



BEST PRACTICE DATA INPUT STANDARDS

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A wider stakeholder advisory group consisting of agricultural industry representatives, regional councils, the Ministry for Primary Industries, the Ministry for the Environment and Irrigation New Zealand have also critiqued and endorsed the Standards.

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Preface

OVERSEER is an agricultural management tool which models the cycling of nutrients within a farming operation; it estimates the inputs, outputs and nutrient flows of various farm management scenarios to assist users to optimise production and environmental outcomes. It estimates nitrogen and phosphorus loss and greenhouse gas emissions allowing the risk of environmental impacts of farm management options to be taken into consideration.

User selection of the input parameters can have a major effect on the estimates of nutrient cycling for the described farm systems and hence the ultimate budget reports. The purpose of providing a 'best practice' Standard is to reduce inconsistencies between different users when operating OVERSEER to model individual farm systems.

These Standards give expert users guidance for data inputs that consistently achieve the most meaningful results. They have not been developed to teach users how to operate OVERSEER, nor have they been designed as an auditing system.

NAVIGATING THE STANDARDS

- The content of the Standards – and the order in which it appears – corresponds to the data entry pages in OVERSEER.
- Most sections contain impact statements, and some sections contain additional information such as notes, guidance, warnings or a justification.
- Where there is more than one recommendation given, the preferred option is listed as 1.
- Throughout the Standards you will notice some input recommendations are compulsory for the dairy industry. If you are completing a nutrient budget for a dairy farm, please follow these recommendations. The compulsory dairy industry recommendations are highlighted by a yellow box.

IMPORTANT INFORMATION ABOUT OVERSEER

- By default, OVERSEER estimates an annual average nutrient budget assuming inputs (management, climate etc.) are constant. OVERSEER uses average rainfall, PET and average annual temperature, with default PET and average annual temperatures based on the long-term climate data and long-term monthly climatic distribution patterns.
- When considering the use of OVERSEER for forward predictions (e.g. consent applications, fertiliser maintenance requirements) it is recommended that the data that describes the typical management system to be adopted is used with long-term average climate data (rainfall, temperature).
- For monitoring purposes, it is recommended annual management data is used with long-term rainfall until this issue is more fully resolved (refer to Appendix 9). If annual data inputs are used, it is also recommended that a rolling average or trend analysis of outputs is used to reduce the impact of year-to-year variability when monitoring the degree of compliance with any target or critical value. In addition, the uncertainty of OVERSEER predictions can be reduced if the focus is on a percentage change over time (rather than an absolute change).

Note

The Standards will be updated and amended as often as is necessary to ensure that they comply with the requirements of new versions of OVERSEER. Known problems have been noted within the MyOVERSEER portal. If you have any comments about the Standards, or have identified an issue, please log your comments in the 'MyOVERSEER' support portal located online at: www.overseer.org.nz

