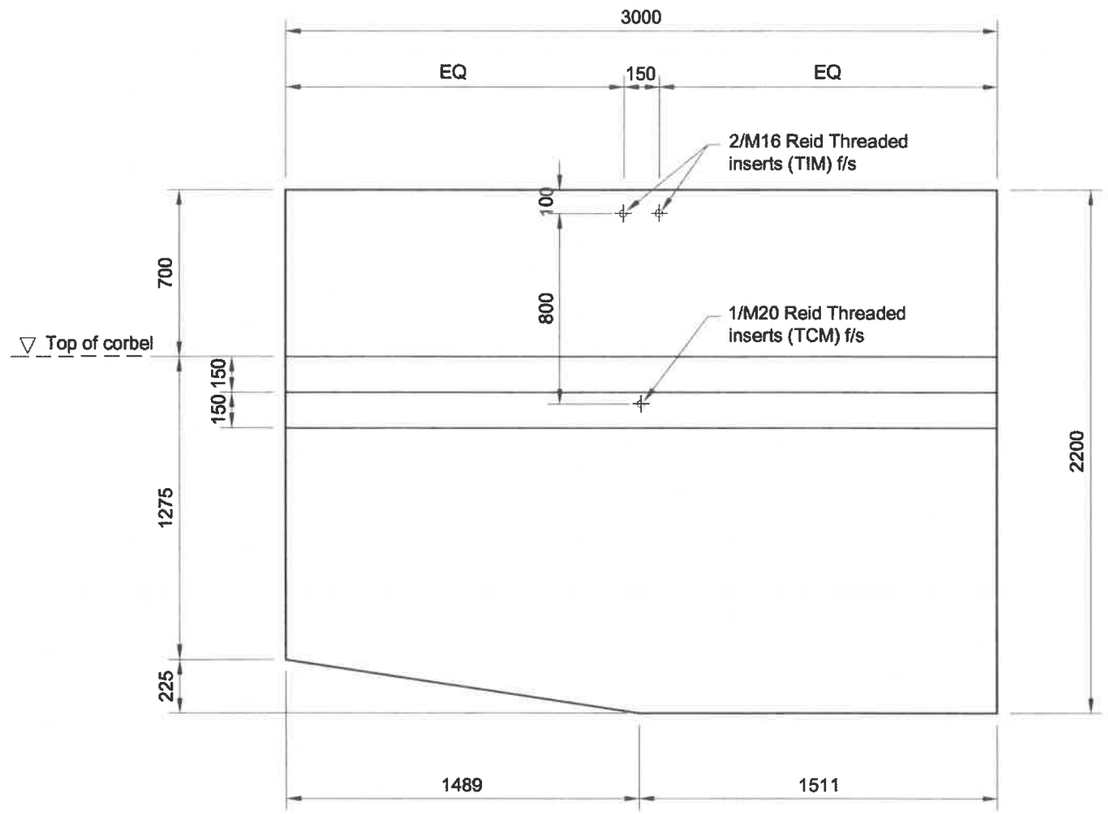


PANEL A-4

1:25



PANEL A-3

1:25

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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PHONE 021 57 3052

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **WALL PANEL A SIZES**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN

SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021

CHECK:

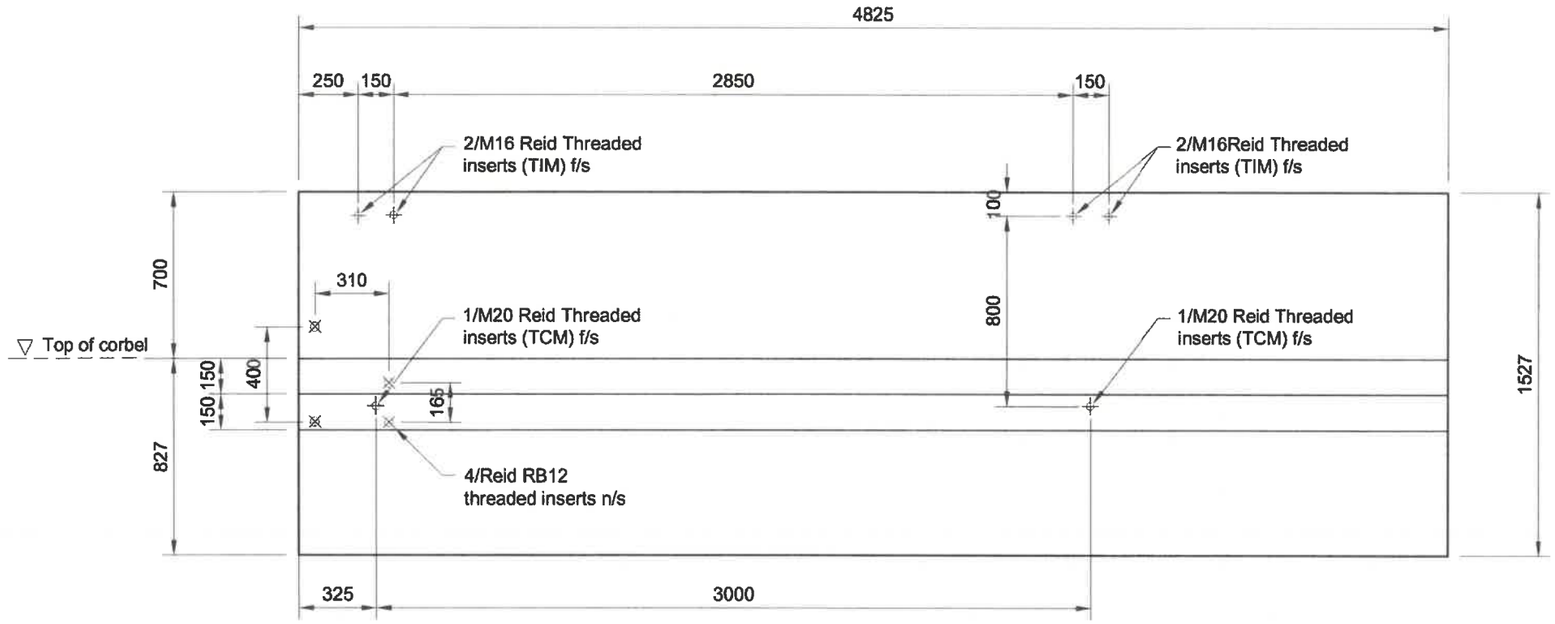
APPROVED: PETER GEDDES

PROJECT No.: **12365**

SHEET: **S11**

REV.: **P1**

20/05/2021 4:39:14 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



PANEL A-5

1:25

HERDHOMES® SYSTEMS LIMITED REF #

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **WALL PANEL A SIZES**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN | SCALE @ A3 AS SHOWN

DRAWN JV MAY 2021 | CHECK | APPROVED PETER GEDDES

PROJECT No. **12365**

SHEET **S12** | REV. **P1**

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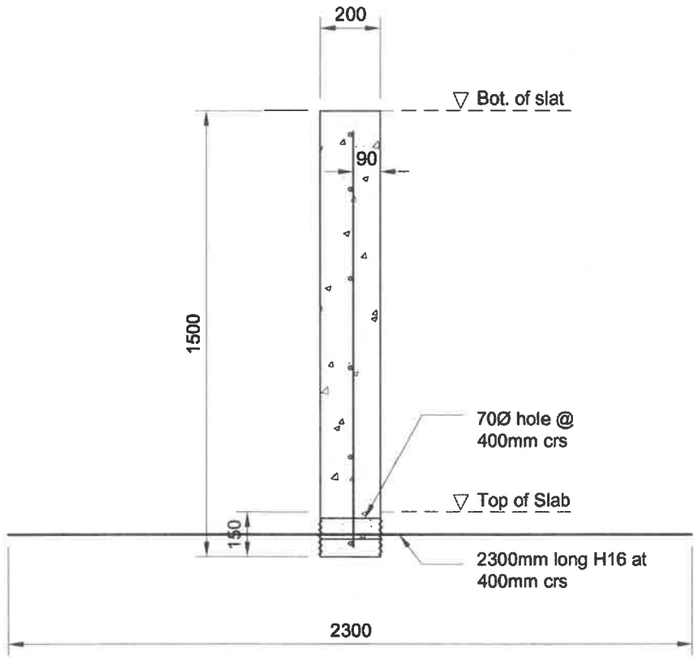
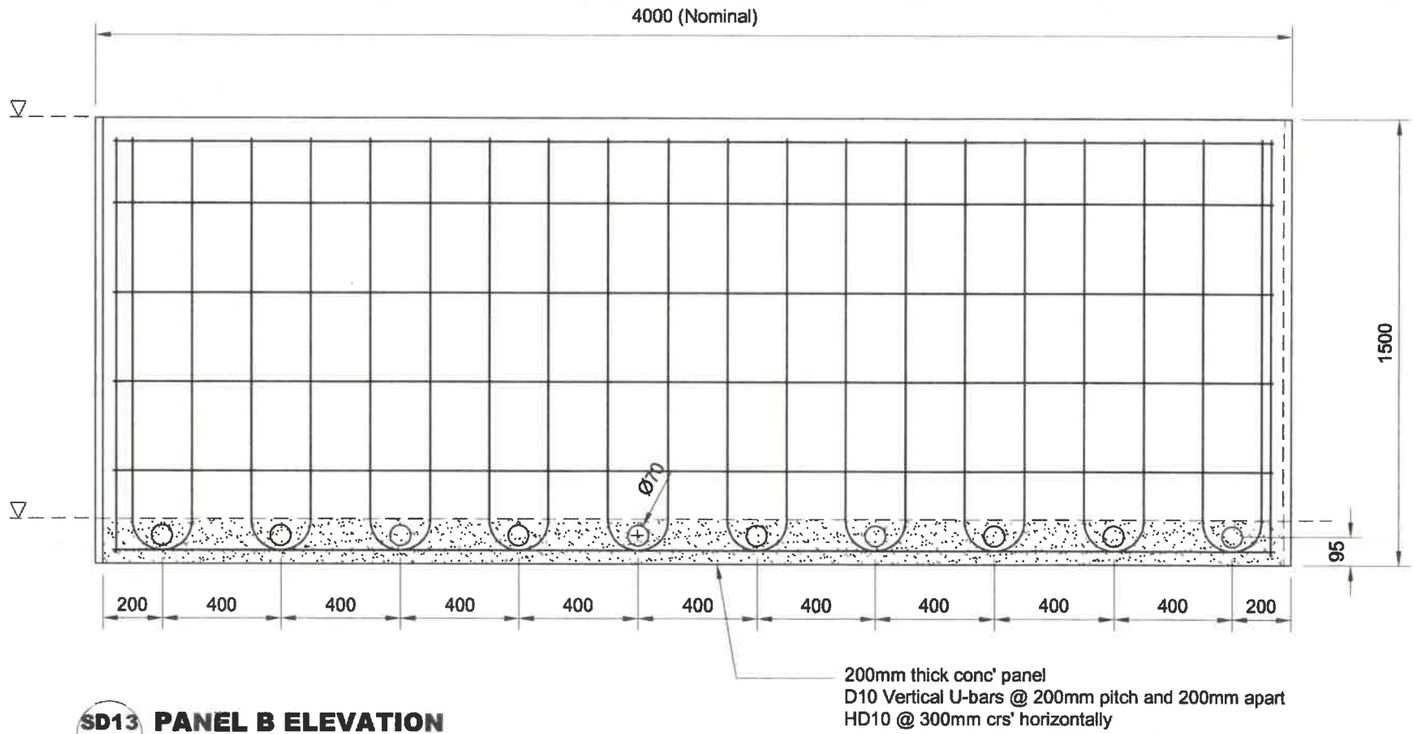


SD12 PANEL B SECTION
S01 SCALE - 1:20



SD13 PANEL B ELEVATION
S01 SCALE - 1:20

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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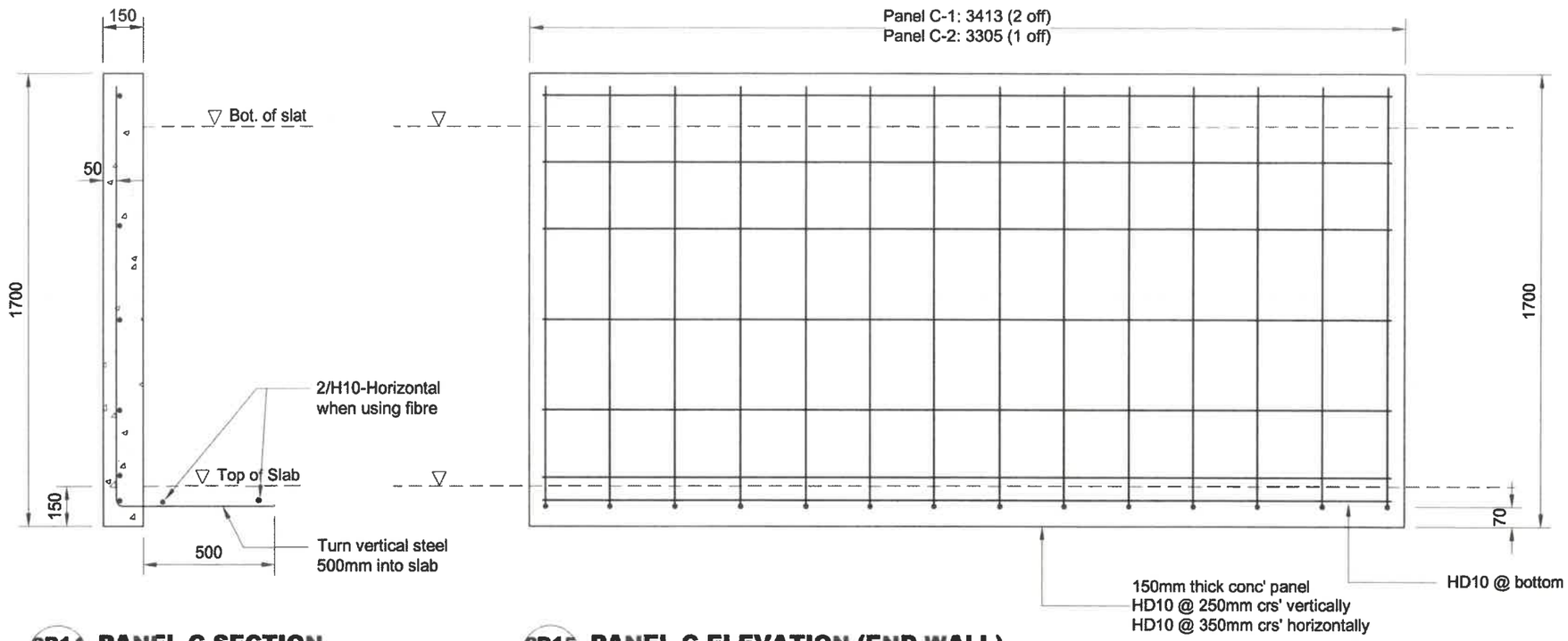
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **WALL PANEL B**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

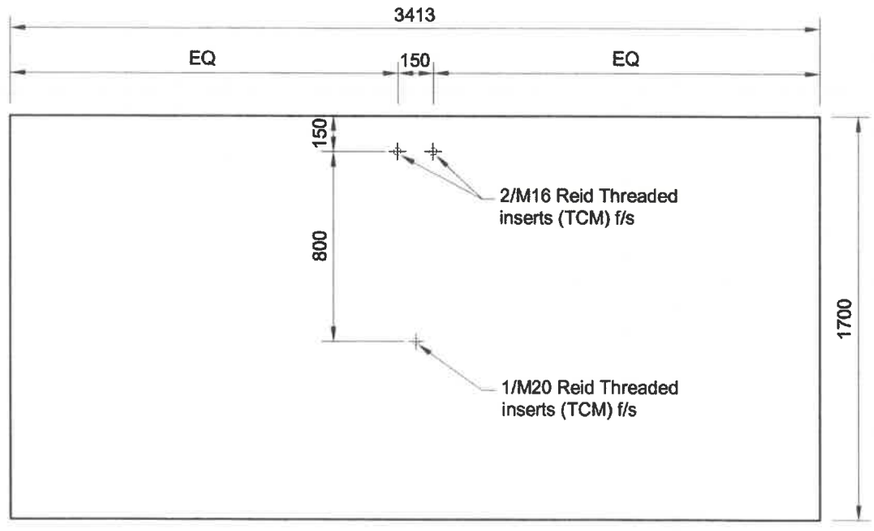
DEVELOPED DESIGN SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S13
REV. P1

20/05/2021 4:39:48 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



SD14 PANEL C SECTION
S01 SCALE - 1:20

SD15 PANEL C ELEVATION (END WALL)
S01 SCALE - 1:20



PANEL C-1
1:25

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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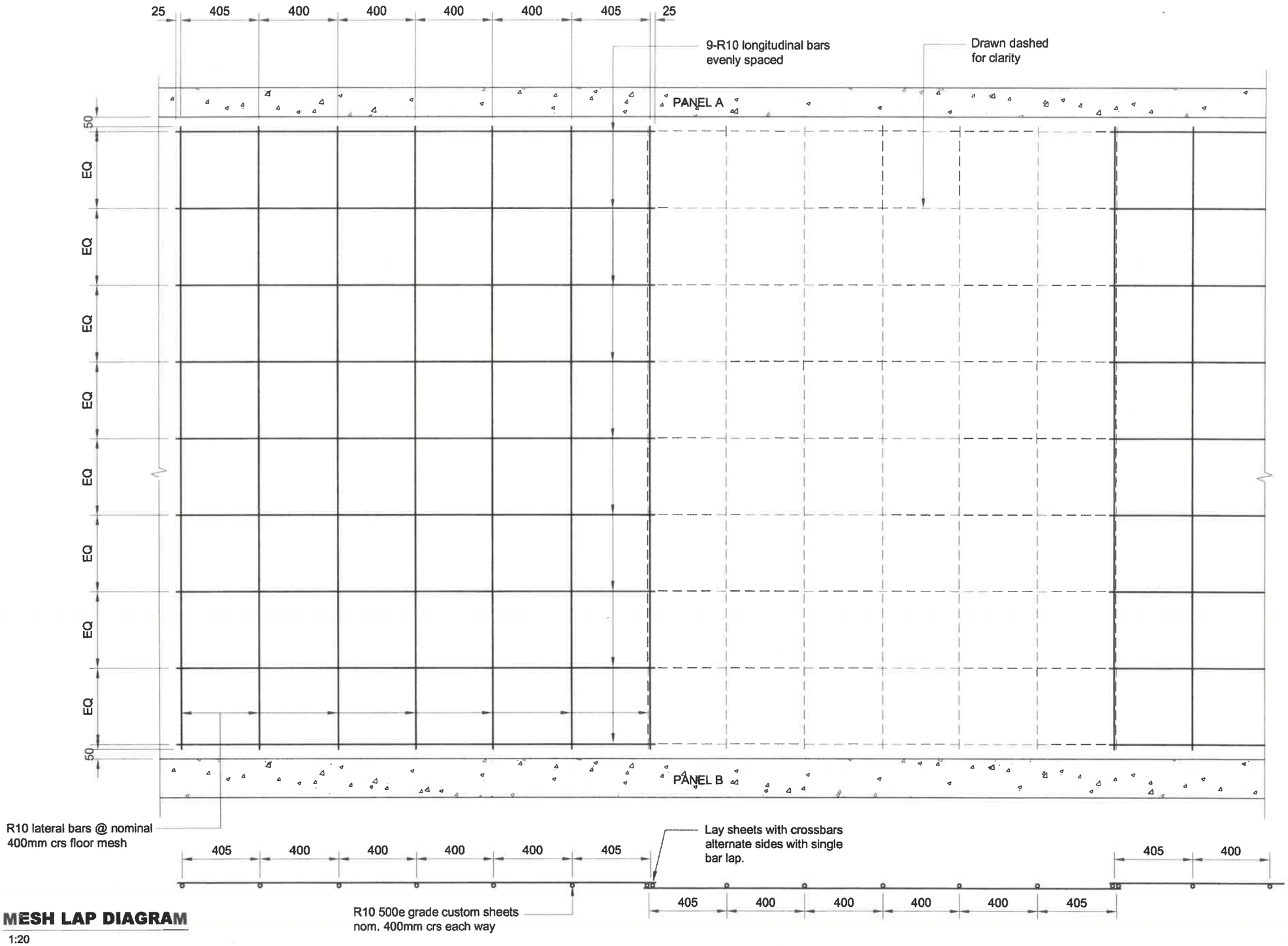
CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **WALL PANEL C**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	20/04/21

