BEFORE THE HEARING PANEL OF SOUTHLAND REGIONAL COUNCIL

In the matter of sections 88 to 115 of the Resource Management Act 1991

And

In the matter Applications for resource consents by:

WOLDWIDE FOUR LIMITED, WOLDWIDE FIVE LIMITED,
Applicants

BRIEF OF EVIDENCE OF CAIN DUNCAN

19 September 2019

QUALIFICATIONS AND EXPERIENCE

1 My full name is Cain Ross Duncan and I am currently employed as the Otago/Southland Sustainable Dairying Manager with Fonterra Co-Operative Group.

2 I hold a Bachelor of Resource Studies and a Masters in Applied Science from Lincoln University which were completed in 2000 and 2005 respectively. I achieved a Certificate of Completion from Massey University for satisfying the course requirements for the Advanced Certificate in Sustainable Nutrient Management in 2014. This is part of the training required for understanding and using of OVERSEER®.

3 In addition to the above qualifications I hold a Certificate of Completion for satisfying the course requirements for Advanced Farm System Modelling from Massey University.

4 I am a current Certified Nutrient Management Advisor having satisfied the criteria under the Nutrient Management Advisor Certification Programme managed by the Fertiliser Association of New Zealand. I completed my last annual assessment for this programme in December 2018.

5 I have 7 years' experience in the dairy industry in the role of a Sustainable Dairy Advisor. This role involves providing advice and support to Fonterra shareholders to assist them in developing and adopting practices that will improve the sustainability of their farming operations. I work one on one with our suppliers, to accelerate their adoption of good management practices, meeting Fonterra's minimum standards and complying with regional rules and consents.

6 Since 2013 Fonterra has annually collected data from its farmer shareholders to enabled modelling of individual farms nitrogen loss using OVERSEER®. Last year this resulted in the processing of over 9500 OVERSEER® files by Sustainable Dairy Advisors and QCONZ. Each year I process between 50-100 OVERSEER® files as part of this programme as well as a number of regulatory and predictive budgets for shareholders throughout the year.

7 I have a sound knowledge of farm systems and their relationship with nutrient management plans, having provided these to Fonterra shareholders in recent years.

8 Prior to my employment with Fonterra I worked for the London Borough of Tower Hamlets and the London Borough of Haringey (United Kingdom) as a Planning Officer/Enforcement Manager in their respective Planning sections for a total of 7 years. Before moving to the United Kingdom I worked as a Compliance Monitoring Officer for Environment Canterbury.

9 I have read, and agree to comply with, the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. Other than where I state that I am relying on the evidence of another person, I confirm that the issues addressed in this evidence are within my area of expertise. I have not omitted to consider material facts known to me that alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

10 This evidence addresses the following issues:

10.1 OVERSEER® FM v6.3.1 modelling for Woldwide Runoff Limited **"WRL"** for the 16/17 and 17/18 seasons as well as a proposed scenario for this area of land based on its future use if consent is granted for expanded dairying at WOL and WTL.

10.2 Additional reductions in phosphorus outside of that modelled in OVERSEER®.

11 I am aware that Dr Freeman's evidence indicates that some of the areas I have modelled do not necessarily need land use consent and that the Applicants' opening legal submissions will deal with this. The fact that I have modelled those areas does not mean that I accept they require a land use consent. That is not an issue on which I am giving evidence, as it is addressed by others.

BACKGROUND

12 The following abbreviations have been used to describe the land associated with the Woldwide group of farms:

WW4 – Woldwide Four Limited

WW5 – Woldwide Five Limited

WRL – Woldwide Runoff Limited incorporating the Merrivale Block and the leased Merriburn Block.

13 I have been involved in producing various end of season and scenario nutrient budgets for the Woldwide Group of farms since early 2017. I have not been directly involved in producing the nutrient budgets for WW4 or WW5 for this hearing or the related consent applications.