Table of Contents

1. FARM SCENARIO	1	3. STRUCTURES	21
1.1 General	2	3.1 Feed Pads	22
1.2 Location	2	3.2 Winter Standoff or Loafing Pads	22
1.3 Blocks	2	3.3 Wintering Pads/Animal Shelter/ Barn/Housing	23
1.4 Enterprises (Stock)	4		
1.5 Structures	4	4. BLOCK DATA	25
1.6 Animal Distribution	5	4.1 General	26
1.7 Dairy Effluent System	5	4.2 Climate	29
1.8 Supplements Imported	6	4.3 Soil Description	30
1.9 DCD (Nitrification Inhibitors)	7	4.4 Soil Profile	31
1.10 Wetlands	7	4.6 Soil Tests	34
1.11 Greenhouse Gas Footprint	8	4.7 Drainage/Runoff	35
1.12 Report Settings	8	4.8 Pasture	36
2. ENTERPRISES	9	4.9 Supplements Made	37
2.1 Numbers	10	4.10 Fertiliser	37
2.2 Production	16	4.11 Irrigation	38
2.3 Health Supplements	17	4.12 Animals	44
2.4 Milking Shed Feeding	17	4.13 DCD (Nitrification Inhibitor)	44
2.5 Left-Over Feeding	17	4.14 Effluent	45
2.6 Outdoor Pigs	18	4.15 Block History	46
		4.16 Fodder Crop Rotation and Crop Rotation	47
		4.17 Outdoor Pig Green Cover	49
APPENDICES			
Appendix 1: Factors to take into account when combining areas into blocks for arable farms			51
Appendix 2: Grouping options for crops of similar N status and canopy duration for specifying the previous crop			52
Appendix 3: Additional information around entering information to the enterprises			54
Appendix 4: Description of New Zealand Soil Orders* in OVERSEER			56
Appendix 5: Definition of soil profile inputs, soil water parameters and OVERSEER texture			58
Appendix 6: Default entry inputs of crops and management options not supported by the OVERSEER Crop rotation page			61
Appendix 7: Additional information around data entry into the crop rotation page			62
Appendix 8: Terminology used in the nutrient budget scenario reports			75
Appendix 9: Technical Note: Using annual or average climate and production data			78
Appendix 10: Definition of irrigation terms used in OVERSEER			80
Appendix 11: OVERSEER irrigation defaults			84
Appendix 12: Optional irrigator questionnaire(to be completed per block)			88
Appendix 13: Seed crops			90



1

**Farm
Scenario**

1. Farm Scenario

1.1 GENERAL

This section is used for identification of the property, owner/client and consultant details.

Farm Scenario/Client/Property/Consultant details

RECOMMENDATION:

Fill in as required. We recommend all boxes are filled in i.e. client name, address of property, legal description of property, valuation number and consultant details.

- For assessment year enter as year dates e.g. 2016/2017.

1.2 LOCATION

IMPACT:

The location sets variable climate defaults and some animal characteristics e.g. calving date.

RECOMMENDATION:

1. Select location by **region**.
2. If your site has similar climatic conditions (i.e. temperature or rainfall) to the **nearest town**, choose that option.

NOTE: Location sets your climate pattern and if you don't use virtual climate station (VCS) data it will determine PET and temperature. If you use VCS data this will override the default PET and temperature set by location, but your climate pattern is still a function of the location you selected.

1.3 BLOCKS

IMPACT:

It is critical to get the farm area and block areas within the farm defined as accurately as possible to truly represent the farm being modelled. It is not the intention of the Standards to instruct users on how to block farms.

RECOMMENDATION:

The total farmed area including relevant tree blocks and non-productive areas must be entered. The total farm area does not have to be contiguous; blocks may be geographically separated but included in the same nutrient budget, however, if blocks are in separate catchments they should be treated as separate nutrient budgets.

- Blocks should be defined based on land uses, management systems (i.e. effluent and/or sludge applied, irrigation applied, cut and carry, support block/runoff), soils, topography and enterprise.
- Typical blocks will be:

» Pastoral	» Outdoor pigs
» Pasture block with fodder crop rotation	» Trees and scrub
» Cut and carry	» Riparian
» Fruit crop	» Wetland
» Crop	» House

- If total area is entered, the difference between total area and sum of effective area is deemed non-productive area. While not recommended, if total area is not entered, OVERSEER will assume a certain percentage of the effective block is lanes, raceways and yards, and this area is added to the effective area entered to give total farm area used in the calculations.
- If a wetland block/area is present on the farm, it is NOT to be set-up as a separate wetland block/area. To recognise the area of land retired from grazing, this area will need to be accounted for as a riparian block. It is recommended not to specify riparian strip P model inputs.

Pastoral

Support blocks:

1. If interested in whole system output, include support block.
2. Where a support block/runoff is contiguous with the milking platform, the support block should be entered as a block within the whole farm.
3. Where the support block/runoff is non-contiguous and in a different catchment it should be treated as a separate farm.