DEVELOPED DESIGN SCALE @ A3 AS SHOWN

DRAWN	JV MAY 2021	PROJECT No. 12365
CHECK		
APPROVED	PETER GEDDES	SHEET S14 / REV. P1

20/05/2021 4:40:04 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



MESH LAP DIAGRAM

1:20

HERDHOMES® SYSTEMS LIMITED REF #

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **MESH LAP DIAGRAM**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	20/04/21

DEVELOPED DESIGN

SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021

CHECK:

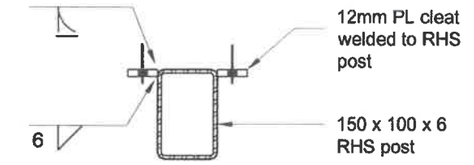
APPROVED: PETER GEDDES

PROJECT No.: 12365

SHEET: S15

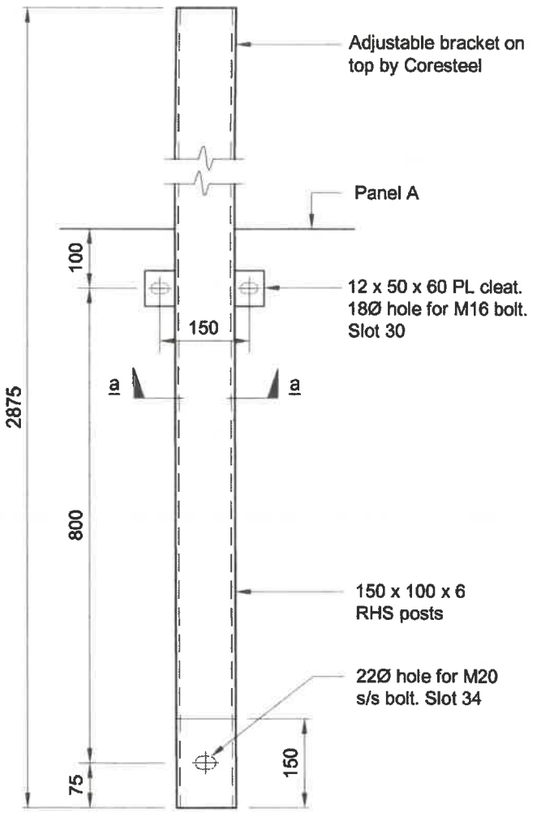
REV.: P1

20/05/2021 4:50:38 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



a - a

Plan



Elevation

SD17 / S09 **RHS POST DETAIL**

SCALE - 1:10 (REFER TO SD11 FOR FIXING)

2021 Set

HERDHOMES® SYSTEMS LIMITED REF #

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CLIENT **HERDHOMES® SYSTEMS LTD**

PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**

DRAWING **RHS POST DETAIL**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	20/05/21

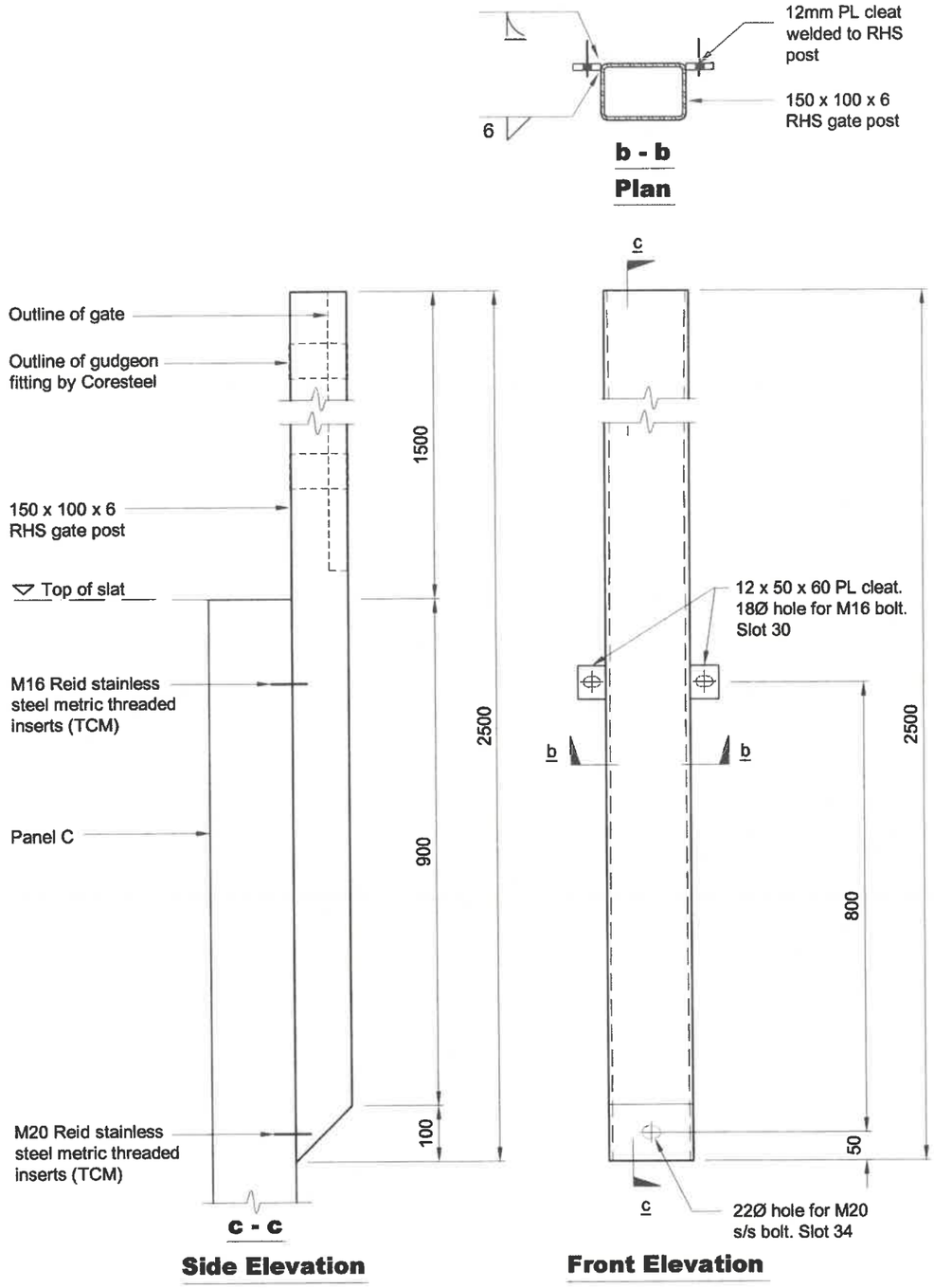
DEVELOPED DESIGN — SCALE @ A3: AS SHOWN

DRAWN: JV MAY 2021 — CHECK: — APPROVED: PETER GEDDES

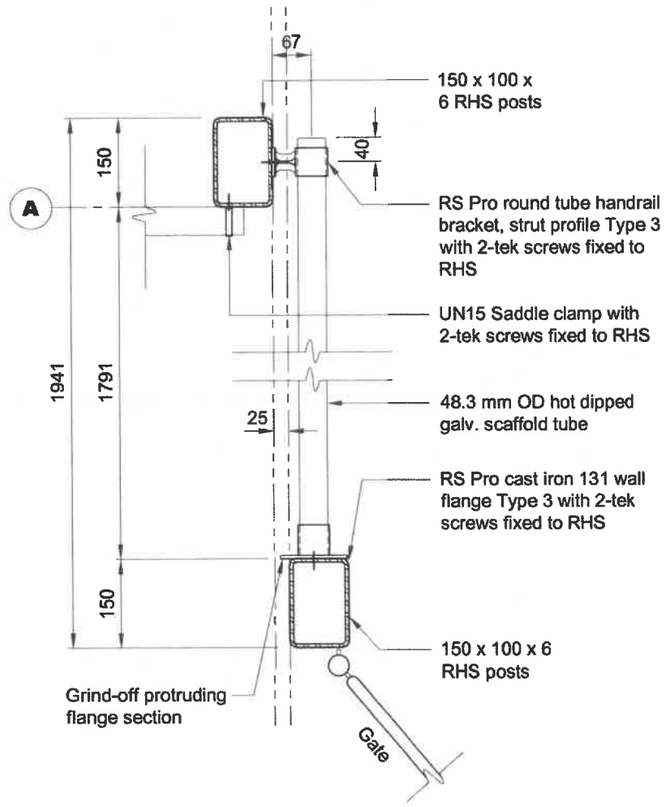
PROJECT No. **12365**

SHEET **S16** — REV. **P1**

20/05/2021 4:40:17 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg



SD18 S07 **GATE POST DETAIL AT PANEL C**
SCALE - 1:10



SD19 S07 **RAILING DETAIL**
SCALE - 1:10

2021 Set

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CLIENT **HERDHOMES® SYSTEMS LTD**
PROJECT **PROPOSED HERDHOMES® WITH 3-BUNKER, 10.8m SHED DEVELOPMENT**
DRAWING **GATE POST AND RAILING DETAILS**

REV.	REVISION DETAILS	BY	DATE
P1	ISSUED FOR CLIENT COMMENT	JV	29/04/21

DEVELOPED DESIGN
SCALE @ A3 AS SHOWN
DRAWN JV MAY 2021
CHECK
APPROVED PETER GEDDES
PROJECT No. 12365
SHEET S17
REV. P1

20/05/2021 4:40:32 PM K:\12365 HerdHomes NZ Ltd - 3 bunker 10.8m wide\10.80 Structural Set.dwg

Appendix B: File Note Titipua Overseer Oct. 21

Mo Topham
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Southland
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File Note: Titipua Ltd Partnership – Additional mitigation strategies

October 2021

1.0 Supporting information to this report:

This file note is not a standalone report. It is intended to be read in conjunction with:

- The Overseer modelling report dated 23rd March 2021 titled "Titipua Ltd Partnership – OverseerFM farm system modelling to support a consent application for expanded dairy".
- The File Note, dated June 2021 titled "File Note: Titipua Ltd Partnership – Pasture grown"
- The File Note, dated September 2021 titled "File Note: Titipua Ltd Partnership – Overseer version change"
- Titipua Ltd Partnership – Wetland mitigation calculations (Oct 2021)
- Landpro Project Memorandum written by Andrea Richardson (Nov 2021)

These reports have been attached to this file note.

2.0 Purpose of this report:

The applicant (Titipua Ltd Partnership) has instructed further modelling be undertaken following a decision to install a 200cow herd home on the property. Updates to the calculations outside of Overseer have also been completed to ensure continuity of the application and to address concerns raised by the consenting officers in the notification report.

3.0 Previously modelled losses as per file note dated September 2021:

In the most recent file note, dated September 2021, the nutrient losses were quantified under Overseer version 6.4.0. These were shown in Tables 3 and 4 of that report, and are repeated below:

Table 1. Estimated nitrogen and phosphorus losses from the current system using Overseer version 6.4.0 as per file note dated September 2021

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	10,196	1,685	11,881
N Loss/ha (kgN/ha/yr)	56	20	45
Total Farm P Loss (kg)	456	191	647
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

Table 2. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.0 as per file note dated September 2021

	Total current	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	11,881	11,434 *(11,656 modelled plus 444 baleage grass wintering minus 666 wetlands calculated outside OverseerFM)*	3.8% decrease
N Loss/ha (kgN/ha/yr)	45	43	
Total Farm P Loss (kg)	647	574 *(617 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note.*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note.*

Since then, there has been another Overseer version change to 6.4.1. This version update introduces changes to some crops and added several new crop type options. These changes have not had any effect on the losses estimated from the Titipua Ltd Partnership models as this property does not have any of the relevant crop types.

4.0 Updated modelling to include a herd home

Titipua Ltd Partnership have recently decided to install a herd home. This herd home will be able to winter 200cows and will also be used in the shoulders of the season as a feed pad. The Titipua Ltd Partnership group expect that this herd home will allow for better pasture management and supplementary feed utilisation in wet conditions. It will also enable the management team to manage a greater proportion of the cow effluent. The herd home will be built in early 2022 and will be utilised from winter 2022 onwards.

The inclusion of the herd home requires addition modelling to be completed. The changes to the system are explained in detail below.

4.1 Overseer modelling input restriction

Overseer has a data entry restriction for off paddock structures. Overseer allows only one of each structure type to be entered into the model. The structure types and a brief description are given below:

- Wintering pad/shelter

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

A wintering pad or animal shelter is a specially constructed area where animals are withheld from pasture for extended periods and supplementary feeds are brought to them.

- Feed pad
  A feed pad is a hard surface area (usually concrete) normally sited adjacent to the farm dairy where stock can be held for some time, either prior to or after milking, and provided with supplementary feed.
- Stand off pad
  A stand-off or loafing pad is a specially built area where stock can be withheld from grazing during wet periods to minimise damage to pasture. There is no provision for stock feeding while the animals are on the pad.

In the modelling completed to date, the calving pad has been modelled as an Uncovered "Wintering pad". However, with the inclusion of the Herd Home in the proposed system, it is recommended to remodel the calving pad as a "Feed pad" (in both the current and proposed systems) and model the herd home as a Covered "Wintering Pad".

The table below shows the input data used in the modelling of the calving pad to date. Changes in red have been made to the models to allow for the addition of the Herd Home in the proposed system:

Table 3. Details of changes made to the current and proposed calving pad inputs to allow for the herd home to be modelled in the proposed system.

Calving Pad	**Current System** Uncovered calving pad Feed pad Carbon rich surface (bark) Concrete base Lined Management: All animals on for24hrs/day 12hrs/day Aug – 19% of animals (98 cows) 38% of animals (196 cows) Sep – 12% of animals (61 cows) 24% of animals (122 cows) Oct – 2% of animals (10 cows) 4% of animals (20 cows) Effluent: Liquid effluent added to farm effluent system Solids are spread on the non effluent blocks in December	**Proposed system** Uncovered calving pad Feed pad Carbon rich surface (bark) Concrete base Lined Management: All animals on for24hrs/day 12hrs/day Aug – 19% of animals (118 cows) 38% of animals (236 cows) Sep – 12% of animals (73 cows) 24% of animals (146 cows) Oct – 2% of animals (12 cows) 4% of animals (24 cows) Effluent: Liquid effluent added to farm effluent system Solids are spread on the non effluent blocks in December

Please note, Overseer does not allow cows to be on a feed pad for 24hrs/day. Therefore, the number of cows on the structure has been doubled and the hours per cow has been halved to ensure that the total hours spent on the structure are the same

4.2 Additional changes to the proposed system

The addition of a herd home will cause downstream changes to how the system is operated in future. A table detailing all of the data inputs has been given in the appendices. Below is a list of inputs that have changed as a result of the inclusion of the herd home:

- Remodel "calving pad" as a "feed pad" as per the explanation above

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

- Add in a Covered wintering structure
- Reduce Fodder beet planted from 12ha to 10ha.
- Increase imported feed of PKE and DDG
- Harvest less baleage (54TDM less) but more silage (323TDM)
- Updated maintenance fertiliser requirements

4.3 Modelling results

The table below shows the modelling results. Where a value has been changed compared to tables 1 and 2 of this report, this has been shown in red. Please note that the adjustments outside of Overseer have not been updated.

Table 4. Estimated nitrogen and phosphorus losses from the current system using Overseer version 6.4.1

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	10,349	1,685	12,034
N Loss/ha (kgN/ha/yr)	57	20	45
Total Farm P Loss (kg)	458	191	649
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

Table 5. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.1

	Total current	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	12,034	10853 *(11,075 modelled plus 444 baleage grass wintering minus 666 wetlands calculated outside OverseerFM)*	9.8% decrease
N Loss/ha (kgN/ha/yr)	45	41	
Total Farm P Loss (kg)	649	580 *(623 modelled minus 43 wetlands calculated outside OverseerFM)*	10.6% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note.*

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

5.0 Updating the outside of Overseer calculations

The proposed system estimated losses included the use of calculations outside of Overseer. These calculations have been recalculated below utilising information from Overseer version 6.4.1.

6.1 Baleage grass wintering:

As explained in the March 2021 report *"OverseerFM is likely to underestimate nitrogen losses as OverseerFM is not able to adequately reflect the on-farm realities of this system. OverseerFM assumes that the pasture plants will regrow post grazing and take up urinary N from the wintering activity. However, due to the soil type and climate on the applicant's property, the plants are not viable following the winter grazing. As a result, the area is cultivated and regrassed in spring. I am unaware of any research that has quantified the impact of baleage grass wintering in terms of nitrate and phosphorus loss. I have therefore completed a desktop modelling exercise that attempts to estimate the nutrient losses from this system more accurately."*

In the March 2021 report, I explained that I had created an Overseer file that showed the baleage grass area as a very low yielding kale crop. This allowed me to add a defoliation and regrassing event to Overseer and ensured that overseer would assume no uptake of urinary N between grazing of the crop and the resowing of the pasture. Further details on how this was modelled can be found in the March 2021 report in section 4.2.1. I have undertaken the same modelling process and rerun the same calculation following the inclusion of the herd home. The results are summarised in the tables below:

Table 6. Total nitrogen losses for the kale or baleage/grass area (10ha)

	OverseerFM version 6.4.1 (No herdhome) *Taken from file note Sept 2021*	OverseerFM version 6.4.1 (Including a herdhome)
Pasture baleage system	433	343
Kale system	877	924
Difference	444kgN higher loss in the Kale system	581kgN higher loss in the Kale system

Feedback from Environment Southland in the recommending report noted that they would have liked to see an adjustment for phosphorus as well as nitrogen in the loss calculations. This had been omitted as the losses under kale were estimated to be lower than under the baleage grass system and therefore a conservative approach was taken. However, for completeness, the calculation is shown below. The same methodology has been utilised for Phosphorus as described above and in previous reports for Nitrogen.

Table 7. Total phosphorus losses for the kale or baleage/grass area (10ha)

	OverseerFM version 6.4.1 (No herdhome)	OverseerFM version 6.4.1 (Including a herdhome)
Pasture baleage system	19	19
Kale system	14	14
Difference	5kgP lower loss in the Kale system	5kgP lower loss in the Kale system

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

Therefore, it is predicted that the losses from the grass baleage wintering system will be 581kgN higher and 5kg P lower than estimated in the OverseerFM Proposed scenario.

6.2 Installation of a wetland

As per the file note "Titipua Ltd Partnership – Wetland mitigation calculations (Oct 2021)" and the subsequent peer review by Andrea Richardson of Landpro (both attached as Appendices), the proposed wetland is expected to mitigate the loss of 476kg N and 39kg P per annum.