14 Farm systems information was provided by Mr De Wolde for the nutrient budgets that have been produced. In addition to this, fertiliser inputs have been provided by Ravensdown.

15 Soil areas were produced from Fonterra's GIS mapping tool, which links to S-Map soil data. Climate settings were obtained directly from the Overseer based on the farms location.

16 The Merriburn Block was incorporated into WRL in the 2017-18 dairy season, however there was only limited information made available on its past production potential and previous stocking rates. This was largely due to the passing away of one of the previous owners who had overseen the property.

17 This has resulted in difficulties being able to source information to model the use of the Merriburn Block prior to 2017. In general terms it is known that the property was used for the rearing and wintering of young stock (R1's and R2's) for the former Milkpride dairy management company.

18 A 2016-17 nutrient budget has been produced for WRL, which reflects the actual inputs for the Merrivale Block (which was under the ownership of WRL) and a conservative estimate of the land use occurring on the Merriburn block.

19 It is important that the use of the land prior to the property being leased to WRL is reflected as the available evidence indicates it was a significantly more intensive use than what is proposed and currently occurring on the Merrivale Block. This is significant as in 2017-18 WRL was understocked, resulting in considerable difficulty controlling pasture growth, which in turn impacted on pasture quality and animal growth rates.

20 In addition, I note that Mrs De Wolde's evidence and that of Dr Freeman describes what can lawfully occur and is likely to happen if the consents are not granted. In that case the applicants are not limited to what happened in 2017-18 and the 2016-17 gives some indication of the types of losses that might occur.

21 A number of updates have been made to the OVERSEER® modelling during the course of the application as a result of updates to OVERSEER®, changes in the interpretation of policies within the Proposed Southland Water and Land Plan and the outcome of hearing decisions, which prompted the need to better reflect the actual baseline losses from WRL. The final version of Nutrient Budgets/Analysis Report is:

– Nutrient Budgets/Analysis Woldwide Runoff (Supplementary Report) Version 3 – 05/09/19.

OVERSEER® ASSUMPTIONS, LIMITATIONS AND UNCERTAINTIES

22 OVERSEER® is a tool used by farmers and advisors to assess nutrient use, loss and movements within a farming system. The computer model calculates and estimates the flow of nutrients in a farming system and identifies the risk of environmental impacts through nutrient loss.

23 OVERSEER® uses animal stocking rate and productivity to estimate animal requirements (MJME), which is then used to estimate production.

Assumptions

24 There are four main assumptions underpinning the use of OVERSEER® as a modelling tool. They are:

24.1 OVERSEER® assumes steady state conditions, i.e. the farm is at a state where there is minimal change each year.

24.2 OVERSEER® uses long term average inputs such as rainfall, PET and temperature and thus produces annual average outputs.

24.3 OVERSEER® assumes the inputs into the model are actual and reasonable.

24.4 OVERSEER® assumes some specific good management practices (GMP's) are used. For effluent and fertiliser it is assumed that the stated rate is applied evenly at the time stated. The model also assumes runoff from yards, races bridges, silage stacks are all dealt with in a manner that doesn't result in large point source discharges. The exception to this is for phosphorus where OVERSEER® assumes 30% of phosphorus deposited on lanes is lost to surface waterways.

Limitations

25 The key limitations of the OVERSEER® model are:

25.1 OVERSEER® does not predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving waterbody.

25.2 OVERSEER® uses long term average climate data and therefore doesn't account for climatic extremes or years where climate allows for exceptional (or poor) pasture growth. The model provides a "typical" year's result based on a long term average.

25.3 OVERSEER® does not calculate the impacts of a conversion process, rather it predicts the long term annual average nutrient budgets for the changed land use.

25.4 OVERSEER® is not spatially explicit beyond the level of defined blocks.

25.5 Not all management practices or activities that have an impact on nutrient loss are captured in the OVERSEER® model.