NOTE: If you are interested in Life Cycle Assessment (LCA) you must also include other properties that are involved in the farming operation i.e. farms where cows are wintered off. However, if animals are placed on a leased block they don't have to be included, but an assessment is made of the embodied costs of having those cows off-farm (i.e. feed costs and transport).

Fodder crop

Use the **fodder crop block type** when fodder or forage crops rotate through selected pastoral blocks and are resown back into permanent pasture within 12 months. Only up to 25% of the area of pastoral blocks through which fodder crop blocks rotate can be cropped.

If your fodder crop doesn't match this, enter as a crop block.

Crop

Use the **crop block type** when one or more of the following occur:

- crops other than fodder or forage crops are part of the crop rotation
- two or more crops are planted consecutively
- the block is not cultivated out of pasture and resown back into pasture within 12 months
- the same paddocks are used continuously for the fodder crop
- the total area of fodder crop blocks is greater than 25% of pastoral blocks through which they rotate.

In situations of multiple crop rotations it may be necessary to treat each paddock as an individual block.

- To minimise the number of blocks, guidelines to consider when amalgamating paddocks/crops into blocks may be found in Appendix 1 and 2.

Outdoor Pigs

The outdoor pig block is only to be used for pigs on outdoor paddocks. There can be separate blocks for the breeding herd and a growing pig block. There may be pigs housed that are on an outdoor block in villages for farrowing or sheds or barns for replacements, mating or gestating sows.

House blocks

House blocks should be entered on small properties (< 20 ha), unless specific Regional Council guidelines require a different approach. House blocks are important on lifestyle properties in sensitive catchments.

Effective area

For all blocks except fodder crop blocks, enter the effective area of the block.

- For pastoral blocks this includes area grazed, but excludes raceways and lanes.
- Fenced off areas of trees within another block (e.g. trees, scrub within a pastoral block) should be amalgamated up and entered as tree blocks.
- Fenced off areas of wetlands should be separated out and entered as a Riparian block.
- For crop blocks, the effective area of a crop block should include headlands, tracks within the block, or other areas defined as not cultivated but plants growing, e.g. pasture around fence lines. These can be further redefined under the crop input options. However, farm tracks should be part of the non-productive area.

JUSTIFICATION:

All of the factors mentioned above are critical to determining the way OVERSEER treats how nutrients cycle between blocks and into and out of the farm.

1.4 ENTERPRISES (STOCK)

IMPACT:

Farm animals are a major source of nutrient loss from the whole farm system.

RECOMMENDATION:

Check the boxes which represent the enterprises on the farm.

1.5 STRUCTURES

IMPACT:

Structures influence the time animals spend on paddocks and how excreta is distributed between paddocks and other surfaces.

RECOMMENDATION:

Check the boxes which represent the structures present on the farm.

- 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 (1-2 hours), either prior to or after milking, and provided with supplementary feed.
- A **winter standoff 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. If stock are held for extended periods on the raceways, treat this as a standoff area.

NOTE: A feed pad and winter standoff or loafing pad can only be selected if dairy cows are present on the property.

- A **wintering pad, animal shelter, barn or housing** are specially built areas constructed where animals are withheld from pasture for extended periods (weeks or months) and supplementary feeds can be brought to them. A wintering pad consists of a bedding area, with or without a concrete feeding apron.

1.6 ANIMAL DISTRIBUTION

IMPACT:

Differences in productivity (amount of pasture growth) and livestock type between blocks will influence the distribution of animal intake and excreta deposition between blocks and hence nutrient cycling and transfers between blocks. If characteristics such as soil, climate, development status or irrigation differ between blocks then this can result in different farm N leaching losses.