6.3 Cumulative effects of mitigations calculated outside of Overseer

Calculations outside of Overseer have been completed to quantify the impact of the baleage grass wintering and the wetland installation. The updated loss estimates are shown in the table below. Differences, as compared to Table 5 of this report are shown in red.

Table 8. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.1

	Total current	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	12,034	11,180 *(11,075 modelled plus 581 baleage grass wintering minus 476 wetlands calculated outside OverseerFM)*	7.1% decrease
N Loss/ha (kgN/ha/yr)	45	42	
Total Farm P Loss (kg)	649	579 *(623 modelled minus 5 baleage grass wintering minus 39 wetlands calculated outside OverseerFM)*	10.8% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note. Updates to these calculations are explained within this report.*

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7.0 Conclusions:

The further modelling requested by the applicant has resulted in changes in the estimated losses of Nitrogen and Phosphorus.

Table 9. Estimated nitrogen and phosphorus losses from the current system using Overseer version 6.4.1

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	10349	1,685	12,034
N Loss/ha (kgN/ha/yr)	57	20	45
Total Farm P Loss (kg)	458	191	649
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

Table 10. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.1

	Total current	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	12,034	11,180 *(11,075 modelled plus 581 baleage grass wintering minus 476 wetlands calculated outside OverseerFM)*	7.1% decrease
N Loss/ha (kgN/ha/yr)	45	42	
Total Farm P Loss (kg)	649	579 *(623 modelled minus 5 baleage grass wintering minus 39 wetlands calculated outside OverseerFM)*	10.8% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note. Updates to these calculations are explained within this report.*

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Appendix 1: Detailed Nutrient Budget Assumptions

A detailed description of modelling inputs is shown below for the budgets included in Oct 2021 File note modelling.

Changes from the file note (dated September 2021) are shown in red. Original modelling inputs are shown in black

<table>
<tr><th>Description</th><th>Current Dairy Farm</th><th>Current Schrama's Block</th><th>Proposed Dairy platform</th></tr>
<tr><td>Area</td><td>Total: 181.5ha (as per LINZ website)
Productive farm area: 175.0ha</td><td>Total: 84.2ha (excluding the 3ha lifestyle block)
Productive farm area: 80.5ha</td><td>Total: 265.7ha
Productive farm area: 255.5ha</td></tr>
<tr><td>Dairy cows (note: cow numbers refer to those on farm on the last day of the month)</td><td>Production: 212,000kgMS (424kgMS/cow at peak)

Mean calving date: 25 Aug
Dry off date: 28 May

<table>
<tr><th>Month</th><th>Dairy Herd – Friesian
Default LWT used</th></tr>
<tr><td>Jul</td><td>315</td></tr>
<tr><td>Aug</td><td>515</td></tr>
<tr><td>Sep</td><td>508</td></tr>
<tr><td>Oct</td><td>500</td></tr>
<tr><td>Nov</td><td>500</td></tr>
<tr><td>Dec</td><td>500</td></tr>
<tr><td>Jan</td><td>500</td></tr>
<tr><td>Feb</td><td>500</td></tr>
<tr><td>Mar</td><td>485</td></tr>
<tr><td>Apr</td><td>485</td></tr>
<tr><td>May</td><td>440</td></tr>
<tr><td>Jun</td><td>315</td></tr>
</table>

Breeding bulls: 8 Jerseys, Dec and Jan</td><td>NA</td><td>Production: 254,400kgMS (424kgMS/cow at peak)

Mean calving date: 25 Aug
Dry off date: 28 May

<table>
<tr><th>Month</th><th>Dairy Herd - Friesian
Default LWT used</th></tr>
<tr><td>Jul</td><td>620</td></tr>
<tr><td>Aug</td><td>620</td></tr>
<tr><td>Sep</td><td>610</td></tr>
<tr><td>Oct</td><td>600</td></tr>
<tr><td>Nov</td><td>600</td></tr>
<tr><td>Dec</td><td>600</td></tr>
<tr><td>Jan</td><td>600</td></tr>
<tr><td>Feb</td><td>580</td></tr>
<tr><td>Mar</td><td>550</td></tr>
<tr><td>Apr</td><td>520</td></tr>
<tr><td>May</td><td>490</td></tr>
<tr><td>Jun</td><td>480</td></tr>
</table>

Breeding bulls: 9 Jerseys Dec and Jan

Note: earlier culling in proposed system</td></tr>
</table>

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<table>
<tr><th>Description</th><th>Current Dairy Farm</th><th>Current Schrama's Block</th><th>Proposed Dairy platform</th></tr>
<tr><td>Beef calves and replacements</td><td>Calves are reared on farm until early January. The dairy replacements are then grazed at a third-party grazier until their return as in calf heifers in late July (18 months later). The beef type calves are sold.

<table>
<tr><th></th><th>Dairy Calves
Breed: Friesian
Age: 1month</th><th>Beef Calves
Breed: Beef type</th></tr>
<tr><td>Jul</td><td></td><td></td></tr>
<tr><td>Aug</td><td>78</td><td>15</td></tr>
<tr><td>Sep</td><td>130</td><td>30</td></tr>
<tr><td>Oct</td><td>130</td><td>30</td></tr>
<tr><td>Nov</td><td>130</td><td>30</td></tr>
<tr><td>Dec</td><td>130</td><td>30</td></tr>
</table></td><td>NA</td><td>Calves are reared on farm and remain on farm until May 1st. The dairy replacements are then grazed at a third-party grazier until their return as in calf heifers in May (12 months later).

<table>
<tr><th></th><th>Dairy Calves
Breed: Friesian
Age: 1month</th><th>In calf heifers
Breed: Friesian
Age: 22months</th></tr>
<tr><td>Jul</td><td></td><td></td></tr>
<tr><td>Aug</td><td>9694
(mistake in original report)</td><td></td></tr>
<tr><td>Sep</td><td>156</td><td></td></tr>
<tr><td>Oct</td><td>156</td><td></td></tr>
<tr><td>Nov</td><td>156</td><td></td></tr>
<tr><td>Dec</td><td>156</td><td></td></tr>
<tr><td>Jan</td><td>156</td><td></td></tr>
<tr><td>Feb</td><td>156</td><td></td></tr>
<tr><td>Mar</td><td>156</td><td></td></tr>
<tr><td>Apr</td><td>156</td><td></td></tr>
<tr><td>May</td><td></td><td>140</td></tr>
<tr><td>Jun</td><td></td><td>140</td></tr>
</table>
Note: Change in young stock policy and removal of beef stock reared.</td></tr>
<tr><td>Sheep</td><td>NA</td><td>Modelled as an average "class 7, S.I. Finishing Otago/Southland" property using benchmarking data from Beef and Lamb NZ. The report is attached to this document.

Lambing percentage: 137%

Breed: Coopworth</td><td>NA</td></tr>
</table>

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<table>
<tr><th>Description</th><th>Current Dairy Farm</th><th>Current Schrama's Block</th><th>Proposed Dairy platform</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th></th><th>Ewes</th><th>Hoggets</th><th>Rams</th><th>Lambs</th></tr>
<tr><td>Jul</td><td>577</td><td>218</td><td>16</td><td></td></tr>
<tr><td>Aug</td><td>577</td><td>218</td><td>16</td><td></td></tr>
<tr><td>Sep</td><td>562</td><td>208</td><td>16</td><td></td></tr>
<tr><td>Oct</td><td>562</td><td>208</td><td>16</td><td></td></tr>
<tr><td>Nov</td><td>547</td><td>208</td><td>16</td><td>1002</td></tr>
<tr><td>Dec</td><td>547</td><td>208</td><td>16</td><td>868</td></tr>
<tr><td>Jan</td><td>532</td><td>208</td><td>16</td><td>738</td></tr>
<tr><td>Feb</td><td>532</td><td>208</td><td>16</td><td>608</td></tr>
<tr><td>Mar</td><td>521</td><td>208</td><td>16</td><td>478</td></tr>
<tr><td>Apr</td><td>521</td><td>208</td><td>16</td><td>348</td></tr>
<tr><td>May</td><td>379</td><td>198</td><td>16</td><td>218</td></tr>
<tr><td>Jun</td><td>379</td><td>198</td><td>16</td><td>218</td></tr>
</table>
Greasy wool: 4650kg
</td><td></td></tr>
<tr><td>In shed feeding</td><td>100% of herd fed inshed Aug – May</td><td>NA</td><td>100% of herd fed inshed Aug – May</td></tr>
<tr><td>Structures</td><td>Current System
Uncovered calving pad Feed pad
Carbon rich surface (bark) Concrete base
Lined

Management:
All animals on for24hrs/day 12hrs/day
Aug – 19% of animals (98 cows)
38% of animals (196 cows)
Sep – 12% of animals (61 cows)
24% of animals (122 cows)
Oct – 2% of animals (10 cows)
4% of animals (20 cows)

Effluent:
Liquid effluent added to farm effluent system</td><td>NA</td><td>Calving Pad
Uncovered calving pad Feed pad
Carbon rich surface (bark) Concrete base
Lined

Management:
All animals on for24hrs/day 12hrs/day
Aug – 19% of animals (118 cows)
38% of animals (236 cows)
Sep – 12% of animals (73 cows)
24% of animals (146 cows)
Oct – 2% of animals (12 cows)
4% of animals (24 cows)

Effluent:
Liquid effluent added to farm effluent system</td></tr>
</table>

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Description	Current Dairy Farm	Current Schrama's Block	Proposed Dairy platform
	Solids are spread on the non effluent blocks in December		Solids are spread on the non effluent blocks in December **Herd Home** Covered wintering shelter No lining material Management: Utilised in the shoulders of the season to feed supplements to milking cows and utilised as a wintering facility through June and July May – 100% (490) animals, 2hrs/day, June – 42% (200) animals, 24hrs/day July – 32% (200) animals, 24hrs/day August – 50% (310) animals, 2hrs/day September – 50% (305) animals, 2hrs/day
Animal distribution	No difference between blocks	No difference between blocks	No difference between blocks
Crop management	Fodder Beet 12ha planted 22TDM/ha yield Rotating through the "rolling" pasture blocks Planted in Nov – conventional cultivation 200kg/ha Cropzeal Boron boost at sowing 500kg/ha Fodder beet base at sowing 120kg/ha sustaiN applied in Jan Grazed in May and Sep for 2hr, and wintered on in June, Jul, Aug 24hrs/day. Sown into permanent pasture in October	Swedes 5.4ha planted (average as seen on Google earth) 12TDM/ha yield Rotating through the pasture blocks Planted in Dec – Conventional cultivation 325kg/ha Cropzeal boron boost at sowing 70kg/ha MOP at sowing 100kg/ha N-rich Urea in February Grazed in Jun, Jul, Aug (24hrs/day) Sown into permanent pasture in November	All cows are wintered on farm, on either Fodder Beet or a Baleage/Grass system or in the herd home as described above Fodder Beet 12ha planted 10ha planted 22TDM/ha yield Rotating through the "rolling" pasture blocks Planted in Nov – conventional cultivation 200kg/ha Cropzeal Boron boost at sowing 500kg/ha Fodder Beet Base mix at sowing 120kg/ha of SustaiN applied in Jan Grazed in May and Sep for 2hr, and wintered on in June, Jul, Aug 24hrs/day. Sown into permanent pasture in October

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Description	Current Dairy Farm	Current Schrama's Block	Proposed Dairy platform
			10ha Baleage/Grass wintering This area rotates around the "rolling" pasture blocks. 205TDM baleage is fed out in paddock throughout the winter. The paddocks are then regrassed following the winter *Note: OverseerFM is not able to effectively model a Southland Baleage Grass wintering system. This block has therefore been modelled as a pastoral block and an adjustment to expected losses has been calculated outside of OverseerFM*
Imported Supplements	Silage – 150tDM fed in paddock and on feed pad Hay – 13TDM fed on feed pad PKE – 200TDM fed in shed DDG – 130TDM fed in shed Baleage – 120TDM fed on the crop	None	PKE – 265TDM 290TDM fed in shed DDG – 175TDM 195TDM fed in shed
Exported supplements	None	None	None
Harvested supplements	Hay – 17TDM fed on the pad Baleage – 24TDM fed on the crop	None	Hay – 36TDM fed on the feed pad Baleage – 144TDM 90TDM fed on the Fodder beet Baleage – 205TDM fed on the baleage grass wintering paddocks Silage – 48TDM fed on the pad and 323TDM fed in the herd home
Soil Fertility	Soil tests were completed in July 2019 Olsen P of 34 QT K of 7 QT Ca of 9 QT Mg of 17	Soil tests were completed in November 2019 Olsen P of 34 QT K of 9 QT Ca of 9 QT Mg of 17	Soil fertility would be targeted at agronomic optimum Olsen P of 30 QT K of 7 QT Ca of 9

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Description	Current Dairy Farm	Current Schrama's Block	Proposed Dairy platform
	QT Na of 6 SO_4 of 13	QT Na of 9 SO_4 of 13	QT Mg of 17 QT Na of 6 SO_4 of 13
Fertiliser	Fertiliser applied to maintenance level. Total P applied – 5,380kg Total K applied – 814kg Total S applied – 3,642kg	Fertiliser applied to maintenance level. Total P applied – 2,070kg Total K applied – 357kg Total S applied – 1,2750kg	Fertiliser applied to maintenance level. Total P applied – 7,728kg 7108kg Total K applied – 7,222kg 6066kg Total S applied – 5,855kg 5280kg
Pastoral Nitrogen Fertiliser	239kgN/ha was applied to the pasture area in split application between Sep and Apr	Taken from fertiliser purchase records 18kg/ha N applied in March	Non Effluent paddocks – 175kgN/ha applied in split applications from Sep – Apr Effluent paddocks – 154kgN/ha applied in split applications from Sep to Apr *Note: No nitrogen fertiliser applied to the baleage grass paddocks in April prior to wintering on them*
Drainage	50% of the property is drained using mole and tile drainage	50% of the property is drained using mole and tile drainage	50% of the property is drained using mole and tile drainage
Effluent system	Holding pond – solids are separated Effluent is applied using a cobra rain gun at an application depth of 12-24mm Liquid effluent is applied to the "eff" blocks Solids are spread on the Non effluent blocks when conditions allow (usually December)	NA	Holding pond – solids are separated Effluent is applied using a cobra rain gun at an application depth of 12-24mm Liquid effluent is applied to the "eff" blocks Solids are spread on the Non effluent blocks when conditions allow (modelled as December)

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Titipua Ltd Partnership

OverseerFM farm system modelling to support
a consent application for expanded dairy

Report prepared for:
Titipua Ltd Partnership
336 Hedgehope Block road
Invercargill

Property Address:
425 Hedgehope Block road
RD2
Invercargill 9872

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23rd March 2021

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1.0 Executive summary:

Titipua Ltd Partnership operate a 181.5ha dairy farm located south of Hedgehope in Central Southland. The farm is currently consented to milk 600 cows. Over the last three seasons the property has milked on average 500 cows at peak, producing 212,000kgMS. Most of the property is rolling although there is a small amount of flat land at the back of the farm running along the Titipua Stream. Currently, 315 cows are wintered on farm on 12ha of Fodder beet.

In mid 2020, the Titipua Ltd Partnership purchased a neighbouring 87.2ha sheep property known as the Schrama block. Upon purchasing the property, the Titipua Ltd Partnership started the process of subdividing and selling 3ha of the Schrama block (including the house and yards).

It is proposed to convert the remaining Schrama block land (84.2ha) and incorporate it into the dairy platform. Cow numbers would increase to 600 at peak producing 254,400kgMS. All cows would be wintered on farm on either a Fodder beet crop or on a grass/baleage system.

Nutrient budgeting has been completed using Overseer version 6.3.5 to support a consent application for expanded dairy. These budgets estimate the nitrogen and phosphorus losses from the farm. Three budgets have been completed:

- The current dairy farm system
  This has been modelled as the average of the last three seasons (17-18, 18-19 and 19-20 seasons).
- The Schrama block
  Please note, detailed records of how the block was operated were not available as the previous owner has died since the property was purchased. As a result, the property has been modelled as an average "Class 7 South Island Finishing" using information in the Beef and Lamb NZ Economic survey (a link to this report is given in the appendices).
- The proposed dairy system
  This has been modelled as a status quo system milking 600cows at peak. Further calculations outside of OverseerFM have been completed to quantify the effect of wintering approximately half of the herd on a baleage/grass system and installing a wetland on farm.

1.1 Nutrient loss estimates including calculations outside of OverseerFM

The table below shows the estimated nutrient losses from the current landuse on the dairy farm and Schrama blocks.

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	11,315	1,738	13,053
N Loss/ha (kgN/ha/yr)	62	21	49
Total Farm P Loss (kg)	455	190	645
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

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The table below compares the estimated nutrient losses from the current landuse with the estimated losses under the proposed system.

	Total current (same as above)	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	13,035	12,181 *(12,749 modelled plus 173 baleage grass wintering minus 741 wetlands calculated outside OverseerFM)*	6.7% decrease
N Loss/ha (kgN/ha/yr)	49	46	
Total Farm P Loss (kg)	645	572 *(615 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2.*

1.2 Drivers of changes in nutrient losses

1.2.1 Nitrogen loss estimates

Nitrogen losses from a farm system can have negative impacts on water quality downstream. This in turn can have negative implications on aquatic life and human health. The use of OverseerFM alongside external calculations has estimated a 6.7% decrease in nitrogen losses between the current and proposed scenarios. This is the cumulative result of many changes to the farm system including:

- A change in culling policy meaning that culls leave the property earlier in the season
- A reduction in imported feed
- Greater use of the calving pad in spring
- Reduced nitrogen fertiliser use

It should also be noted that in the proposed system there will be a reduction in the off-site effect of wintering as all cows will be wintered on farm. There will also be a reduction in the off site effect of the young stock grazing due to a change in grazing policy with these animals. These reductions in offsite effects have not been quantified.

1.2.2 Phosphorus loss estimates

Phosphorus losses from the farm can cause algal growth in surface waterways. The use of OverseerFM alongside external calculations has estimated a 11.3% decrease in Phosphorus losses in the proposed system. Key changes include:

- Reducing the farm Olsen P to 30 and therefore reduce maintenance fertiliser P requirements
- A larger area available for spreading solid effluent

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2.0 Report purpose

The results of the budgets will be utilised to support a land use consent application for expanded dairying and the introduction of dairy support.

This report will emphasise the relevant requirements in the proposed Southland Water and Land Plan, and the National Environmental Standards from a nutrient budgeting perspective. The broader range of requirements should be captured in the Farm Environmental Management Plan (FEMP). This report will inform the FEMP which will be completed separately.