25.6 OVERSEER® has not been calibrated against measured data from all farming systems, soil types or environments.

Uncertainty

26 Uncertainty pertaining to the OVERSEER® centres around the model's ability to accurately determine nutrient losses, however these are practically impossible to measure accurately. Measured results from parts of paddocks or more rarely whole paddocks have been carried out using lysimeters, suctions cups and other collection technologies but it is not possible to capture nutrient losses from a whole farm and across the multiple soil and landscape variations that may occur. This means there are few benchmarks to compare against.

27 OVERSEER® is used for modelling a wide range of farm systems in many different geographical settings; validation or calibration data for all circumstances is not possible, therefore the issue is really the uncertainty associated with whole farm nutrient loss estimates will increase for situations that are well outside the calibration /validation range.

28 Pastoral blocks within OVERSEER® have been through the most calibration and testing (most of which has been on dairy farms) but more data from calibration/validation of the OVERSEER® model is required to reduce the uncertainty, most notably for:

- Cropping and Sheep and Beef
- Clay and shallow and light textured soils

- High Rainfall locations >1200mm

29 Traditionally Overseer has been calibrated against a set of farmlet trials however Version 6 (2012) has also undergone a range of logic tests to ensure that parts of the model were responding as expected and to test for unforeseen consequences of changes. In addition to this expert opinion on the model and its responses were also provided. The farmlet trials utilised in the calibration and validation of Overseer are outlined in Table 1 below:

Management block	Nitrogen calibration	Phosphorus calibration
Pastoral	Calibration (undertaken in 2012) used nutrient loss measurements from farmlet studies at eight locations. These were: Edendale, Southland (intensive beef); Tussock Creek, Southland (dairy); Kelso, Otago (dairy); Lincoln University Dairy Farm, Canterbury (dairy); Massey University Dairy Farm, Manawatū-Whanganui (dairy); Ruakura, Waikato (dairy); Scott Farm, Waikato (dairy); and Wharenui, Bay of Plenty (dairy). A recalibration exercise is currently underway.	Calibration (undertaken in 2005) used data from 23 sites: Canterbury (2), Otago (3), Southland (2), Manawatū (5), Northland (2), Waikato (4), West Coast (2), Wellington (1), Hawkes Bay (2).
Crop	Arable crops – very limited calibration (one Lincoln site).	Arable crops – none due to a lack of experimental sites. Forage crops – limited to 2 sites in Otago and 1 in Southland.
Fruit crop	None due to a lack of experimental sites.	None due to a lack of experimental sites.
Trees and scrub	None due to a lack of experimental sites.	None due to a lack of experimental sites.
Wetlands and riparian	Very limited calibration based on published studies.	Very limited calibration based on published studies.
House	Very limited calibration (based on one international study).	None.

Table 1 – Overseer Calibration and Validation (Parliamentary Commissioner for the Environment, 2018[1])

30 Uncertainty around OVEERSEER® outputs tends to be much lower within the range of the calibration data set outlined in Table 1. Most of the calibration and validation data used to date is focused on flat, pastoral, dairy enterprises, with primarily free draining soils and moderate rainfall located in the Waikato, Southland, Canterbury and Manawatu.

[1] Parliamentary Commissioner for the Environment (2018). *Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways.* Pg 31.

31 The modelling undertaken on WRL is for a pastoral enterprise located on a mix of flat to rolling topography with some steeper areas. Rainfall is moderate <1200mm/yr and over 85% of the land area is located on well to moderately well drained soils.

32 The WRL farm system has a number of similarities with the farm systems used to calibrate/validate the OVERSEER® model and would not be classified as being well outside the calibration/validation range of the model.

33 Consistency in entering inputs into OVEERSEER® is critical to the precision of the model i.e. do multiple users get the same result. Insuring modelling is consistent across scenarios and following agreed protocols such as the Overseer Input Standards are essential to obtaining accurate farm loss estimates and consistency between modelled scenarios.

34 When scenarios are compared the focus should be on the difference in modelled outputs rather than the overall nutrient loss estimate.