Relative Productivity

RECOMMENDATION:

1. Where differences in block productivity are unknown use the default **no differences between blocks**.
2. Where relative pasture productivity is likely to be different e.g. irrigated vs. dryland, flat country vs. hill country, relative productivity differences should be entered based on credible information (e.g. measured or farmer knowledge of pasture yield assessment, grazing days and/or stocking rate).
 - When using **animal assessment**, actual stocking rate differences can be used e.g. flats 14 su/ha and hills 7 su/ha.

Distribution of animal classes within blocks

RECOMMENDATION:

1. Select **same as ratio of total animal intake** if it can be assumed that, on pasture blocks, animals eat pasture in the same ratio as farm intake. (This is the same as previously selecting the box 'Assume all animals on block eat pasture at the same rate as farm intake').
2. If the proportion of pasture eaten by a given animal type differs between blocks select **user-defined for each block**. (This is the same as previously leaving the box unchecked 'Assume all animals on block eat pasture at the same rate as farm intake').

DAIRY INDUSTRY

Select **same as ratio of total animal intake**.

JUSTIFICATION:

When there are obvious differences between block productivity it is important to try and represent that in the best way possible, otherwise nutrient uptake and deposition by grazing animals will not be properly represented.

1.7 DAIRY EFFLUENT SYSTEM

IMPACT:

Only displayed if dairy or dairy goat enterprise has been selected. Entering the correct management system is critical to determine the fate of effluent nutrients.

Management System

RECOMMENDATION:

Select the most appropriate management system from the drop down box.

- If **spray from sump** is selected or **all exported**, nothing further is required on this page.
- If **2 pond + discharge** is selected further information is required on pond solid management i.e. either **spread on selected blocks** or **exported**.
- If spread on selected blocks is selected, then enter the frequency in years that **ponds are emptied**.

- If **holding pond** is selected further information is required.
 - » If **solids are separated** out before entering the holding pond, check the appropriate box, information on management method and storage method of the solids will be required.
 - » If pond solids are **spread on selected blocks** enter frequency in years that **ponds are emptied**. Pond solids can be exported.
 - » For liquid management select the appropriate method from the drop down box.

JUSTIFICATION:

Effluent management systems and fate of solids and liquid effluent should be easily identified on-farm and from farm records.

1.8 SUPPLEMENTS IMPORTED

IMPACT:

Supplements are an important source of nutrients coming into a farm system and an accurate description of the type and amount of supplements brought in is critical to nutrient cycling assessments on-farm.

Supplement description and source

RECOMMENDATION:

1. Records (purchased or freight) of the types and quantities of the purchased feeds must be used to populate the fields required. Supplement source can be **purchased** or **from storage**.
 - Where the nutrient budget is based on a one year assessment – feeds that were purchased or imported in the year of assessment but put in storage at the end of the year must NOT be included.
 - If your supplement is not available from the drop down lists, select the supplement with the closest characteristics (crude protein or N content) or enter as **user defined supplement**.
2. When no records exist, farmer estimates will suffice, although it is unsatisfactory.

Weight

RECOMMENDATION:

Enter actual weight (in tonnes) of supplement where known.

- Take care to check the box **weight on dry weight basis** if the weight is recorded on this basis.
- For bale feeds where actual weights are not known click **use bale size**. Where no information is given enter 12 for the number of standard bale equivalents/bale.

Storage

RECOMMENDATION:

Leave as **average**, unless there is good evidence to alter this.

Destination

RECOMMENDATION:

Select most appropriate destination where the supplement is fed, from the choices in the drop down list.

RECOMMENDATION:

Select appropriate utilisation, or if unknown, use **average**, unless on a pad where the default is very good. Refer to OVERSEER HELP file for additional information.

*NOTE: Select **specify timing of feeding** if timing is concentrated around certain times of the year e.g. maize silage in autumn. This should be based on on-farm records. Note that the feed balance needs to be more precise when timing is selected. If an error occurs around too much or too little feed, sometimes unchecking **specify timing of feeding** will resolve this.*

*NOTE: Where the destination of the supplement is **in shed feeding**, this option will only become available after filling out the milking shed feeding section under the dairy enterprise feeding. The dairy enterprise inputs must be entered prior to entering supplement input page.*

JUSTIFICATION:

Because this is such a potentially important source of nutrients, farmers will need to be educated into obtaining and retaining accurate records of all supplementary feed purchased and fed.