Potential environmental risks on the property have been considered and should be included in the FEMP. These include:

- Contamination of ground water
- Contamination of surface water
- Undesired changes in soil nutrient status
- Nutrient application to non-target land
- Accumulation of non-nutrient impurities in the soil profile
- Excess stocking rate
- Pugging and compaction
- Poor cultivation methods

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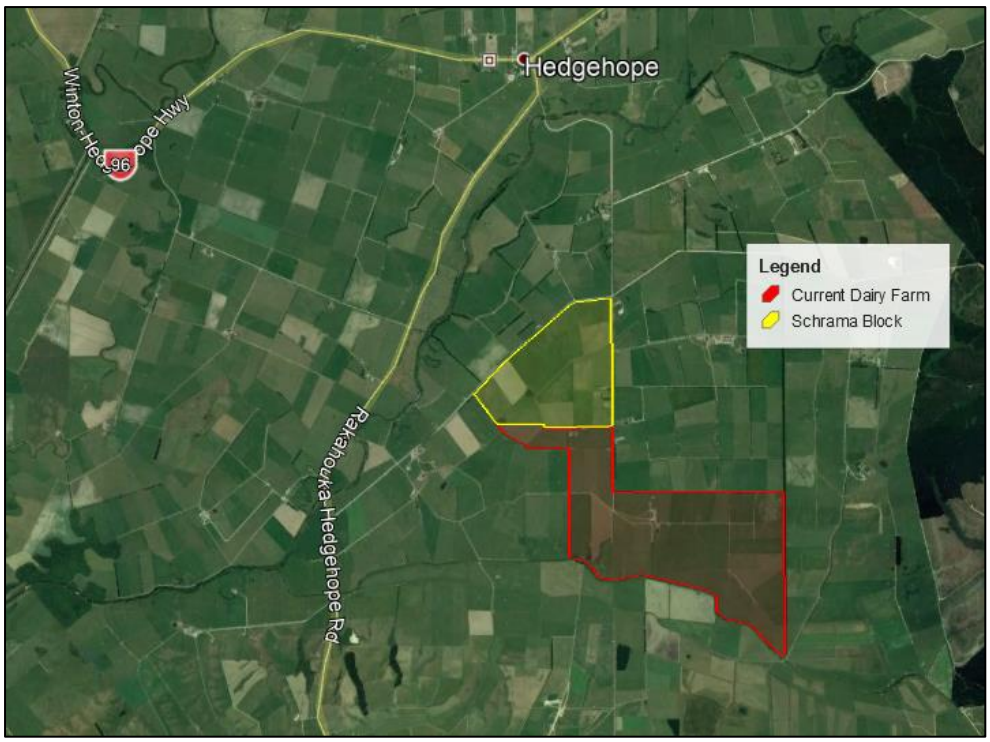
3.0 Farm overview

3.1 Ownership

The property is owned by the Titipua Ltd Partnership.

3.2 Location



3.3 Farm particulars:

Address	Titipua Ltd Partnership 425 Hedgehope Block road RD2 Invercargill 9872
Legal Description	Current Dairy Platform: • Lot 1 and 2 Deposited Plan 386399 • Lot 1 Deposited Plan 470872 • Lot 2 Deposited Plan 4406 • Lot 2 Deposited Plan 420431 • Lot 3 Deposited Plan 1494 Schrama block • Lot 1 Deposited Plan 4406 – please note, 3ha (the house and stock yards) is in process of being subdivided from this block and sold.
Area	Current dairy platform: 181.5ha Schrama block: 87.2ha (before subdivision) - 3.0ha to be subdivided and sold from Schramas Total area for proposed system: 265.7744ha

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3.4 Farm system overview

A detailed description of the modelling methodology and Overseer input data is given in the appendices of this report. This section gives an overview of the farm system modelled in each budget.

3.4.1 Current Dairy Platform

A budget was completed for the average of the last three seasons (2017-18, 2018-19 and 2019-20)

Stock and production:

- 500 cows were milked at peak
- Average seasonal production of 212,000kgMS
- 130 dairy young stock were reared on farm. They were grazed at a third party graziers property from 1st January until returning as incalf heifers
- 30 beef type calves were reared on farm each year and sold in early January
- 315 cows were wintered on the platform on a fodder beet crop while the remaining cows were wintered off farm with a third party grazier

Feed

- Imported feed was:
  - PKE - 200tDM fed in shed
  - Hay – 13tDMfed on the pad
  - DDG – 130tDM fed in shed
  - Baleage – 120tDM fed on the crop
  - Silage – 150TDM fed in paddock or on the calving pad
- An average of 17tDM hay and 24tDM Baleage were harvested on the property each year
- The farm has grown on average 12ha of Fodder beet each year. This is utilised on the shoulders of the season as well as for wintering 315 cows.

Fertiliser

- Soil test results from July 2019 have been used in the nutrient budget. These tests show that the property is operating at, or slightly higher than, optimum soil fertility levels.
- Maintenance fertiliser rates have been entered into Overseer.
- Farm nitrogen was 239kgN/ha applied in split dressings from September to April.

Structures

- Dairy effluent is separated into solids and liquids. The liquid portion is applied to a 99.7ha effluent area using a cobra rain gun. The solid portion is applied during dry weather (usually December) to the non-effluent portion of the property.
- The farm has a calving pad. This is utilised in Aug, Sep and Oct for springer cows. The structure is uncovered with a bark chip base and is fully lined. Liquid effluent is added to the dairy shed effluent system. The solid effluent portion is spread on the non effluent blocks when conditions allow (usually December).

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- There is an inshed feeding system installed on farm. This is utilised throughout the milking season when there is a pasture deficit

3.4.2 Schrama Block current system

A budget was completed to estimate the nitrogen and phosphorus losses from the current management of the Schrama block.

Please note, detailed information of the management of the block was unavailable due to the death of the previous owner. Therefore, a nutrient budget has been created using data from the Beef and Lamb NZ economic survey alongside information available from Google earth and the purchaser.

The Schrama block is 87.2ha in total. Upon purchasing the property, the Titipua Ltd Partnership started the process of subdividing and selling 3ha of the Schrama block (including the house and yards).

Stock and production:

- The farm was operated as a sheep property wintering on swedes
- Stock numbers and production have been assumed using information from the Beef and Lamb NZ economic survey. It was considered that the farm is most similar to the "Class 7 South Island, Finishing Otago/Southland" benchmark.
- Wintered sheep numbers are assumed to be:
  - 577MA ewes
  - 218 Hoggets
  - 16 rams
- A 137% lambing rate is achieved (measured as lambs at tailing compared to those mated)
- 4650kg greasy wool is sold

Feed

- An average of 5.4 ha of swedes were planted over the last three seasons. This was verified using Google earth imagery. Fertiliser records were utilised to determine an average crop fertiliser policy for the three years.
- No feed is imported or exported from the property

Fertiliser

- Soil test taken in Nov 2019 and Nov 17 were available. They show that the farm Olsen P averaged 34 and 35 respectively.
- Maintenance fertiliser rates have been entered into Overseer for the pastoral blocks.
- Fertiliser purchase records show that a small application of nitrogen was made to the pastoral area each year. Therefore, it has been assumed that an application of 18kgN/ha is made in March each year.

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3.4.3 Proposed Dairy System

A budget was completed for the proposed dairy system

Stock and production:

- 600 cows will be milked at peak
- Production is expected to be 254,400kgMS
- 156 dairy young stock would be reared on farm. They would be grazed on farm until the 1st May when they would be grazed at a third party graziers property. In the following May, 140 in calf heifers will return to the property and be wintered on farm
- The entire herd would be wintered on farm on either a fodder beet crop or a baleage grass wintering system

Feed

- Imported feed in an average season is estimated to be:
  - PKE – 265tDM fed in shed
  - DDG – 175tDM fed in shed
- It is expected that the farm will harvest 48tDM of silage, 349tDM baleage and 36tDM hay
- No feed will be exported
- The farm will grow 12ha of Fodder beet each year. This would be utilised on the shoulders of the season as well as for wintering. A further 10ha would be utilised for a baleage grass wintering system.

Fertiliser

- Soil fertility will target the agronomic optimum. This will mean a decrease in Olsen P from 34 to 30.
- Maintenance fertiliser rates have been entered into Overseer.
- Farm nitrogen use will be reduced on the dairy platform although there will be an increase in nitrogen applied to the Schrama Block.
  - 175kgN/ha on the non effluent blocks (Sep – Apr)
  - 154kgN/ha on the effluent blocks (Sep- Apr)

Structures

- Dairy effluent is separated into solids and liquids. The liquid portion is applied to a 99.7ha effluent area using a cobra rain gun. The solid portion is during dry weather (usually December) to the non-effluent portion of the property.
- The farm has a calving pad. This is utilised in Aug, Sep and Oct for springer cows. The structure is uncovered with a bark chip base and is fully lined. Liquid effluent is added to the dairy shed effluent system. The solid effluent portion is spread on the non-effluent blocks when conditions allow (usually December).

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4.0 OverseerFM nutrient loss estimates

4.1 OverseerFM loss estimates

Nutrient budgets have been prepared to support the assessment of effects of the current and proposed dairy systems. The table below shows the OverseerFM version 6.3.5 estimated nutrient losses from the current landuse on the dairy farm and Schrama blocks.

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	11,315	1,738	13,053
N Loss/ha (kgN/ha/yr)	62	21	49
Total Farm P Loss (kg)	455	190	645
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

The table below compares the OverseerFM version 6.3.5 estimated nutrient losses from the current landuse with the estimated losses under the proposed system.

	Total current (same as above)	Proposed
Area (ha)	265.7	265.7
Total Farm N Loss (kg)	13,053	12,749
N Loss/ha (kgN/ha/yr)	49	48
Total Farm P Loss (kg)	645	615
P loss/ha (kgP/ha/yr)	2.4	2.3
Pasture Grown (tDM/ha)		16.1

4.1.1 Notes for interpretation of OverseerFM outputs

Estimated pasture grown

It should be noted that the estimated pasture grown outputs from Overseer are higher than expected. Overseer uses a default value for ryegrass/white clover pasture quality irrespective of the land use and management. The default Overseer value in Southland ranges from 10.5 to 11.17 MJ ME/ kg DM depending on the month (reference: Characteristics of pasture, June 2018, D M Wheeler AgResearch Ltd). Pasture cuts from an Eastern Southland monitor farm show MEs of 11.5 to 12.2 (reference: Pasture growth and quality on Southland and Otago dairy farms, D. E. Dalley and T. Geddes, DairyNZ, NZ Grasslands Publication 2012).

The Overseer default values have been used throughout the entirety of this modelling as the Best Practice Data Input Standards state that "*there needs to be a very good long-term average evidence of clover content, pasture utilisation, pasture N content and pasture quality to justify changes from the default OVERSEER values. This level of information would be rare.*"

To ensure that comparisons are valid between the baseline and proposed the same method has been used to ensure that an "apples with apples" approach is taken.

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4.2 Calculations outside of OverseerFM

Calculations outside of OverseerFM have been completed to account for the baleage grass wintering system and the installation of a wetland on farm. These mitigations cannot be modelled within OverseerFM.

4.2.1 Baleage grass wintering:

OverseerFM has estimated that the loss of nitrogen from the grass baleage system is 523kgN (or 52kgN/ha). Modelling of the grass baleage wintering system in OverseerFM is likely to underestimate nitrogen losses as OverseerFM is not able to adequately reflect the on-farm realities of this system. OverseerFM assumes that the pasture plants will regrow post grazing and take up urinary N from the wintering activity. However, due to the soil type and climate on the applicant's property, the plants are not viable following the winter grazing. As a result, the area is cultivated and regrassed in spring.

I am unaware of any research that has quantified the impact of baleage grass wintering in terms of nitrate and phosphorus loss. I have therefore completed a desktop modelling exercise that attempts to estimate the nutrient losses from this system more accurately.

The following assumptions have been made:

- Same as the proposed system file
    - Soils / climatic conditions
    - Tile drains
    - Stock numbers
    - Imported / exported supplement
    - Fertiliser and nitrogen use

- Different from the proposed system file
    - Used kale instead of pasture to allow a defoliation event and regrassing activity
    - Used kale as has a similar crude protein to average quality pasture
    - Reduced yield of kale to 3TDM/ha to reflect pasture accumulated for winter in practice
    - Regrassed the area in October in line with when the applicant would usually regrass following a grass baleage wintering event
    - Direct drilled kale (rather than conventional cultivation to minimise the impact of the mineralisation of N during cultivation)

Overseer predicted that the losses from the Kale block would be 70kgN/ha (total of 696kgN lost for the 10ha wintered on). Without comparative research, it is difficult to assess the accuracy of the above results. However, from a common sense perspective, losses from the baleage grass system are likely to be more comparable to a traditional fodder crop paddock than a permanent pasture paddock.

Therefore, it is predicted that the losses from the grass baleage wintering system will be 173kgN higher than estimated in the OverseerFM Proposed scenario.

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4.2.2 Installation of a wetland

Titipua Ltd Partnership have sought advice from David Moate of the Environment Southland Land Sustainability team regarding the opportunity to install a wetland on the property. David Moate visited the property in January 2021 to identify potential wetland locations, construction, and effectiveness. A short report was then completed to give an estimate of the potential effectiveness of a wetland. This report is attached in full in the appendices.

Titipua Ltd Partnership have agreed to install a wetland in the South Western corner of the property as per David Moate's recommendation. The photo below, taken from David's report, shows the site of the wetland (blue), the catchment area (green outline) and the land titles (red). For orientation purposes, I have marked on the map where the cowshed is with a blue cross.

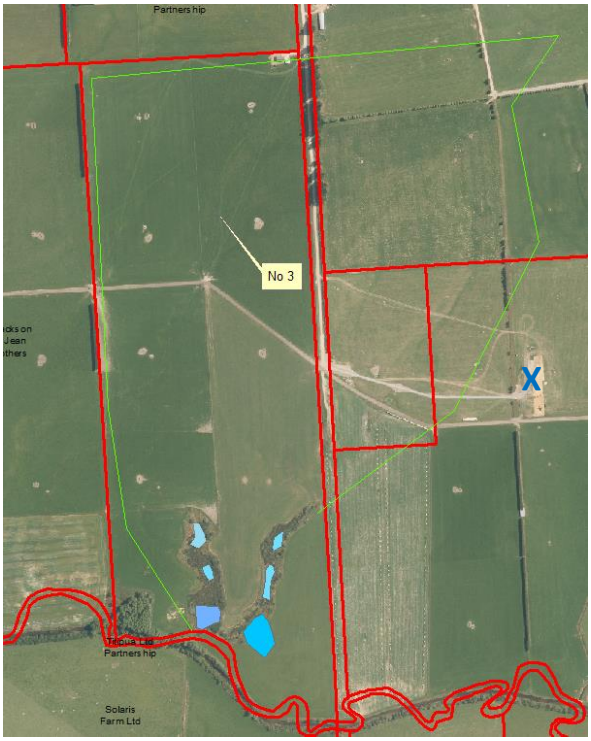

Figure 1. Site of wetland (from David Moate report)

David has estimated that this wetland has a 50ha catchment of land. However, some of this catchment area is outside the Titipua Ltd Partnership farm boundary (North eastern corner). Of the 50ha in the wetland catchment, approximately 38ha is within the Titipua Ltd Partnership farm boundary. The tables below calculate expected reduction in nitrogen and phosphorus loss from the 38ha within the farm boundary.

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The table below calculates the expected amount of nitrogen captured by the wetland. Total nitrogen losses captured in the wetland are estimated to be 741kgN/annum.

Overseer block name	Area (ha)	OverseerFM estimated nitrogen leaching loss (kgN/ha)	Reduction in N leaching due to wetland (from David Moate's report) (%)	Total reduction (kgN) (Ha x kgN/ha x %)
Non-Eff, Rolling – Puke, Apar	32.2	40.6	50	653.66
Eff, Rolling – Puke, Apar	2.1	43.0	50	45.15
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.7			
Total block Nitrogen loss mitigated	**38.0**			**698.81**
Plus reduction in other sources losses	38/265.7	589	50	42.12
Total farm Nitrogen loss mitigated				**740.93**

The table below calculates the expected amount of phosphorus captured by the wetland. Total phosphorus losses captured in the wetland are estimated to be 43.13kgP/annum.

Overseer block name	Area (ha)	OverseerFM estimated P loss (kgP/ha)	Reduction in P loss due to wetland (from David Moate's report) (%)	Total reduction (kgP) (Ha x kgP/ha x %)
Non-Eff, Rolling – Puke, Apar	32.2	2.14	48	33.08
Eff, Rolling – Puke, Apar	2.1	2.20	48	2.22
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.7			
Total block Phosphorus loss mitigated	**38.0**			**35.3**
Plus reduction in other sources losses	38/265.7	114	48	7.83
Total farm Phosphorus loss mitigated				**43.13**

Therefore, it is predicted that the wetland will reduce nutrient losses from the proposed dairy system by 741kgN and 43kgP.

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5.0 Conclusions

5.1 Nutrient loss estimates including calculations outside of OverseerFM

The table below shows the estimated nutrient losses from the current landuse on the dairy farm and Schrama blocks.

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	11,315	1,738	13,053
N Loss/ha (kgN/ha/yr)	62	21	49
Total Farm P Loss (kg)	455	190	645
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

The table below compares the estimated nutrient losses from the current landuse with the estimated losses under the proposed system.

	Total current (same as above)	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	13,053	12,181 *(12,749 modelled plus 173 baleage grass wintering minus 741 calculated outside OverseerFM)*	6.7% decrease
N Loss/ha (kgN/ha/yr)	49	46	
Total Farm P Loss (kg)	645	572 *(615 modelled minus 43 calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

5.2 Drivers of changes in nutrient losses

5.2.1 Nitrogen Loss estimates

Nitrogen losses from a farm system can have negative impacts on water quality downstream. This in turn can have negative implications on aquatic life and human health.

OverseerFM has estimated a 6.7% decrease in nitrogen losses between the current and proposed scenarios. This is the cumulative result of many changes to the farm system including:

- A change in culling policy meaning that culls leave the property earlier in the season
- A reduction in imported feed
- Greater use of the calving pad in spring
- Reduced nitrogen fertiliser use

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It should also be noted that in the proposed system there will be a reduction in the off-site effect of wintering as all cows will be wintered on farm. There will also be a reduction in the off site effect of the young stock grazing due to a change in grazing policy with these animals. This reduction in offsite effects has not been quantified.

5.2.2 Phosphorus loss estimates

Phosphorus losses from the farm can cause algal growth in surface waterways. OverseerFM has estimated a 11.3% decrease in Phosphorus losses in the proposed system. Key changes include:

- Reducing the farm Olsen P to 30 and therefore reduce maintenance fertiliser P requirements
- A larger area available for spreading solid effluent

5.3 Recommendations from here

OverseerFM can model a specific range of good management practices. Below is a summary of the potential environmental risks on this property and gives recommendations to mitigate these risks.

Good practice for fertiliser use:

- Regular soil testing is used to inform fertiliser recommendations that target agronomic optimum P, K, S, Mg and Ca levels.
- Develop a fertiliser plan with your fertiliser representative. Recommend you make this OverseerFM modelling available to your fertiliser representative to assist them in developing the fertiliser recommendations.
- Apply using a Spreadmark accredited company for fertiliser application – apply at correct rate and with a buffer to waterways.
- Use of Fertmark registered products.
- Record fertiliser applications (location, date of application and amount applied).

Nitrogen:

- Apply nitrogen strategically to meet plant demand.
- Applications should generally be avoided in May due to rapidly declining growth rates.
- Spring nitrogen applications should not be on soil less than 7 degrees Celsius.

Phosphorus:

- OverseerFM is not spatially explicit and a phosphorus mitigation plan should be developed to reduce phosphorus losses.

Critical source areas:

- These include laneways, gateways, swales in paddocks and wallows.
- Review your Farm Environmental Management Plan to update as required and take action on mitigating risk on any new critical source areas identified.

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The Proposed Water and Land Plan is currently in the appeals process and is partially operative. It will be important to stay up to date with developments in Environment Southland policy and rules, including the limit setting process which will develop over the next few years.