35 The use of OVERSEER® as a modelling tool has been recognised by a number of Regional Councils across New Zealand and has been accepted by the Environment Court for use by councils in regional plans to manage nitrogen losses. It is specifically recognised in the Proposed Southland Water and Land Plan where an OVERSEER® nutrient budget (or an approved alternative) is required for Farm Environmental Management Plans (FEMPs) for all landholdings over 20ha. I am not aware of alternative being approved by Environment Southland.

<u>Modelling Steps Taken to Reduce Uncertainty</u>

36 The following steps have been undertaken to minimise the impact of uncertainties on the modelling results:

36.1 The Best Practice Data Input Standards (BPDIS) have been complied with to ensure consistency in entering inputs into OVERSEER®. No deviations from the BPDIS were made.

36.2 A consistent method and methodology was used between scenarios to ensure comparable results.

36.3 Blocking was undertaking using farm level soil mapping and took into account land use, management systems, soils, stock and topography.

36.4 An experienced and qualified OVERSEER® user with a good knowledge of dairy farm systems was used to drive the model and produce the associated nutrient budgets.

36.5 The outputs from the OVERSEER® modelling were sense checked against expected results relative to soil types, land use, climate and inputs.

36.6 A site visit was made to all properties associated with the OVERSEER® modelling to ensure a good understanding was obtained of the land features.

OVERSEER® Modelling Results

37 Modelling has been undertaken for WRL which is comprised of two neighbouring properties totalling 892ha located at Merrivale in Southland. The 507ha Merrivale Block is owned by WRL and the 385ha Merriburn Block is leased to WRL.

38 WRL is used to graze young stock from five dairy farms with baleage being made during periods of surplus grass production. Baleage is used to supplement the winter grazing of young stock at WRL and is also sold to other Woldwide farms. In addition to the raising of young stock and baleage production, WRL also has approximately 100ha of commercial pine plantation and 60ha of Beech forest.

39 Changes to the farming systems at WW4, WW5 and two other dairy farms in the Woldwide group mean changes are proposed to occur at WRL. The only significant change from the 2017-18 season is the wintering of 450 R2's (young stock) over June and July, however this is less wintering than what is estimated to have occurred in the 16/17 season. Previously young stock (R2's) have been wintered on support blocks in the Heddon Bush area, close to the Woldwide dairy farms.

40 Detailed information on the inputs used in the OVERSEER® modelling and changes that have occurred year on year and between current and proposed scenarios are covered in the following report and for brevity are not included in this brief of evidence:

– Nutrient Budgets/Analysis Woldwide Runoff (Supplementary Report) Version 3 – 05/09/19

Woldwide Runoff (WRL) Results

41 The results of the baseline nutrient budgets and proposed nutrient budget prepared for WRL are shown in Table 5 below (OVERSEER®FM version 6.3.1):

	16/17	17/18	Average	Proposed	% Change
Total N Loss (kg)	26134	19931	23033	22603	-1.9
N Loss/ha (kg)	29	22	26	25	
Total P Loss (kg)	500	532	516	489 (454)*	-5.2 (-12)*
P Loss/ha (kg)	0.6	0.6	0.6	0.5	
Pasture Grown (kg/DM/ha /yr)	12639	11024	11832	13282	

Table 5 – Current and Proposed Nutrient Losses Woldwide Runoff

* Figures in brackets are total phosphorus reductions including mitigations calculated outside of OVERSEER® - See paragraphs 50-52.

42 Using OVERSEER®, nutrient budgets have been produced comparing nutrient losses from the 16/17 and 17/18 seasons against those from the proposed system. OVERSEER® predicts that nitrogen loss will decrease by 1.9% and phosphorus by 5.2%.

43 The key reasons for the small reduction in nitrogen are:

- Reduction in cows wintered on crop compared to the 2016/17 season.
- Additional land (12ha) planted in trees
- More efficient use of nitrogen fertiliser

44 The key reasons for the reductions in phosphorus are:

- Additional land (12ha) planted in trees
- Reducing larger applications of phosphorus fertiliser
- Reduction in cows wintered on crop compared to the 2016/17 season.