- Utilisation and storage – inappropriate values entered are one reason why messages on insufficient or too much feed are generated.

1.9 DCD (NITRIFICATION INHIBITORS)

IMPACT:

DCD can be used to mitigate some of the impacts of nitrogen losses.

RECOMMENDATION:

Do not fill in this section at all as DCD is not currently available on the market.

1.10 WETLANDS

IMPACT:

Wetlands can operate as denitrification zones and can act as mitigation for off-farm N losses.

RECOMMENDATION:

1. Ignore wetlands if not a significant feature of the farm.
2. If a wetland block/area is present on the farm and is a significant feature of the farm, it is NOT to be set-up as a separate wetland block/area. To recognise the area of land retired from grazing, this area will need to be accounted for as a riparian block. It is recommended not to specify riparian strip P model inputs.

JUSTIFICATION:

Farmers should be given the mitigation 'credit' for purposefully having and maintaining functioning wetlands within their farm systems. At this stage a Riparian block is the best way to capture the area retired from grazing. The wetland model is currently under review.

1.11 GREENHOUSE GAS FOOTPRINT

RECOMMENDATION:

Ignore this section unless interested in 'cradle-to-farm gate' inputs for LCA analysis, or altering greenhouse gas emission factors.

1.12 REPORT SETTINGS

IMPACT:

This allows the user to customise some of the reports out of OVERSEER with respect to benchmarking data, regional council permitted activity rules requirements/thresholds and fertiliser nutrient costs. You can alter report setting for all your subsequent farm reports by going to the Options>Report tab. Or customise for a particular farm using the Farm Scenario>Report setting drop down menu list.

RECOMMENDATION:

1. Enter the most appropriate data to customise output reports.
 - a. Select from drop down list of **farm type for benchmarking data**. Select **typical dairy farm** for dairy farms and **typical sheep and beef farm** for all other farm types.
 - b. Enter the appropriate regional council permitted activity or consented N application rate as effluent.
 - c. Enter the applied fertiliser nutrient costs per ha into the appropriate boxes.
2. If unknown, use OVERSEER defaults.



2

Enterprises

2. Enterprises

IMPACT:

The type and amount of animals on-farm, their weight and the associated maintenance, growth, gestation, lactation and production has a direct influence on metabolisable energy requirements, which is used to determine pasture dry matter intake, which in turn directly influences nutrient cycling between animals and pasture. For additional guidance around entry of inputs to the enterprise panes refer to Appendix 3.

2.1 NUMBERS

2.1.1 Dairy, Dairy Grazing, Dairy Goats

Breeding stock numbers

IMPACT:

The entry of monthly stock numbers must be as accurate as possible to ensure that a relevant nutrient budget is produced.

The numbers of animals entered per stock type and class has a direct effect on metabolisable energy and dry matter uptake, nutrient cycling, and ultimately, nutrient losses.

NOTE: Section 2.1.3 below provides more detail on entering mob parameters.

How would you like to enter your stock numbers?

RECOMMENDATION:

1. Where monthly stock numbers are known and can be verified choose **specify based on specific stock numbers**.
2. If monthly stock numbers are not known use **generate milking mob for dairy and replacements**, or **generate breeding mob for dry-stock classes and dairy goats**. This will make assumptions about stock numbers and management on-farm throughout the year. The user will need to modify monthly numbers to accurately reflect actual on-farm animal numbers.

*NOTE: Check **breeding numbers are constant** only if all culling occurs at the time replacements are brought on.*

NOTE: Do not enter number of other animal types (non-dairy) on-farm if <20 stock units (follow the standards for non-dairy animals on a dairy farm if >20).