A National Environmental Standard (NES) has recently been gazetted. This has implications for the wintering of stock on crop, stock exclusion from waterways, nitrogen fertiliser use, changes in landuse and the use of stockholding areas for cattle.

Both the Proposed Water and Land Plan and the National Environmental Standards require a farm of this size to have a farm environmental management plan. This should be updated to include the recommendations within this report.

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Appendices

Appendix 1. Modelling Methodology

Nutrient losses have been estimated using the OverseerFM Version 6.3.5 model. OverseerFM is a software application that models nutrient movements within a farm system. Input data detailing the farm system is entered into the software and interpreted through the use of a series of sub-model that calculate the flow of seven major farm nutrients (Nitrogen, Phosphorus, Sulphur, Calcium, Magnesium and Sodium). Output data is reported for interpretation and to inform farm management practices. It currently requires an expert user to describe the physical and management details of a farm.

OverseerFM assumptions

Within the OverseerFM software, assumptions have been made of the farm management:

- 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
  OverseerFM assumes the property is managed at industry agreed good management practice for a specific list of factors including effluent and fertiliser applications. OverseerFM does not assume that all industry agreed good management practices are undertaken on farm.

OverseerFM limitations

Key limitations of the OverseerFM model are:

- OverseerFM does not predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving water body. A catchment model is needed to estimate the effects of the nutrient losses from farms on groundwater, river or lake water quality.
- OverseerFM does not calculate outcomes from extreme events (floods and droughts) but provides a typical years result based on a long-term average.
- OverseerFM does not calculate the impacts of a conversion process, rather it predicts the long-term annual average nutrient budgets for changed land use.
- OverseerFM 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 OverseerFM model.
- OverseerFM does not represent all farm systems in New Zealand.
- Components of OverseerFM have not been calibrated against measured data from every combination of farm systems and environment.

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Information on OverseerFM can be obtained from the following reports:

- Technical Description of OVERSEER for Regional Councils, September 2015
- Review of the phosphorus loss submodel in OVERSEER®, September 2016
- Using OVERSEER® in Regulation – Technical Resources and Guidance for Regional Councils, August 2016

Data input standards

Nutrient budgets have been constructed using the OverseerFM Version 6.3.5 model.

The nutrient budgets have been developed in accordance with the Overseer data input protocols - "Overseer, Best Practice Data Input Standards, March 2018" and the "OverseerFM User Guide, October 2019." No deviations have been made from these protocols.

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Appendix 2. Modelling Inputs

Soil types

Soil type has a large bearing on nutrient loss levels from a property. This is due to different soil types having different water holding capacities, and drainage characteristics. It is therefore important that soil type is inputted correctly.

The table below gives a brief description of the soil types found on the Titipua Ltd Partnership and Schrama property.

S-map ref	Soil Order and Group	Drainage class	Description
Pukem_6a.1	Pallic, Recent/yge/bge	Poor	Moderately deep, poorly drained, silt over clay
Apar_2a.1	Brown, Sedimentary	Imperfect	Deep, imperfectly drained, silt over clay
Makar_3b.1	Gley, Sedimentary	Poor	Deep, poorly drained, clay
Paro_4a.1	Gley, Sedimentary	Poor	Deep, poorly drained, silt
Ymai_25a.1	Gley, Sedimentary	Poor	Deep, poorly drained, loamy peat over silt
Makar_4c.1	Gley, Sedimentary	Poor	Moderately deep, poorly drained, clay

The table below shows the area and the proportion of the block that the soils identified covered:

S-map ref	Total area	% of productive blocks
Pukem_6a.1	127.7 ha	50.0%
Apar_2a.1	85.1 ha	33.3%
Makar_3b.1	22 ha	8.6%
Paro_4a.1	9.2 ha	3.6%
Ymai_25a.1	6.1 ha	2.4%
Makar_4c.1	5.4 ha	2.1%

Climate Data

The following climate information has been used from the OverseerFM climate station tool:

	Current dairy platform	Current Schrama block	Proposed dairy platform
Annual Rainfall (mm)	1122 – 1130	1122	1121 – 1130
Mean Annual Temp (°C)	10 – 10.1	10	10 – 10.1
Annual PET (mm)	735 – 744	734	734 – 744

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Blocks

The farms have been split into the following pastoral, riparian and fodder crop blocks based on soil type, contour, drainage and land use.

	Topography	Current dairy platform	Current Schrama block	Proposed dairy platform
			Area (ha)	
Pasture blocks				
Non-effluent				
Non eff, flat - makar, paro	Flat	18.2		18.2
Non eff, flat - ymai	Flat	2.8		2.8
Non eff, rolling - makar	Rolling	4.3		4.1
Non eff, rolling - puke, apar	Rolling	49.5		47.3
Non eff, rolling - makar, paro	Rolling	0.5		0.5
Effluent				
Eff, flat - makar, paro	Flat	2.0		2.0
Eff, flat - puke, apar	Flat	7.2		7.2
Eff, flat - ymai	Flat	3.3		3.3
Eff, rolling - makar, paro	Rolling	2.3		2.3
Eff, rolling - puke, apar	Rolling	84.9		80.9
Schrama block				
Schrama, non eff, rolling - puke, apar	Rolling		71.2	68.0
Schramas, non eff, rolling makar	Rolling		9.3	8.9
Baleage Grass Wintering Blocks				
Baleage/Grass – Non Eff, Makar	Rolling			0.2
Baleage/Grass – Non Eff, Puke Apar	Rolling			2.2
Baleage/Grass – Eff, Puke Apar	Rolling			4.0
Baleage grass - schrama, rolling puke apar	Rolling			3.2
Baleage grass - schrama, rolling, makar	Rolling			0.4
	Productive Block Area	**175.0**	**80.5**	**255.5**
	Riparian area	1.9		1.9
	Non-effective area	4.6	3.7	8.3
	Total area	**181.5**	**84.2**	**265.7**
Rotating fodder crops				
Fodder beet		12		12
Swedes			5.4	

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Farm System Inputs

<table>
<tr><th>Description</th><th>Current Dairy Farm</th><th>Current Schrama's Block</th><th>Proposed Dairy platform</th></tr>
<tr><td>Area</td><td>Total: 181.5ha (as per LINZ website)
Productive farm area: 175.0ha</td><td>Total: 84.2ha (excluding the 3ha lifestyle block)
Productive farm area: 80.5ha</td><td>Total: 265.7ha
Productive farm area: 255.5ha</td></tr>
<tr><td>Dairy cows</td><td>Production: 212,000kgMS (424kgMS/cow at peak)

Mean calving date: 25 Aug
Dry off date: 28 May

<table>
<tr><th>Month</th><th>Dairy Herd – Friesian
Default LWT used</th></tr>
<tr><td>Jul</td><td>315</td></tr>
<tr><td>Aug</td><td>515</td></tr>
<tr><td>Sep</td><td>508</td></tr>
<tr><td>Oct</td><td>500</td></tr>
<tr><td>Nov</td><td>500</td></tr>
<tr><td>Dec</td><td>500</td></tr>
<tr><td>Jan</td><td>500</td></tr>
<tr><td>Feb</td><td>500</td></tr>
<tr><td>Mar</td><td>485</td></tr>
<tr><td>Apr</td><td>485</td></tr>
<tr><td>May</td><td>440</td></tr>
<tr><td>Jun</td><td>315</td></tr>
</table>

Breeding bulls: 8 Jerseys, Dec and Jan</td><td>NA</td><td>Production: 254,400kgMS (424kgMS/cow at peak)

Mean calving date: 25 Aug
Dry off date: 28 May

<table>
<tr><th>Month</th><th>Dairy Herd - Friesian
Default LWT used</th></tr>
<tr><td>Jul</td><td>620</td></tr>
<tr><td>Aug</td><td>620</td></tr>
<tr><td>Sep</td><td>610</td></tr>
<tr><td>Oct</td><td>600</td></tr>
<tr><td>Nov</td><td>600</td></tr>
<tr><td>Dec</td><td>600</td></tr>
<tr><td>Jan</td><td>600</td></tr>
<tr><td>Feb</td><td>580</td></tr>
<tr><td>Mar</td><td>550</td></tr>
<tr><td>Apr</td><td>520</td></tr>
<tr><td>May</td><td>490</td></tr>
<tr><td>Jun</td><td>620</td></tr>
</table>

Breeding bulls: 9 Jerseys Dec and Jan

Note: earlier culling in proposed system</td></tr>
<tr><td>Beef calves and replacements</td><td>Calves are reared on farm until early January. The dairy replacements are then grazed at a third-party grazier until their return as in calf heifers in late July (18 months later). The beef type calves are sold.

<table>
<tr><th></th><th>Dairy Calves
Breed: Friesian
Age: 1month</th><th>Beef Calves
Breed: Beef type</th></tr>
<tr><td>Jul</td><td></td><td></td></tr>
<tr><td>Aug</td><td>78</td><td>15</td></tr>
<tr><td>Sep</td><td>130</td><td>30</td></tr>
<tr><td>Oct</td><td>130</td><td>30</td></tr>
<tr><td>Nov</td><td>130</td><td>30</td></tr>
<tr><td>Dec</td><td>130</td><td>30</td></tr>
</table></td><td>NA</td><td>Calves are reared on farm and remain on farm until May 1st. The dairy replacements are then grazed at a third-party grazier until their return as in calf heifers in May (12 months later).

<table>
<tr><th></th><th>Dairy Calves
Breed: Friesian
Age: 1month</th><th>In calf heifers
Breed: Friesian
Age: 22months</th></tr>
<tr><td>Jul</td><td></td><td></td></tr>
<tr><td>Aug</td><td>96</td><td></td></tr>
<tr><td>Sep</td><td>156</td><td></td></tr>
<tr><td>Oct</td><td>156</td><td></td></tr>
<tr><td>Nov</td><td>156</td><td></td></tr>
<tr><td>Dec</td><td>156</td><td></td></tr>
<tr><td>Jan</td><td>156</td><td></td></tr>
<tr><td>Feb</td><td>156</td><td></td></tr>
<tr><td>Mar</td><td>156</td><td></td></tr>
</table></td></tr>
</table>

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<table>
<tr><th>Description</th><th>Current Dairy Farm</th><th>Current Schrama's Block</th><th>Proposed Dairy platform</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Apr</td><td>156</td><td></td></tr>
<tr><td>May</td><td></td><td>140</td></tr>
<tr><td>Jun</td><td></td><td>140</td></tr>
</table>

Note: Change in young stock policy and removal of beef stock reared.
</td></tr>
<tr><td>Sheep</td><td>NA</td><td>Modelled as an average "class 7, S.I. Finishing Otago/Southland" property using benchmarking data from Beef and Lamb NZ. The report is attached to this document.

Lambing percentage: 137%

Breed: Coopworth

<table>
<tr><td></td><td>Ewes</td><td>Hoggets</td><td>Rams</td><td>Lambs</td></tr>
<tr><td>Jul</td><td>577</td><td>218</td><td>16</td><td></td></tr>
<tr><td>Aug</td><td>577</td><td>218</td><td>16</td><td></td></tr>
<tr><td>Sep</td><td>562</td><td>208</td><td>16</td><td></td></tr>
<tr><td>Oct</td><td>562</td><td>208</td><td>16</td><td></td></tr>
<tr><td>Nov</td><td>547</td><td>208</td><td>16</td><td>1002</td></tr>
<tr><td>Dec</td><td>547</td><td>208</td><td>16</td><td>868</td></tr>
<tr><td>Jan</td><td>532</td><td>208</td><td>16</td><td>738</td></tr>
<tr><td>Feb</td><td>532</td><td>208</td><td>16</td><td>608</td></tr>
<tr><td>Mar</td><td>521</td><td>208</td><td>16</td><td>478</td></tr>
<tr><td>Apr</td><td>521</td><td>208</td><td>16</td><td>348</td></tr>
<tr><td>May</td><td>379</td><td>198</td><td>16</td><td>218</td></tr>
<tr><td>Jun</td><td>379</td><td>198</td><td>16</td><td>218</td></tr>
</table>

Greasy wool: 4650kg</td><td>NA</td></tr>
<tr><td>In shed feeding</td><td>100% of herd fed inshed Aug – May</td><td>NA</td><td>100% of herd fed inshed Aug - May</td></tr>
<tr><td>Structures</td><td>Uncovered calving pad
Carbon rich surface (bark)
Lined

Management:
All animals on for24hrs/day
Aug – 19% of animals (98 cows)
Sep – 12% of animals (61 cows)
Oct – 2% of animals (10 cows)

Effluent:
Liquid effluent added to farm effluent system
Solids are spread on the non effluent blocks in December</td><td>NA</td><td>Uncovered calving pad
Carbon rich surface (bark)
Lined

Management:
All animals on for24hrs/day
Aug – 19% of animals (118 cows)
Sep – 12% of animals (73 cows)
Oct – 2% of animals (12 cows)

Effluent:
Liquid effluent added to farm effluent system
Solids are spread on the non effluent blocks in December</td></tr>
</table>

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Description	Current Dairy Farm	Current Schrama's Block	Proposed Dairy platform
Animal distribution	No difference between blocks	No difference between blocks	No difference between blocks
Crop management	<u>Fodder Beet</u> 12ha planted 22TDM/ha yield Rotating through the "rolling" pasture blocks Planted in Nov – conventional cultivation 200kg/ha Cropzeal Boron boost at sowing 500kg/ha Fodder beet base at sowing 120kg/ha sustaiN applied in Jan Grazed in May and Sep for 2hr, and wintered on in June, Jul, Aug 24hrs/day. Sown into permanent pasture in October	<u>Swedes</u> 5.4ha planted (average as seen on Google earth) 12TDM/ha yield Rotating through the pasture blocks Planted in Dec – Conventional cultivation 325kg/ha Cropzeal boron boost at sowing 70kg/ha MOP at sowing 100kg/ha N-rich Urea in February Grazed in Jun, Jul, Aug (24hrs/day) Sown into permanent pasture in November	All cows are wintered on farm on either Fodder Beet or a Baleage/Grass system <u>Fodder Beet</u> 12ha planted 22TDM/ha yield Rotating through the "rolling" pasture blocks Planted in Nov – conventional cultivation 200kg/ha Cropzeal Boron boost at sowing 500kg/ha Fodder Beet Base mix at sowing 120kg/ha of SustaiN applied in Jan Grazed in May and Sep for 2hr, and wintered on in June, Jul, Aug 24hrs/day. Sown into permanent pasture in October <u>10ha Baleage/Grass wintering</u> This area rotates around the "rolling" pasture blocks. 205TDM baleage is fed out in paddock throughout the winter. The paddocks are then regrassed following the winter *Note: OverseerFM is not able to effectively model a Southland Baleage Grass wintering system. This block has therefore been modelled as a pastoral block and an adjustment to expected losses has been calculated outside of OverseerFM*
Imported Supplements	Silage – 150tDM fed in paddock and on pad Hay – 13TDM fed on pad PKE – 200TDM fed in shed DDG – 130TDM fed in shed Baleage – 120TDM fed on the crop	None	PKE – 265TDM fed in shed DDG – 175TDM fed in shed
Exported supplements	None	None	None
Harvested supplements	Hay – 17TDM fed on the pad Baleage – 24TDM fed on the crop	None	Hay – 36TDM fed on the pad Baleage – 144TDM fed on the Fodder beet

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Description	Current Dairy Farm	Current Schrama's Block	Proposed Dairy platform
			Baleage – 205TDM fed on the baleage grass wintering paddocks Silage – 48TDM fed on the pad
Soil Fertility	Soil tests were completed in July 2019 Olsen P of 34 QT K of 7 QT Ca of 9 QT Mg of 17 QT Na of 6 SO_4 of 13	Soil tests were completed in November 2019 Olsen P of 34 QT K of 9 QT Ca of 9 QT Mg of 17 QT Na of 9 SO_4 of 13	Soil fertility would be targeted at agronomic optimum Olsen P of 30 QT K of 7 QT Ca of 9 QT Mg of 17 QT Na of 6 SO_4 of 13
Fertiliser	Fertiliser applied to maintenance level. Total P applied – 5,380kg Total K applied – 814kg Total S applied – 3,642kg	Fertiliser applied to maintenance level. Total P applied – 2,070kg Total K applied – 357kg Total S applied – 1,2750kg	Fertiliser applied to maintenance level. Total P applied – 7,728kg Total K applied – 7,222kg Total S applied – 5,855kg
Pastoral Nitrogen Fertiliser	239kgN/ha was applied to the pasture area in split application between Sep and Apr	Taken from fertiliser purchase records 18kg/ha N applied in March	Non Effluent paddocks – 175kgN/ha applied in split applications from Sep – Apr Effluent paddocks – 154kgN/ha applied in split applications from Sep to Apr *Note: No nitrogen fertiliser applied to the baleage grass paddocks in April prior to wintering on them*
Drainage	50% of the property is drained using mole and tile drainage	50% of the property is drained using mole and tile drainage	50% of the property is drained using mole and tile drainage
Effluent system	Holding pond – solids are separated Effluent is applied using a cobra rain gun at an application depth of 12-24mm Liquid effluent is applied to the "eff" blocks Solids are spread on the Non effluent blocks when conditions allow (usually December)	NA	Holding pond – solids are separated Effluent is applied using a cobra rain gun at an application depth of 12-24mm Liquid effluent is applied to the "eff" blocks Solids are spread on the Non effluent blocks when conditions allow (modelled as December)

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Appendix 3: OverseerFM Data Outputs

Dairy Farm Current system

Farm nutrient budget

	Total loss (kg/yr)	Loss per ha (kg/yr)
Nitrogen	11,315	62
Phosphorus	455	2.5

Nutrients added (kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Fertiliser, lime and other	224	30	4	20	0	0	3
Irrigation	0	0	0	0	0	0	0
Supplements	81	16	51	10	18	10	7
Rain/clover fixation	78	0	2	5	3	6	27

Nutrients removed (kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Leached from root zone	62	2.5	14	42	69	8	23
As product	92	16	22	5	21	2	6
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	102	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
Change in pools (kg/ha/yr)	**N**	**P**	**K**	**S**	**Ca**	**Mg**	**Na**
Organic pool	121	15	9	-14	2	1	1
Inorganic mineral	0	2	-25	0	-2	-3	-4
Inorganic soil pool	8	10	46	0	-70	8	10

Nitrogen summary

	Total loss (kg)	Loss per ha (kg/ha)	N in drainage (ppm)	Added (kg/ha)	Surplus (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Eff, flat - makar, paro	90	45.2	10	267	257	239	0	28
Eff, flat - puke, apar	392	54.4	12	267	255	239	0	28
Eff, flat - ymai	137	42	9	267	247	239	0	28
Eff, rolling - makar, paro	97	46.2	10	267	257	239	0	28
Eff, rolling - puke, apar	4494	58.2	12	267	257	239	0	28
Non eff, flat - makar, paro	760	41.6	9	262	251	239	0	23
Non eff, flat - ymai	112	40	9	262	244	239	0	23
Non eff, rolling - makar	173	43.4	10	262	255	239	0	23
Non eff, rolling - puke, apar	2419	53.4	12	262	252	239	0	23
Non eff, rolling - makar, paro	21	42.2	9	262	253	239	0	23
Fodder beet	2130	178	32	135	190	135	0	0
Pond and wetland	6	3	-	0	0	0	0	0