45 The core of the Overseer sub-model is based on the work of McDowell et al (2005)[2], which estimates phosphorus losses due to run-off up to second order streams (a stream with two tributaries) from a grazed-pastoral system. Run-off includes the combined losses from surface and sub-surface flows, but excludes deep drainage to groundwater and mass movement. At block level OVERSEER® accounts for general topography attributing a higher phosphorus loss risk with increased slope, however it is unable to define specific areas of risk within a block, such as critical source areas. Due to this limitation the model can't account for specific mitigations to deal with those higher risk areas.

46 A key assumption in the OVERSEER® phosphorus sub-model is that there is a connection between a phosphorus source and a second order stream. On properties with no waterways or on a flat farm with minimal critical source areas this assumption may not hold true. In addition to this, OVERSEER® automatically estimates that there will be phosphorus loss from lanes to waterways. It assumes that all excreted phosphorus ends up as dung and that 30% of the phosphorus deposited on lanes is lost to water with the remaining 70% expected to remain on the lane or return to the adjacent paddock. This is a significant assumption and a major component of modelled phosphorus loss, reported as part of "other sources" in the OVERSEER® model.

47 Taking into account the mechanics of the OVERSEER® phosphorus sub-model, proposed mitigations that isolate a source of phosphorus from a waterway or reduce the amount of phosphorus getting to a waterway through specific landscape features will result in additional reductions in phosphorus above those calculated in OVERSEER®.

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[2] McDowell, R.W., Monaghan, R.M., Wheeler, D. (2005). *Modelling phosphorus losses from pastoral farming systems in New Zealand*. New Zealand Journal of Agricultural Research 48: 131-141.

Details of these mitigations for WRL are contained in the following report attached to the Farm Environmental Management Plan:

- Woldwide Runoff Phosphorus Mitigation Plan Version 2 – 05/09/19.

48 When specific phosphorus mitigations measures relating to unfenced waterways (mitigation of 19.7kg P/year) and the management of critical source areas (mitigation of 15kg P/year) are calculated outside of OVERSEER® the predicted total reduction in phosphorus as a result of implementing the proposed farming system is 62kg P/year or 12%.

49 As noted in paragraphs 16-19, the section of the 2016-17 nutrient budget that relates to the Merriburn block has been based on a conservative estimate of the land use that was likely to be occurring. Stock data estimates were provided by a former farm manager with the crop and supplement requirements to fed stock over winter being determined by the Dairy NZ crop calculator.

50 To support the winter grazing assumptions made for the Merriburn Block aerial imagery (Google Earth) was used to look at areas of the farm that were under cultivation. The most recent image of the farm prior to it being leased to WRL is December 2015. The areas cultivated at this time were placed onto a farm map (attached in the Woldwide Runoff Nutrient Budget/Analysis Report – Appendix 3) showing paddocks and their subsequent size. The area under cultivation was approximately 120ha. Assuming half of this area was returning to grass (which is conservative as some paddocks would be double cropped) then 60ha would have been utilised for winter grazing. This can be compared to the 58ha under winter crop in the Merriburn Block in the 2016/17 Nutrient Budget.

51 Conservative fertiliser inputs and baleage production figures were also used in forming the 2016-17 nutrient budget. Full details are available in the following report:

- Nutrient Budgets/Analysis Woldwide Runoff (Supplementary Report) Version 3 – 05/09/19.

CONCLUSION

52 OVERSEER® modelling undertaken for WRO predicts losses of nitrogen and phosphorus to decrease when compared to modelling undertaken for the proposed farming system. When additional mitigations for phosphorus are applied outside of OVERSEER® total phosphorus losses are predicted to decrease by 12%. Nitrogen loss is predicted to decrease by 1.9% between the current average and the proposed scenario.

Dated 19 September 2019

Cain Duncan