3. Enter 'specify using peak cow numbers'.

NOTE:

- A default **replacement rate for breeding cows and goats** is provided, adjust if differs from actual replacement rate.
 - » Annual Replacement rate percentage is calculated by: number of cull breeding animals sold per year/number of breeding animals present at 30th June (including dry animals).
- If **calves are fed milk powder** check box, otherwise OVERSEER assumes fed on whole milk to weaning.
- Enter the most appropriate descriptor for class and breed.

- Enter median calving date, drying off/lactation length and weight if known, or leave as OVERSEER defaults (see section 3.3).

NOTE: OVERSEER defaults are provided for mean lambing, calving, fawning and weaning dates; these can be adjusted if there is good information to justify the changes.

- Actual breeding rates and replacement rates for ewes, cows and hinds must be entered.
 - » Breeding rate is calculated by: weaned animals/number of breeding animals present at 30 June (including dry animals).
 - » Replacement rate focusses on the breeding mob and refers to: number of cull breeding animals sold per year/number of breeding animals present at 30 June (including dry animals).
 - » Enter average weaning weight for the stock class.
 - » If the weaning weight is not known leave the pane blank – this will assign a national average weaning weight based on stock type and breed.
- Check **replacements are mated** if they are mated within the 12 month (July–June) stock entry and are therefore differentiated from the original lamb and heifer mobs.
 - » If there is a hogget or heifer mating mob, this must be entered as a separate breeding replacement mob to allow for them to be mated within the 12 month (period above), and are therefore differentiated from the lamb or heifer mob.

NOTE: For all stock types, where there are regular stock movements or strict compliance requirements, the best approach is to enter monthly numbers on a grazing day's basis.

The following formula must be used to calculate numbers per month:

Number of animals ÷ days in the month x number of days present on-farm for that month.

The above calculation applies to any animals on-farm for part of the month.

JUSTIFICATION:

The most accurate representation is using actual monthly stock figures, otherwise, OVERSEER will make assumptions around mating, culling, calving/lambing/fawning/kidding, which may or may not reflect on-farm practice.

For dairy, calving date, lactation length and drying off can be an important factor in N leaching loss.

Outdoor Pigs

Enter stock numbers in hand assuming a continuous turnover.

Other (e.g. Goats, Horses, Alpacas, Llamas)

RECOMMENDATION:

1. To enter in other animals such as goats, horses, alpacas or llamas, select the correct stock class under each tab and enter the number of stock present on-farm.
 - This is an annual stock number entry. If stock are present for only a portion of the year then calculate an annual average figure using the following formula:

$$\text{Number of stock} \div 52 \text{ weeks} \times \text{number of weeks on-farm.}$$
2. If the stock type is not listed, the operator will need to identify an appropriate RSU. These animals are treated similarly to sheep.

2.1.2 Drystock Farming (Sheep, Beef, Deer)

Trading stock numbers

IMPACT:

The entry of monthly stock numbers must be as accurate as possible to ensure that a relevant nutrient budget is produced.

The numbers of animals entered per stock type and class has a direct effect on metabolisable energy and dry matter uptake, nutrient cycling, and ultimately, nutrient losses.

NOTE: Section 2.1.3 below provides more detail on entering mob parameters.

How would you like to enter your stock numbers?

RECOMMENDATION:

All monthly stock numbers should be entered using the selection **specify based on specific stock numbers**.

NOTE: For all stock types, where there are regular stock movements or strict compliance requirements, the best approach is to enter monthly numbers on a grazing days basis.

The following formula must be used to calculate numbers per month:

Number of animals ÷ days in the month x number of days present on-farm for that month.

The above calculation applies to any animals on-farm for part of the month.

2.1.3 Mob Detail Entry Parameters

These data entry standards apply to all stock classes being entered into OVERSEER – including breeding, trading and milking animals.