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Phosphorus summary

	Total loss (kg)	Loss per ha (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Eff, flat - makar, paro	2	0.7	29	0	0
Eff, flat - puke, apar	6	0.8	30	0	0
Eff, flat - ymai	3	0.9	29	0	0
Eff, rolling - makar, paro	5	2.2	33	0	0
Eff, rolling - puke, apar	188	2.4	34	0	0
Non eff, flat - makar, paro	13	0.7	16	0	13
Non eff, flat - ymai	2	0.8	16	0	13
Non eff, rolling - makar	8	2.1	20	0	13
Non eff, rolling - puke, apar	105	2.3	21	0	13
Non eff, rolling - makar, paro	1	2.1	20	0	13
Fodder beet	29	2.4	77	0	0
Pond and wetland	0	0.1	0	0	0

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Schrama Block Current System

Farm nutrient budget

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	1,738	21
Phosphorus	190	2.3

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	23	25	4	15	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	74	0	2	5	3	6	27

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	21	2.3	10	36	44	9	28
As product	11	1	0	2	2	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	38	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
CHANGE IN POOLS (KG/HA/YR)	**N**	**P**	**K**	**S**	**CA**	**MG**	**NA**
Organic pool	24	12	0	-18	0	0	0
Inorganic mineral	0	2	-21	0	-2	-3	-4
Inorganic soil pool	10	8	27	0	-39	1	3

Nitrogen summary

	Total loss (kg)	Loss per ha (kg/ha)	N in drainage (ppm)	Added (kg/ha)	Surplus (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Rolling - makar	91	10.4	2	18	89	18	0	0
Rolling - puke, apar	809	12.2	3	18	87	18	0	0
Swedes	807	149	26	100	85	100	0	0

Phosphorus summary

	Total loss (kg)	Loss per ha (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Rolling - makar	18	2.1	23	0	0
Rolling - puke, apar	151	2.3	23	0	0
Swedes	12	2.3	63	0	0

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Proposed Dairy Farm System

Farm nutrient budget

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	12,749	48
Phosphorus	615	2.3

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	158	29	27	22	0	0	2
Irrigation	0	0	0	0	0	0	0
Supplements	45	11	19	6	10	7	5
Rain/clover fixation	113	0	2	5	3	6	27

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	48	2.3	14	42	59	8	23
As product	76	13	18	4	18	2	5
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	86	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
CHANGE IN POOLS (KG/HA/YR)	**N**	**P**	**K**	**S**	**CA**	**MG**	**NA**
Organic pool	102	15	8	-15	2	1	1
Inorganic mineral	0	2	-29	0	-2	-3	-4
Inorganic soil pool	6	8	42	0	-63	6	9

Nitrogen summary

	Total loss (kg)	Loss per ha (kg/ha)	N in drainage (ppm)	Added (kg/ha)	Surplus (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Baleage grass - schrama, rolling puke apar	165	51.4	11	168	493	154	0	13
Baleage grass - schrama, rolling, makar	16	41.4	9	168	586	154	0	13
Baleage/grass - non eff, rolling, makar	8	41.4	9	168	482	154	0	13
Baleage/grass - eff, rolling, puke apar	220	54.8	11	168	485	136	0	32
Baleage/grass - non eff, rolling, puke apar	114	51.4	11	168	451	154	0	13
Eff, flat - makar, paro	66	33	7	186	200	154	0	32
Eff, flat - puke, apar	289	40.2	9	186	198	154	0	32
Eff, flat - ymai	102	31	7	186	188	154	0	32
Eff, rolling - makar, paro	72	34.6	7	186	197	154	0	32
Eff, rolling - puke, apar	3274	43	9	186	196	154	0	32
Non eff, flat - makar, paro	586	32	7	188	189	175	0	13
Non eff, flat - ymai	86	31	7	188	180	175	0	13
Non eff, rolling - makar	129	33	7	188	192	175	0	13
Non eff, rolling - puke, apar	1800	40.6	9	188	188	175	0	13
Non eff, rolling - makar, paro	18	35	8	188	209	175	0	13
Schrama, non eff, rolling - puke, apar	2589	40.6	9	188	188	175	0	13
Schramas, non eff, rolling makar	276	33	7	188	192	175	0	13
Fodder beet	2345	195	36	135	235	135	0	0
Pond and wetland	6	3	-	0	0	0	0	0

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Phosphorus summary

	Total loss (kg)	Loss per ha (kg/ha)	Fertiliser (kg/ha)	Irrigation (kg/ha)	Effluent (kg/ha)
Baleage grass - schrama, rolling puke apar	6	1.9	0	0	8
Baleage grass - schrama, rolling, makar	0	1.7	0	0	8
Baleage/grass - non eff, rolling, makar	0	1.7	0	0	8
Baleage/grass - eff, rolling, puke apar	8	2	0	0	0
Baleage/grass - non eff, rolling, puke apar	5	1.9	0	0	8
Eff, flat - makar, paro	2	0.7	30	0	0
Eff, flat - puke, apar	5	0.7	31	0	0
Eff, flat - ymai	3	0.8	31	0	0
Eff, rolling - makar, paro	5	2	34	0	0
Eff, rolling - puke, apar	168	2.2	34	0	0
Non eff, flat - makar, paro	12	0.7	23	0	8
Non eff, flat - ymai	2	0.8	23	0	8
Non eff, rolling - makar	8	1.9	26	0	8
Non eff, rolling - puke, apar	96	2.1	27	0	8
Non eff, rolling - makar, paro	1	1.9	23	0	8
Schrama, non eff, rolling - puke, apar	136	2.1	27	0	8
Schramas, non eff, rolling makar	17	1.9	26	0	8
Fodder beet	29	2.4	77	0	0
Pond and wetland	0	0.1	0	0	0

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Appendix 4: Beef and Lamb NZ Economic Survey Data

The Schrama Block Current farm nutrient budget has been completed using information from a recent Beef and Lamb NZ Economic Survey. This can be found at https://beeflambnz.com/sites/default/files/data/files/2019%20SSI.pdf

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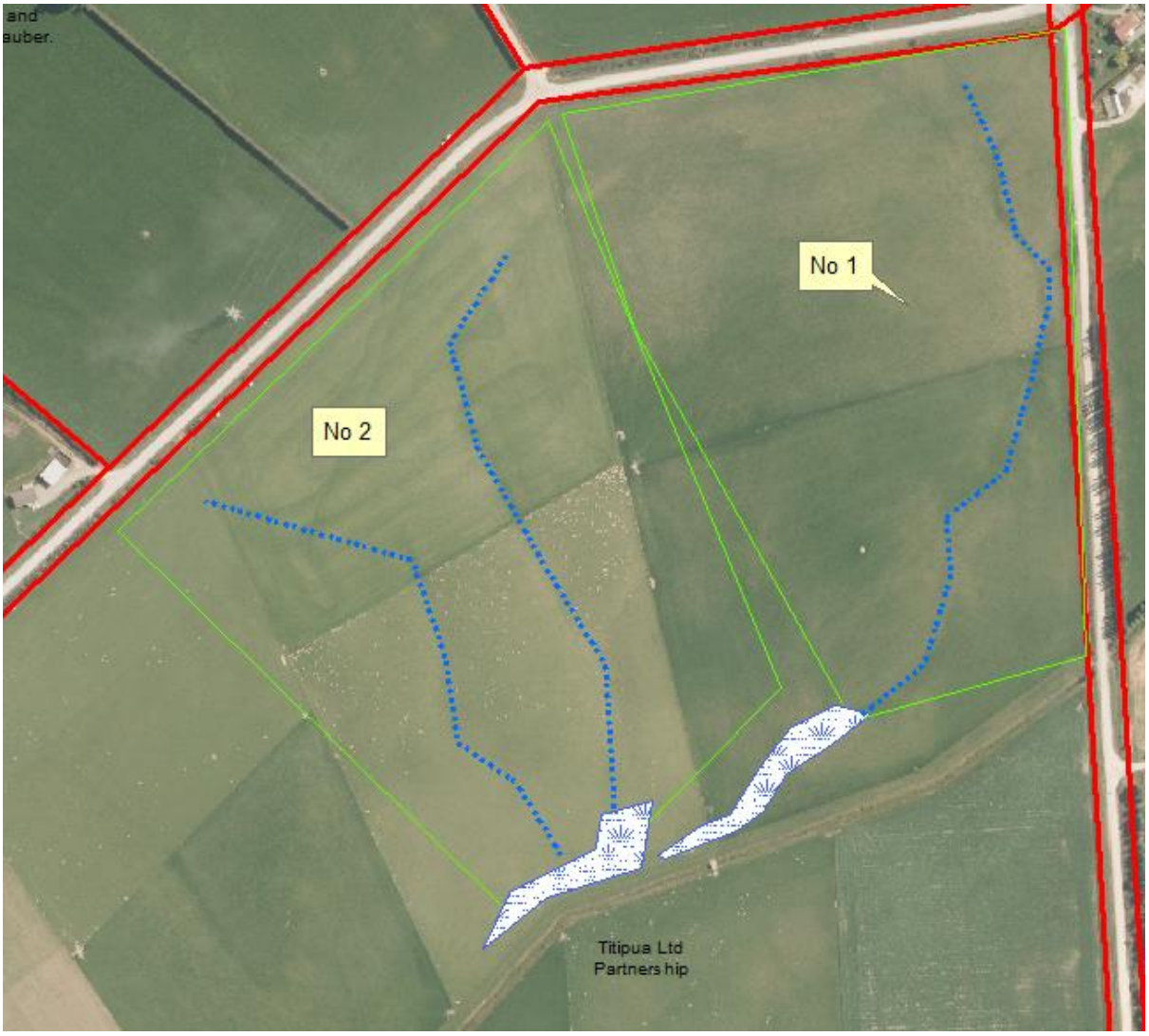
Appendix 5: David Moate Wetlands Report

Titipua Ltd Partners Wetland Ideas



No 1

- 9 Ha catchment
- 900m2 wetland = 1 % of the catchment that will remove 50% of sediment, 25% of N, 25% P

No 2

- 10 Ha catchment
- 1000m2 wetland = 1% of catchment that will remove 50% of sediment, 25% of N, 25% P

Design Features

- First half 0.5m deep to improve tile outfalls, collected sediment and kill bacteria
- Second half 0.3m deep planted heavily with Carex secta
- Banks can be planted for in short plants for erosion control and aesthetics
- All 3 options do not require a resource consent

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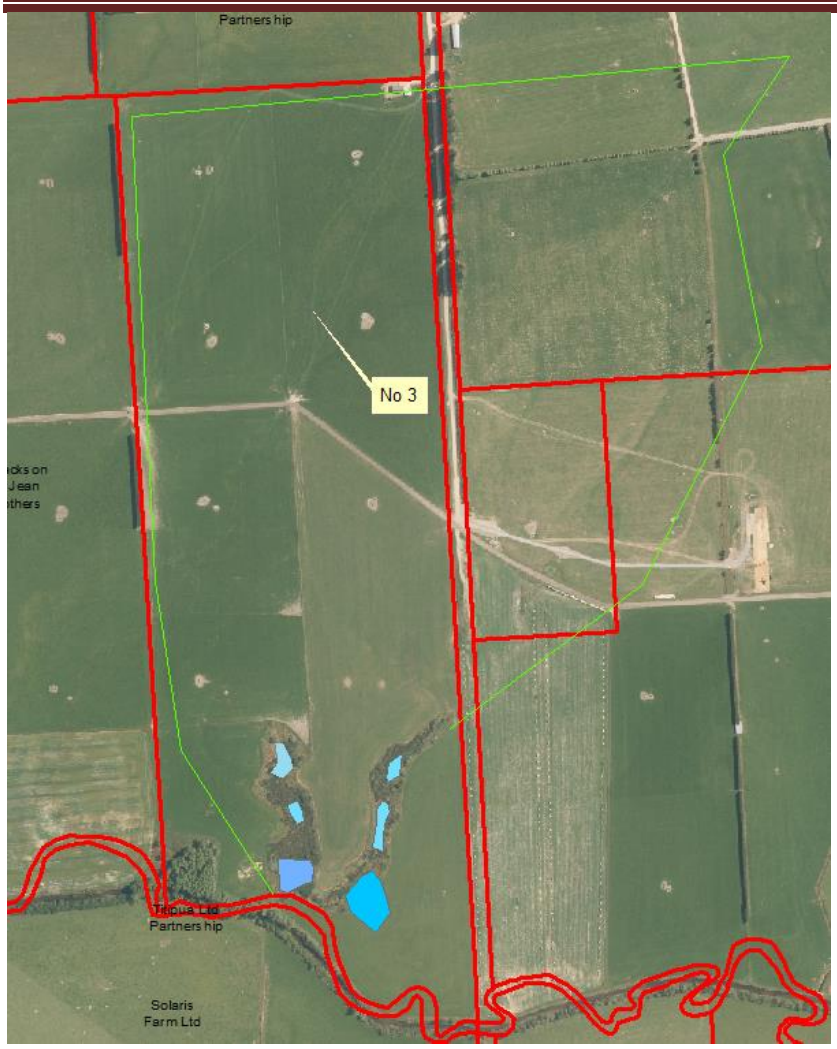

No 3

- 50 Ha
- 2.216 Ha wetland = 4.5% of the catchment that will remove 86% of sediment, 50% of N, 48% of P

Design Features

This existing area can be added too by creating more open water sections to store more water for longer allowing sunlight and wind to kill bacteria, sediment to be stored and N reduced. Open water areas created by bunds or digging out hollows. Make any overflows from earth not pipe and maybe lined with rock to prevent scouring in heavy rain events.

Main Creek

- Too risky trying to build anything in this waterway best to treat water before it gets there
- Permission required from ES catchment for nay planting
- Planting a row of Crow's nest or Tasman poplars or Moutere or Matsudana willow would benefit water quality and farm production and animal welfare
- For free Matsudana willow wands that only require a trim to length (1-1.2m) call Aaron Baird Otautau 021867522

The following warnings attach to this communication
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File Note: Titipua Ltd Partnership – Pasture Grown

June 2021

1.0 Supporting information to this report:

This file note is not a standalone report. It is intended to be read in conjunction with:

- The Overseer modelling report, dated 23rd March 2021 titled "Titipua Ltd Partnership – OverseerFM farm system modelling to support a consent application for expanded dairy". This report has been attached to this file note.

2.0 Purpose of this report:

The Overseer Nutrient Budget Review, completed by Nicky Watt of Irricon raised points of clarification over the pasture grown estimates in the proposed nutrient budget scenario when compared to that estimated in the current dairy and Schrama block scenarios. This report seeks to explain the pasture grown figures to give council confidence that they are reasonable.

3.0 Modelled pasture grown results:

Table 1 below has been completed using information from the Overseer modelling report (section 1.1 and appendix 2 in that report). It shows the estimated pasture grown in each of the scenarios modelled – current dairy, Schrama block and the proposed dairy system.

Table 1. Estimated pasture grown figures in the current, Schrama and proposed system scenarios as per the Overseer report, dated 23rd March 2021.

	Current system	**Schrama Block**	**Proposed system**
Pasture grown (TDM/ha)	16.8	11.2	16.1
N Fertiliser applied (kgN/ha)	239	18	166 (average for pastoral area) *175 (non Effluent areas)* *154 (effluent areas)*

4.0 Overseer modelling process

Overseer calculates pasture grown from the data inputted using a back calculation and an assumed pasture quality. Overseer is not able to check the feasibility of these pasture production estimates and therefore the user must check them.

For the Titipua Ltd Partnership, input data was collected for the last three seasons and then averaged to reduce the impact of one seasons climatic conditions during the period.

As described in the Overseer modelling report, detailed input data for the Schrama block was not available due to the death of the previous owner. Therefore, a nutrient budget has been created

using data from the Beef and Lamb NZ economic survey alongside information available from Google Earth and the purchaser. The property has been modelled in a conservative approach that resulted in a pasture grown estimate at the lower end of the expected range. It should be noted that if a conservative approach had not been taken it would have resulted in higher nutrient losses, and thus an easier threshold for the Titipua Ltd Partnership to reach.

The proposed dairy system model is the Titipua Ltd Partnerships preferred future farm system. The inputs for the proposed system were discussed with the client at length to ensure that a viable system was modelled.

The Schrama block, when compared to the current dairy platform, has the same soil types, drainage, topography, rainfall and temperature, and similar or better soil fertility.

In Southland there are significant differences between sheep and dairy grazing systems. Sheep farms tend to be set stocked for a significant part of the season and grazed to lower residuals. These practices influence growth rates, and result in lower growth rates than a dairy farming system. It is not relevant to make direct comparisons between sheep and dairy farming growth rates. It should be noted that Woodlands growth data is from a sheep farm, but as it uses "caged cuts" is not reflective of standard sheep grazing practices.

The Schrama block, given the same farm system, nitrogen use and pasture management, has the same potential to grow pasture as the current dairy farm. Therefore, the pasture grown estimate in the proposed scenario should be compared to the current dairy farm only (not the previous sheep grazing system).

4.0 Interpretation of Overseer pasture grown estimates:

Section 4.1.1 of the Overseer modelling report discusses that the pasture grown estimations in Overseer for Southland dairy farms are higher than expected. I have included this section below:

"It should be noted that the estimated pasture grown outputs from Overseer are higher than expected. Overseer uses a default value for ryegrass/white clover pasture quality irrespective of the land use and management. The default Overseer value in Southland ranges from 10.5 to 11.17 MJ ME/ kg DM depending on the month (reference: Characteristics of pasture, June 2018, D M Wheeler AgResearch Ltd). Pasture cuts from an Eastern Southland monitor farm show MEs of 11.5 to 12.2 (reference: Pasture growth and quality on Southland and Otago dairy farms, D. E. Dalley and T. Geddes, DairyNZ, NZ Grasslands Publication 2012).

The Overseer default values have been used throughout the entirety of this modelling as the Best Practice Data Input Standards state that "there needs to be a very good long-term average evidence of clover content, pasture utilisation, pasture N content and pasture quality to justify changes from the default OVERSEER values. This level of information would be rare."

To ensure that comparisons are valid between the baseline and proposed the same method has been used to ensure that an "apples with apples" approach is taken."

The Overseer Nutrient Budget Review completed by Irricon also noted that Overseer assumes a lower ME (metabolizable energy) than that found in the South Island. The lower ME assumed results in pasture grown estimates that are higher than expected.

Table 2 below shows the estimated pasture grown figures for the dairy scenarios at 10.8ME (as per the average of the Overseer assumed pasture quality) and at 11.85ME (as per the average of the pasture quality measured by Dalley and Geddes, 2012).

Table 2. Pasture grown estimates taken directly from Overseer compared to an updated pasture grown figure using pasture quality figures measured on Southland dairy farms.

	Current system	Schrama Block	Proposed system
Overseer Pasture grown estimate – 10.8 MJME/kgDM (TDM/ha)	16.8	11.2	16.1
Updated pasture grown estimate – 11.85MJME (TDM/ha)	15.3	NA	14.7

Therefore, the pasture production estimated by Overseer and corrected for Metabolisable Energy content is 15.3TDM/ha and 14.7TDM/ha on the current and proposed dairy system scenarios, respectively.

5.0 Expected pasture grown in Southland

Pasture production has been measured at the Woodlands Research Station on a fortnightly basis since 2000. The trial is operated in a nil nitrogen, optimal soil fertility system. The results of these measurements are publicly available, and I note that the Irricon report referenced a paper written about this trial which averaged pasture production from 2001 – 2012. Recent data released by the Woodlands Research Station including the years 2013 - 2021 showed that the average annual pasture production for this trial is now 13.0 TDM/ha (with no nitrogenous fertiliser input).

Pasture production in the current and proposed dairy farm scenarios is 2.3 and 1.7 TDM/ha higher respectively than the Woodlands Research Station average. This difference can be explained by nitrogen fertiliser pasture growth. As shown in Table 1, the current and proposed dairy farm scenarios included fertiliser nitrogen use of 239 and 166kgN/ha respectively. At a 10:1 response rate (10kgDM per 1kgN applied per ha), we would expect that the current and proposed would grow 2.39TDM/ha and 1.66TDM/ha more than the Woodlands Research Station. **This equates to an expected pasture grown of 15.39TDM/ha and 14.66TDM/ha on the current and proposed system respectively.**

5.0 Conclusions:

Due to differences in pasture management and its effect on pasture production, it is not justifiable to directly compare pasture grown figures rates for a sheep and dairy system. This comparison, by Irricon has led to incorrect conclusions regarding robustness of the modelling.

Pasture production is estimated by Overseer using a back calculation and an assumed pasture quality. Overseer overestimates pasture production on Southland dairy farms due to an under estimation of pasture quality. After correcting for this error, Overseer estimates pasture production on the current and proposed scenarios to be 15.3 and 14.7TDM/ha respectively.

Report disclaimer: The OverseerFM 6.3.5 model has been utilised to assess the nutrient losses and estimate pasture grown on this property. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

The Woodlands Research Station has measured pasture production for the last 20yrs. The average annual pasture production on a Nil Nitrogen site is 13.0TDM. Considering the nitrogen applied to the current and proposed system, and a 10:1 response rate, we would expect pasture production on the Titipua Ltd Partnership property to be 15.39 and 14.66TDM/ha in the current and proposed systems respectively.

Given that the corrected Overseer pasture grown estimates are within 0.1TDM/ha of the Woodlands + nitrogen estimates, it can be concluded that the pasture grown is feasible and sensible.

Report disclaimer: The OverseerFM 6.3.5 model has been utilised to assess the nutrient losses and estimate pasture grown on this property. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

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File Note: Titipua Ltd Partnership – Overseer version change

September 2021

1.0 Supporting information to this report:

This file note is not a standalone report. It is intended to be read in conjunction with:

- The Overseer modelling report, dated 23rd March 2021 titled "Titipua Ltd Partnership – OverseerFM farm system modelling to support a consent application for expanded dairy".
- The File Note, dated June 2021 titled "File Note: Titipua Ltd Partnership – Pasture grown"

These reports have been attached to this file note.

2.0 Purpose of this report:

Since the completion of the nutrient budgeting report, and the subsequent audit, there has a version change of Overseer. This has resulted in changes in the estimated losses of N and P. This file note seeks to update the nutrient loss figures so that Environment Southland have current loss estimates.

3.0 Overseer version change:

Periodically, Overseer releases a new version of the model. The version changes are generally a result of new science becoming available. The original report for Titpua Ltd Partnership was written using information calculated in Overseer version 6.3.5. On the 28th July 2021, after the consent application was lodged, Overseer released version 6.4.0. The update is as follows:

- *NIWA climate data - The climate data for OverseerFM has been updated to use NIWA data from 1991-2020.*
- *All climate data used in the model will be based on the location of the block. If the block does not have a location, the location of the farm will be used. Where farms do not have a location, the model will not run until a location is set. This ensures that each analysis is using the best representation of climate for their farm.*
  (taken from the Overseer website)

Upon further reading of the Overseer version 6.4.0 release notes, I also note that there has been a change to using monthly climate data rather than annual. This climate data update has affected the modelled rainfall, average temperature, and potential evapotranspiration (PET). This in turn affects modelled drainage volumes and biological activity (particularly volatilisation).

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

4.0 Previously modelled losses:

The tables below show the losses as calculated using Overseer version 6.3.5 and presented in the Overseer modelling report, dated 23rd March 2021.

Table 1. Estimated nitrogen and phosphorus losses from the current system using Overseer version 6.3.5

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	11,315	1,738	13,053
N Loss/ha (kgN/ha/yr)	62	21	49
Total Farm P Loss (kg)	455	190	645
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

Table 2. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.3.5

	Total current (same as above)	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	13,035	12,181 *(12,749 modelled plus 173 baleage grass wintering minus 741 wetlands calculated outside OverseerFM)*	6.7% decrease
N Loss/ha (kgN/ha/yr)	49	46	
Total Farm P Loss (kg)	645	572 *(615 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note.*

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

5.0 Updated modelled losses:

Following the version update to 6.4.0, I have reopened the relevant Overseer budgets. There have been no other changes made to the budgets. The tables below show the updated Overseer outputs. For ease of reading, changes have been shown in red.

Table 3. Estimated nitrogen and phosphorus losses from the current system using Overseer version 6.4.0

	Current Dairy Platform	Schrama's block	Total current
Area (ha)	181.5	84.2	265.7
Total Farm N Loss (kg)	10,196	1,685	11,881
N Loss/ha (kgN/ha/yr)	56	20	45
Total Farm P Loss (kg)	456	191	647
P loss/ha (kgP/ha/yr)	2.5	2.3	2.4
Pasture Grown (tDM/ha)	16.8	11.2	

Table 4. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.0

	Total current (same as above)	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	11,881	11,088 *(11,656 modelled plus 173 baleage grass wintering minus 741 wetlands calculated outside OverseerFM)*	6.7% decrease
N Loss/ha (kgN/ha/yr)	45	42	
Total Farm P Loss (kg)	647	574 *(617 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note. These calculations have NOT been updated in light of the update in Overseer version.*

6.0 Updating the outside of Overseer calculations

The proposed system estimated losses included the use of calculations outside of Overseer. These calculations have been recalculated below utilising information from version 6.4.0.

6.1 Baleage grass wintering:

As explained in the March 2021 report *"OverseerFM is likely to underestimate nitrogen losses as OverseerFM is not able to adequately reflect the on-farm realities of this system. OverseerFM assumes that the pasture plants will regrow post grazing and take up urinary N from the wintering*

activity. However, due to the soil type and climate on the applicant's property, the plants are not viable following the winter grazing. As a result, the area is cultivated and regrassed in spring. I am unaware of any research that has quantified the impact of baleage grass wintering in terms of nitrate and phosphorus loss. I have therefore completed a desktop modelling exercise that attempts to estimate the nutrient losses from this system more accurately."

In the March 2021 report, I explained that I had created an Overseer file that showed the baleage grass area as a very low yielding kale crop. This allowed me to add a defoliation and regrassing event to Overseer and ensured that overseer would assume no uptake of urinary N between grazing of the crop and the resowing of the pasture. Further details on how this was modelled can be found in the March 2021 report in section 4.2.1. I have rerun the same calculation and summarised the results below:

	Total nitrogen losses for the kale or baleage/grass area (10ha)	
	OverseerFM version 6.3.5 (taken from the March 2021 report)	OverseerFM version 6.4.0
Pasture baleage system	523	433
Kale system	696	877
Difference	173	444

Therefore, it is predicted that the losses from the grass baleage wintering system will be 444kgN higher than estimated in the OverseerFM Proposed scenario.

6.2 Installation of a wetland

As per the March 2021 report, Titipua Ltd Partnership have sought advice from David Moate of Environment Southland regarding the installations of wetlands. Following this advice, they have agreed to install a wetland on the property. Calculations outside of Overseer have been completed to quantify the expected reduction in nitrogen and phosphorus loss because of the wetland. The catchment of the wetland is 50ha, although only 38ha of this is on the Titipua ltd Partnership property.

The table below calculates the expected amount of nitrogen captured by the wetland. This has been updated following the Overseer version change. Updated figures are shown in red. The original figures are also shown for completeness.

Overseer block name	Area (ha)	OverseerFM estimated nitrogen leaching loss (kgN/ha) (updated in red)	Reduction in N leaching due to wetland (from David Moate's report) (%)	Total reduction (kgN) (Ha x kgN/ha x %) (updated in red)
Non-Eff, Rolling – Puke, Apar	32.2	40.6 36.2	50	653.66 582.82
Eff, Rolling – Puke, Apar	2.1	43.0 38.6	50	45.15 40.53
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.7			
Total block Nitrogen loss mitigated	**38.0**			**698.81** **623.35**
Plus reduction in other sources losses	38/265.7	589 593	50	42.12 42.40
Total farm Nitrogen loss mitigated				**740.93** **665.75**

The table below calculates the expected amount of nitrogen captured by the wetland. This has been updated following the Overseer version change. Updated figures are shown in red. The original figures are also shown for completeness. As there has been no change in the estimated Phosphorus losses at a block and other sources level, there is no change to the total loss mitigated.

Overseer block name	Area (ha)	OverseerFM estimated P loss (kgP/ha)	Reduction in P loss due to wetland (from David Moate's report) (%)	Total reduction (kgP) (Ha x kgP/ha x %)
Non-Eff, Rolling – Puke, Apar	32.2	2.14 2.14	48	33.08
Eff, Rolling – Puke, Apar	2.1	2.20 2.20	48	2.22
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.7			
Total block Phosphorus loss mitigated	**38.0**			**35.3**
Plus reduction in other sources losses	38/265.7	114 114	48	7.83
Total farm Phosphorus loss mitigated				**43.13**

Therefore, it is predicted that the wetland will reduce nutrient losses from the proposed dairy system by 666kgN and 43kgP.

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

6.3 Cumulative effects of mitigations calculated outside of Overseer

Calculations outside of Overseer have been completed to quantify the impact of the baleage grass wintering and the wetland installation. The updated loss estimates are shown in the table below. Differences, as compared to Table 2 of this report are shown in red.

Table 3. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.0

	Total current	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	11,881	11,434 *(11,656 modelled plus 444 baleage grass wintering minus 666 wetlands calculated outside OverseerFM)*	3.8% decrease
N Loss/ha (kgN/ha/yr)	45	43	
Total Farm P Loss (kg)	647	574 *(617 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

1. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
2. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note. These calculations have NOT been updated in light of the update in Overseer version.*

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

7.0 Conclusions:

A version change of Overseer has resulted in changes in the estimated losses of Nitrogen and Phosphorus.

Table 4. Estimated nitrogen and phosphorus losses from the current and proposed systems including calculations outside of Overseer. This modelling utilises Overseer version 6.4.0

	Total current (same as above)	Proposed	
Area (ha)	265.7	265.7	
Total Farm N Loss (kg)	11,881	11,434 *(11,656 modelled plus 444 baleage grass wintering minus 666 wetlands calculated outside OverseerFM)*	3.8% decrease
N Loss/ha (kgN/ha/yr)	45	43	
Total Farm P Loss (kg)	647	574 *(617 modelled minus 43 wetlands calculated outside OverseerFM)*	11.3% decrease
P loss/ha (kgP/ha/yr)	2.4	2.2	
Pasture Grown (tDM/ha)		16.1	

Note:

3. *Estimated pasture grown figures are higher than expected. This is discussed in section 4.1.1 of the "Overseer modelling report, dated 23rd March 2021" attached to this file note*
4. *Calculations outside of OverseerFM have been required in the proposed system modelling. These are explained in full in section 4.2. of the "Overseer modelling report, dated 23rd March 2021" attached to this file note. These calculations have NOT been updated in light of the update in Overseer version.*

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File Note: Titipua Ltd Partnership – Wetland mitigation calculations

October 2021

1.0 Supporting information to this report:

This file note utilises information collected from the following sources:

- Overseer modelling of the proposed dairy system
- The wetland ideas report written by David Moate – former ES Land Sustainability
- The resource "constructed wetlands to reduce contaminant loss from pastoral farms"

These reports have been attached to this file note in the appendices.

2.0 Background

Titipua Ltd Partnership have applied for a consent to expand their dairy farm located in Southland. One of the proposed mitigations is to install a wetland on the property. During the consenting process, the applicant compiled information and sought expertise to design a wetland. Initially, this involved inviting former Environment Southland Land Sustainability officer David Moate to the property. David suggested possible locations for three wetlands. David's report is attached to this report in the appendices. Two of the three wetlands were later disregarded due to their proximity to an ES managed waterway. The third wetland location was deemed by the applicants and David Moate to be a good opportunity to mitigate losses.

The location of this wetland within the boundaries is shown in Figure 1. Figure 2 shows the location and size of the recommended wetland (in blue) and the wetland catchment area (green line). The area that will become the wetland is currently a duck pond and waste area.

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

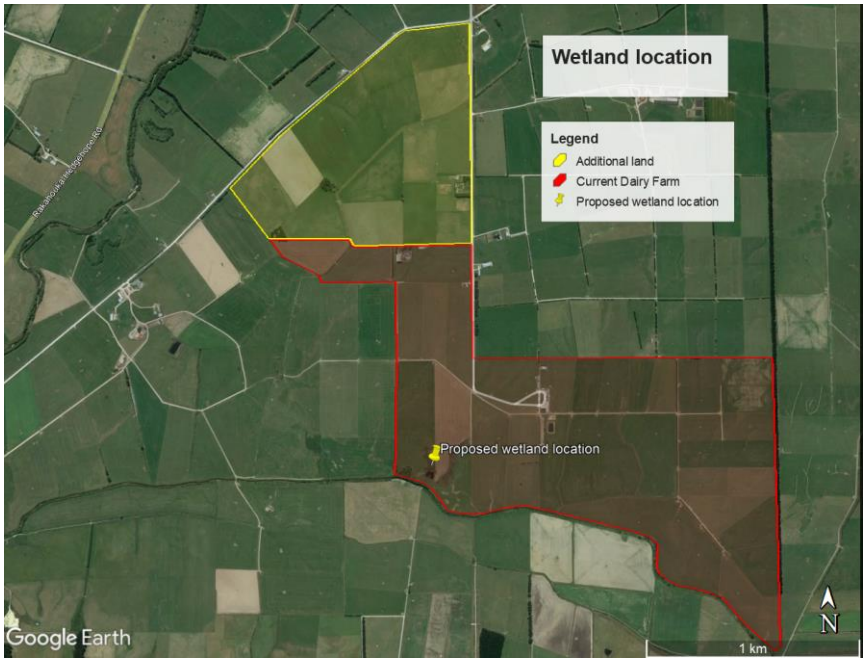

Figure 1. Farm boundaries and location of the proposed wetland.

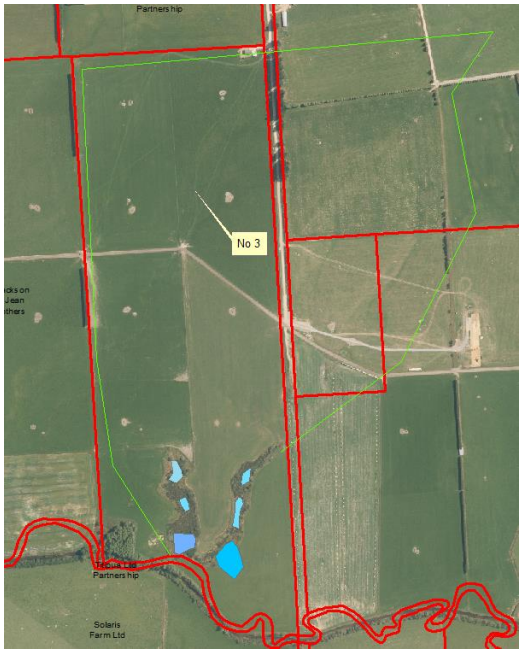

Figure 2. Schematic of the proposed wetland and catchment area - taken from David Moate's wetland ideas report.

David's report included information regarding the size of the wetland and the catchment, and the expected mitigation potential of the wetland. These were utilised in the original application to quantify the mitigation potential. Since then, it has become apparent that there were errors within this report regarding wetland catchment area and the mitigation efficiency of the wetland.

3.0 Purpose of this report:

This report seeks to update the calculations completed outside of Overseer considering the errors identified in the original calculations. This report will then be peer reviewed by a suitably qualified person to ensure the reductions calculated are feasible.

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

4.0 Proposed wetland location and design:

Farm location:	Hedgehope Block road, south of Hedgehope in Central Southland
Climate (Overseer):	Annual average temperature of 10.2-10.3°C
NIWA climate zone:	"Cool Zone" as defined by NIWA in the attached "Constructed Wetlands to Reduce Contaminant Loss from Pastoral Farms" resource.
Wetland location:	As per the pin on Figure 1
Wetland size:	2.2ha as per the blue areas shown in Figure 2
Catchment area:	44ha with 34ha of this within the Titipua Limited Partnership boundary. This is shown in Figure 3.
Wetland design:	As per the constructed wetland design recommendations in the attached "Constructed Wetlands to Reduce Contaminant Loss from Pastoral Farms" resource"

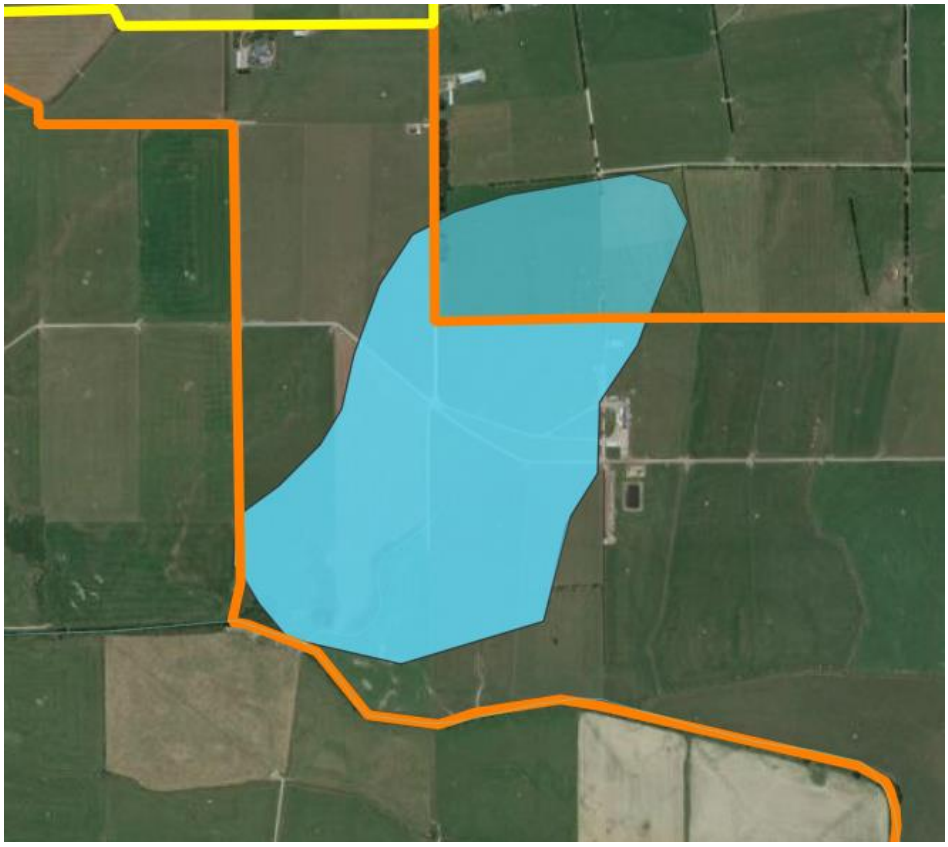

Figure 3. Catchment area of wetland. Orange line depict the property boundaries. Total wetland catchment area is 44ha with 34ha of this falling within the property boundary.

5.0 Estimated mitigation potential of the wetland

Calculations have been made outside of Overseer to estimate the mitigation potential of the wetland. These calculations utilise performance estimates from the resource "constructed wetlands to reduce contaminant loss from pastoral farms" shown below on the following page. The full report is given in the appendices of this report.