Notes regarding class

Breeding Stock

- All mixed age breeding stock and dairy cows only have a selection for maximum weight. If this weight is unknown leave blank and a national average default weight will be assigned based on breed and class.
- Breeding replacements are assumed to enter the breeding mob, although some may be sold (indicated by a decrease in numbers). For sheep or beef, if hoggets or heifers are mated ensure the **replacements are mated** tick box is checked.

Trading Stock

- Trading stock should be entered as lambs, calves, fawns, hogget's, heifers, hinds, wethers, bulls, steers, stags with an appropriate start and end weight if there are records, or use age at start.
 - » Lambs, calves, fawns: source = weaned imply (weaners have been weaned directly from the breeding stock on-farm). They are treated as trading stock (sold for store or to the works).
- Weaners (lambs, calves, and fawns) are to be entered starting (the first monthly entry) from their weaning date (entered above).
- The correct type of dairy grazing stock must be entered (dairy grazing milking cows are pregnant; dairy grazing replacements are dry yearlings or autumn-born heifers).

- Dairy grazers – this animal class can be specifically selected under Beef animals to cover dairy cows wintered on or dairy replacements grazed off-farm. The model assumes that the energy intake required for pregnancy is included, but that any lactation occurs on the main (parent) farm.
- Cryptorchid lambs are entered as Ram Lambs (Lincoln University Farm Technical Manual states that they grow almost as fast as entire Rams).

Notes regarding entering animal weights

INTRODUCTION:

The entry of animal weights and weight gain is preferred as it will more accurately reflect what is happening on-farm in terms of maintenance and production requirements from pasture metabolisable energy, and any associated nutrient losses.

RECOMMENDATION:

1. If **mature weight** or weight gain (**start and end weights**) are known, enter these weights in preference to **age at start**.

DAIRY INDUSTRY

Leave mature weight as OVERSEER default (i.e. leave blank).

2. If only the mature weight is known, enter this with **age at start** (this will provide you with a more accurate growth curve compared with age at start only).
3. If mature weight is not known, enter **age at start** only.

2.1.3.1 Mature weight

IMPACT:

This will affect the nutrient budget.

- For mixed aged animals, the mature weight is the average mob weight throughout the year (excluding conceptus* if applicable). Mature weight will differ between breeds and classes during different times of the year. If weight is entered it must be fairly accurate and auditable to ensure that the resultant nutrient budget is accurate.

*Conceptus is the embryo, chorionic sac, placenta, and foetal membranes in the uterus

- For growing (replacements) or trading animals the mature weight is the weight when fully grown, or weight at sale or slaughter.

RECOMMENDATION:

1. Enter the mature weight if known.
2. If the mature weight is not known leave the data entry pane blank – this will assign a national average weight based on the breed and class.

JUSTIFICATION:

For mixed aged animals, the average mob weight is important as this affects maintenance requirements. For growing or trading animals requirements for weight gain is important and mature weight sets the shape of the growth curve.

2.1.3.2 Start and end live weight

IMPACT:

This setting determines live weight gain that in turn affects the flow of nutrients. Greater weight gain will require more metabolisable energy uptake and result in greater N cycling. This will impact on N leaching. If weights are entered they have to be correct to ensure that the resultant nutrient budget is accurate.

RECOMMENDATION:

1. Enter **live weight at the start** (for the month when the mob first appears on the stock reconciliation), and **end live weight** (for the month when the mob ends on the stock reconciliation (are sold) or at the end of the year in June).
 - **End live weights** (or carcase weight) for mobs sold to the works are usually available on the sales docket (kill sheet).
2. If end live-weight is known but not the start weight, then enter both **age at start** and **live-weight at end**. If start weight is known but not the end live-weight, then enter both age at start and start weight.
3. If the weights are unknown or unreliable enter **age at start** only (see below).