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

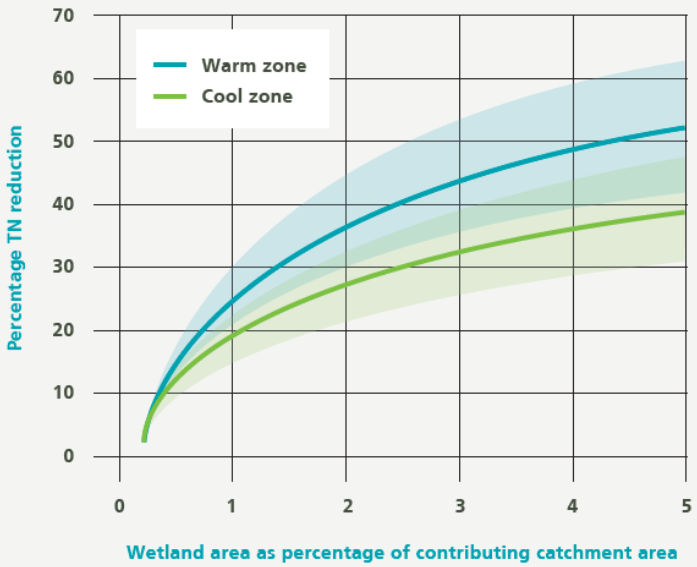

Figure 2: Long-term median annual Total Nitrogen (TN) reduction performance expectations. Performance is for appropriately constructed wetlands receiving surface run-off and drainage from pastoral farmland for warm (median annual temperature >12°C) and cool (median annual temperature 8-12°C) climatic zones in New Zealand and with catchment rainfall within NZ norms. Solid lines show expected medians for each zone; shaded areas show inter-annual and inter-site range of performance expected.

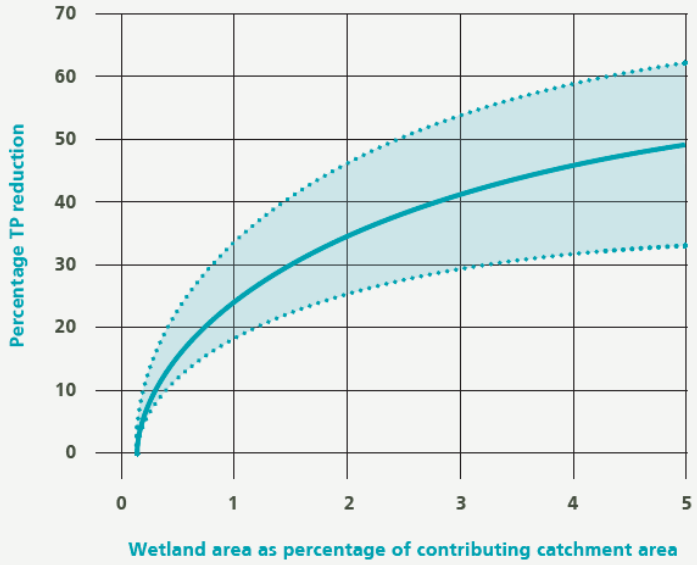

Figure 3: Long-term median annual Total Phosphorus (TP) reduction performance expectations. Performance is for appropriately constructed wetlands receiving surface run-off and drainage from pastoral farmland in New Zealand with catchment rainfall within NZ norms. Solid line shows expected median; shaded area shows inter-annual and inter-site range of performance expected. These predictions do not apply for constructed wetlands whose main source is subsurface drainage containing predominantly dissolved forms of phosphorus.

A wetland of 2.2ha in a catchment of 44ha is 5% of the contributing area.

Using the graphs above, at 5.0% of the catchment area, the proposed wetland is expected to mitigate the following losses:

- 38% reduction in total nitrogen lost with a range of 31-46%. This utilises the cool zone climate estimates which are for areas with a median average temperature of 8-12°C. Overseer estimates that the average temperature on the property is 10.2-10.3°C.
- 48% reduction in total Phosphorus with a range of 33-60%

6.0 Calculations outside of Overseer

Overseer has been utilised to estimate the per hectare losses from the catchment without a wetland present. These loss estimates are taken from the nitrogen summary, farm details report, and block details report. The proposed wetland captures water from two productive blocks within overseer as

well as some non-effective area. The catchment area within the Titipua Limited Partnership property is 34ha. The calculations below do not account for the mitigation of losses that have originated on the neighbouring property.

Using the midpoint of the estimates given above, the table below has been created to calculate the amount of nitrogen expected to be mitigated by the wetland.

Table 1. Estimated nitrogen mitigation because of the wetland installation

Overseer block name	Area of block captured by wetland (ha)	OverseerFM estimated nitrogen leaching loss (version 6.4.1) (kgN/ha)	Reduction in N leaching due to wetland (estimated from wetland resource) (%)	Total reduction (Ha x kgN/ha x %) (kgN)
Non-Eff, Rolling – Puke, Apar	21.4	39.4	38	320.4
Eff, Rolling – Puke, Apar	9.1	36.0	38	124.5
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.5			
Total block Nitrogen loss mitigated	**34.0**			**444.9**
Plus reduction in other sources losses	34/265.7	637	38	31.0
Total farm Nitrogen loss mitigated				**475.9**

Using the midpoint of the mitigation estimates given above, the table below has been created to calculate the amount of phosphorus expected to be mitigated by the wetland.

Table 2. Estimated phosphorus mitigation because of the wetland installation

Overseer block name	Area (ha)	OverseerFM estimated P loss (kgP/ha)	Reduction in P loss due to wetland (estimated from wetland resource) (%)	Total reduction (kgP) (Ha x kgP/ha x %)
Non-Eff, Rolling – Puke, Apar	21.4	2.14	48	22.0
Eff, Rolling – Puke, Apar	9.1	2.20	48	9.6
Non effective area (laneways and tracks) – the losses from this area are accounted for in "other sources" below.	3.5			
Total block Phosphorus loss mitigated	**34.0**			**31.6**
Plus reduction in other sources losses	34/265.7	115	48	7.1
Total farm Phosphorus loss mitigated				**38.7**

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

6.0 Conclusion

It is expected that the wetland will mitigate 38% of the nitrogen and 48% of the phosphorus losses from the catchment area. 34ha of the 44ha captured by the wetland are situated on the Titipua Ltd Partnership property. The wetland is expected to reduce nutrient loss from this 34ha by 476kgN and 39kgP.

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

Appendices

Appendix 1: David Moate – wetland ideas

Titipua Ltd Partners Wetland Ideas

No 1

- 9 Ha catchment
- 900m2 wetland = 1 % of the catchment that will remove 50% of sediment, 25% of N, 25% P

No 2

- 10 Ha catchment
- 1000m2 wetland = 1% of catchment that will remove 50% of sediment, 25% of N, 25% P

Design Features

- First half 0.5m deep to improve tile outfalls, collected sediment and kill bacteria
- Second half 0.3m deep planted heavily with Carex secta
- Banks can be planted in short plants for erosion control and aesthetics

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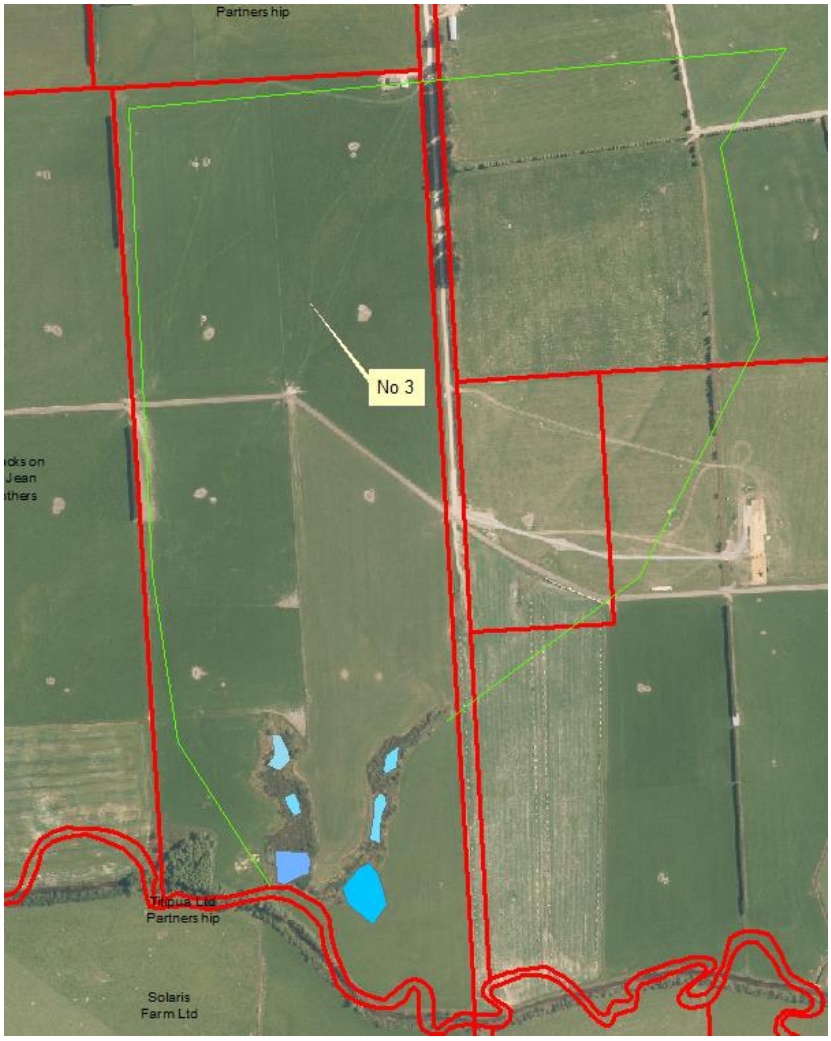
- All 3 options do not require a resource consent



No 3

- 50 Ha
- 2.216 Ha wetland = 4.5% of the catchment that will remove 86% of sediment, 50% of N, 48% of P

Design Features

This existing area can be added too by creating more open water sections to store more water for longer allowing sunlight and wind to kill bacteria, sediment to be stored and N reduced. Open water areas created by bunds or digging out hollows. Make any overflows from earth not pipe and maybe lined with rock to prevent scouring in heavy rain events.

Main Creek

- Too risky trying to build anything in this waterway best to treat water before it gets there
- Permission required from ES catchment for nay planting
- Planting a row of Crow's nest or Tasman poplars or Moutere or Matsudana willow would benefit water quality and farm production and animal welfare
- For free Matsudana willow wands that only require a trim to length (1-1.2m) call Aaron Baird Otautau 021867522

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

Appendix 2: Constructed wetlands to reduce contaminant loss from pastoral farms

This is available at the following website:
https://niwa.co.nz/sites/niwa.co.nz/files/Summary%20of%20Constructed%20Wetland%20Guidelines%202020%20v2.pdf

Appendix 3: Overseer 6.4.1 outputs

Overseer estimates the per hectare losses from each block on the property. It also estimates losses from "other sources" which are losses that are expected to occur outside of the productive area (ie the ineffective area).

The table below shows the summary table of losses from Overseer for the proposed dairy farm scenario. The blocks that have areas captured by the wetland are highlighted:

Name	Area (ha)	N loss	N loss/ha	N surplus/ha	P loss	P loss/ha
Baleage grass - Schrama, rolling Puke Apar	3.2	106	33.2	426	6	1.9
Baleage grass - Schrama, rolling, Makar	0.4	10	24.2	539	0	1.7
Baleage/Grass - Non Eff, rolling, Makar	0.2	5	23.8	435	0	1.7
Baleage/grass - Eff, rolling, Puke Apar	4	149	37.2	430	8	2
Baleage/grass - Non Eff, Rolling, Puke Apar	2.2	73	33.2	464	5	2
Eff, Flat - Makar, Paro	2	52	26.4	195	2	0.7
Eff, Flat - Puke, Apar	7.2	243	33.8	181	6	0.8
Eff, Flat - Ymai	3.3	85	26	188	3	0.8
Eff, Rolling - Makar, Paro	2.3	63	29	195	5	2.1
Eff, Rolling - Puke, Apar	80.9	2,782	36	181	173	2.2
Non Eff, Flat - Makar, Paro	18.2	510	28	238	12	0.7
Non Eff, Flat - Ymai	2.8	80	29	238	2	0.8
Non Eff, Rolling - Makar	4.1	119	30.4	248	8	2
Non Eff, Rolling - Puke, Apar	47.3	1,772	39.4	231	97	2.14
Non eff, Rolling - Makar, Paro	0.5	15	29.4	238	1	2
Schrama, Non Eff, Rolling - Puke, Apar	68	2,132	32.6	180	141	2.1
Schramas, Non Eff, Rolling Makar	8.9	207	24.4	178	17	2
Fodder beet	10	2,028	203	168	24	2.4
Pond and Wetland	1.9	6	3	0	0	0.1
Other sources	-	637	-	-	115	-

Report disclaimer: This file note is intended to be read alongside the reports listed in section 1.0 of this report. Details of how the properties are operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement and industry benchmarks.

Project Memorandum

4 December 2021

Landpro Reference: 20544
Council Reference: APP-20211092

To: Matilda Ballinger

From: Andrea Richardson

Subject: Titipua Ltd Partnership - Review of Wetland Mitigation

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1. Technical Review Details

Review Scope	Technical review of the wetland mitigation calculations for estimated total nitrogen and total phosphorus mitigation in the document "Titipua Ltd Partnership – Wetland mitigation calculations (October 2021) by AgriAce Consulting Limited.
Applicant	Titipua Limited Partnership
Physical Address	354 Hedgehope Block Road, Hedgehope, Southland
Reference Documents	- AgriAce Consulting Limited. (2021). *File Note: Titipua Ltd Partnership – Wetland mitigation calculations.* - Resource Consent Application to Environment Southland – Prepared for Titipua Limited Partnership (10 May 2021) - NIWA. (2021). *Technical guidelines for constructed wetland treatment of pastoral farm run-off* (NIWA Client Report 20200208.120200208.1HN). - NIWA (n.d.) *Constructed wetland guidelines.* https://niwa.co.nz/freshwater-and-estuaries/management-tools/restoration-tools/constructed-wetland-guidelines
Date of Site Visit	No site visit undertaken for this technical review
Limitations	The review is limited to the wetland mitigation calculations described in the AgriAce Consulting Limited document. The review does not extend to the appropriateness or accuracy of the Overseer modelling.

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2. Location of wetland

The NIWA 2021 Report[1] states that the highest contaminant reductions will generally be achieved by targeting areas of elevated contaminant discharge and by maximising the proportion of discharge able to be captured. Constructed wetlands are often best located in natural swales, depressions and gullies that provide the dominant pathways for water flow (and associated contaminant loads). These areas also provide suitable landforms to contain the wetland with minimal excavation and earthmoving.

The general location of the proposed wetland complex is shown in Figure 1 of the AgriAce Report. Figure 2 of the Report shows that the wetlands will be constructed within two main depressions, each with three connected wetlands (a total of six within the wetland complex). The contributing catchment area to this constructed wetland complex is shown in Figure 3 of the Report.

Aerial photos show that the proposed wetland area is within two existing vegetated depressions downslope of natural swales. The wetland area is within 200 m of Titipua Stream, approximately 20m at its closest point at the southern end, and any surface water runoff would flow towards Titipua Stream. As the proposed wetland complex is at the base of ephemeral watercourses (the natural swales), I consider the location is suitable to intercept run-off and drainage flows in the pastoral catchment and discharge any surface flows into the stream.

The Tiaki Farm Environment Plan (attached to the Consent Application) recommends that Titipua Limited Partnership develop a subsurface tile drainage map. I recommend that the applicant considers diverting the discharges from these drains into the constructed wetland (where appropriate) to expand the contributing wetland catchment area.

3. Size of wetland

Generally, contaminant reduction efficacy increases as constructed wetland area increases, but subject to gradually diminishing returns. Wetlands intercepting agricultural runoff and drainage flows need to be between 1% and 5% of their contributing catchment to significantly reduce contaminant loads. The wetland sizes proposed refer to the actual wetted area under normal flows. They do not include the additional areas required for embankments or marginal plantings. Wetlands smaller than this will provide insufficient residence time to enable contaminant reduction and, unless they have a high flow bypass, will be frequently overwhelmed by stormflows.[1]

The AgriAce Report estimates the contributing catchment area to this wetland complex is 44 ha, of which 34 ha is within the Titipua Ltd Partnership property. The extent of the estimated wetland catchment is shown in Figure 3 the Report. I consider that the outline of the estimated catchment area is appropriate based on aerial photos and contour maps.

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[1] NIWA. (2021). *Technical guidelines for constructed wetland treatment of pastoral farm run-off*

For a total contributing catchment area of approximately 44 ha, the recommended (NIWA, 2021) size of the wetted area of the constructed wetland equates to 0.44 to 2.2 ha (i.e., 1-5% of the catchment). Accordingly, the proposed wetland size of 2.2 ha is appropriate, noting that the actual wetted area of the constructed wetland complex under normal flows may be slightly smaller but still within the NIWA wetland sizing recommendations.

4. Predicted wetland contaminant reduction

The NIWA 2021 Report states that the performance of constructed wetlands depends to a large extent on the retention time of water within the wetland. This is influenced by the size of the wetland relative to its inflow, and how uniform the flow is as it passes through the wetland. The evenness or efficiency of flow distribution through the wetland is primarily determined by its internal design and distribution of emergent vegetation. In general, to maximise nutrient reduction it is important to maintain the majority of the wetland in shallow planted zones for microbial/plant induced attenuation. Deeper zones target sediment removal and promote an even flow distribution. Nutrient reduction processes are also affected by temperature, so performance will vary seasonally and for different climatic regions.

Sections 4 and 5 of the AgriAce Report specifies the percentage total nitrogen and total phosphorus reductions for a wetland area that is 5.0% of the contributing catchment area. I note that these percentage reduction figures are based on the assumption that the actual wetted area of the constructed wetland under normal flows will be 2.2 ha, and that areas taken up by any associated bunds, embankments and riparian plantings are additional.

I agree with the figures provided in the AgriAce Report for the expected long-term performance estimates for reduction of total nitrogen by a well-constructed and maintained wetland, being 38% reduction in total nitrogen lost with a range of 31-46%. Based on the NIWA 2021 Report, the figures for 'cool zones' are relevant to the subject site. However, it is reasonable to expect that the impacts of climate change in Southland[2] may result in the performance estimates for 'warm zones' (median annual air temperatures above 12 degrees Celsius) being more relevant in future years. Nitrogen reduction rates generally increase as temperature increases, meaning that the percentage nitrogen losses achieved by the proposed wetland complex may increase over time.

I also agree with the expected percentage total phosphorus reduction figures for an appropriately constructed wetland stated in the AgriAce Report, being 48% reduction in total Phosphorus with a range of 33-60%. The performance predictions for total phosphorus do not apply for constructed wetlands whose main source is sub-surface drainage containing predominantly dissolved forms of phosphorus, or where soils comprise ≥35% clay. The sub-surface drain locations have not been

[2] Ministry for the Environment (2018, 31 May). *Climate change projections for the Southland region*. https://environment.govt.nz/facts-and-science/climate-change/impacts-of-climate-change-per-region/projections-southland-region/#temperature

provided with the documentation, so I assume that the main source of runoff is from the ephemeral waterway.

Kind Regards

Andrea Richardson

Position: Landpro Senior Planner

Relevant qualifications: Bachelor of Engineering (Honours, Civil)