*NOTE: When using start and end weights in the situation where mobs of animals are being sold in groups throughout the year, or when they reach a certain weight (e.g. lambs), different entries or **lines to sale** must be entered to accurately depict weight gain for each drafted mob. The worked example in Appendix 3 sets out the method to be followed.*

2.1.3.3 Carcass weight

RECOMMENDATION:

If the **end weight** is not known, **carcass weight** may be entered (only for some stock classes).

NOTE: This is not relevant to breeding mobs and replacements. It is only relevant to trading stock. This is only visible when Fate = sold to works.

2.1.3.4 Source

IMPACT:

Source describes the origin of the mob – Bought, Weaned, or On-farm (i.e. already present from last year). If **on-farm** or **bought** is selected a **live weight** or **age at start** must be entered.

Because of the possible impacts and variables of setting weight or age, this input may change predicted N leaching. The accurate setting of source is useful when reviewing the nutrient budget inputs or parameter report with the farmer.

NOTE: Source does not directly affect N leaching. It is directly concerned with greenhouse gas emissions. However, it is important because it indicates the type of information that should be used when determining the weight or age of the mob, both of which are critical to accurate estimation of nutrient losses.

RECOMMENDATION:

1. Enter source and enter **weights** or **age** as required.
2. For lambs, fawns, calves, if the animals originate from the breeding stock, enter weaned.
 - If **weaned** is selected only **weight** settings are available. Follow the weight entry protocols above.

2.1.3.5 Age at start

IMPACT:

Where accurate or reliable weights are not available the **age at start** data entry must be used. This will assign stock in the mob being entered to national average weights and weight gain rates based on their age, class and breed.

RECOMMENDATION:

Enter in the **age at start** for the month when the mob first appears on the monthly stock reconciliation.

- **Age at start** is usually calculated from the date entered in Mean Lambing, Calving, and Fawning date.
- The **age** entered is the age at their next monthly birthday i.e. 0-30 days old = 1 month, 30-60 days old = 2 months etc.
- See the **age at start** table in Appendix 3 for further guidance.

2.1.3.6 Sex

IMPACT:

This setting applies to weaners (lambs, calves and fawns).

RECOMMENDATION:

1. Select **mixed sex** for weaners born on-farm.
 - In most cases in an on-farm breeding situation, **mixed sex** is selected. Here OVERSEER assumes equal numbers of male and female present in the monthly stock reconciliation. If the weaners are still on-farm after the end of June they should be entered as their stock class – i.e. hogget, heifer, steer, hind, etc.
2. Select male or female if weaner animals of a particular sex are bought onto the farm for breeding or finishing.
 - Only enter as weaners if under 1 year old – i.e. before the end of June. After this they will be entered as hogget's, wethers, heifers, steers, hinds, stags, etc.

2.1.3.7 Fate

IMPACT:

This setting is available for finishing mobs (trading animals) only. The accurate setting of fate is useful when reviewing the nutrient budget inputs or parameter report with the farmer.

RECOMMENDATION:

Select the most appropriate option for the mob being entered.

- **Remain on-farm:** for mobs that will remain on-farm after the end of the year (stock reconciliation).
- **Sold to works:** for mobs being sold for slaughter at the point of their last entry on the monthly stock reconciliation.
- **Sold to store/removed:** for mobs being sold to store or leaving the farm to be grazed on another property owned by the same landowner.

2.1.3.8 Replacements are mated

IMPACT:

This setting affects predicted N leaching. When selected the model assumes increased metabolisable energy and dry-matter uptake for gestation resulting in increased nutrient cycling and possibly N leaching.

RECOMMENDATION:

This check box is only available for replacement sheep or beef animals:

- **For sheep**, only select for hogget mobs that will be mated or tupped before the last entry in the stock reconciliation (typically June).
- **For beef**, only select for replacement mobs that are calved as R2 heifers. The animals become pregnant after 12 months of age.

2.2 PRODUCTION

Dairy

RECOMMENDATION:

Depending on purpose of modelling:

- Enter current year's milk solid production data based on records.

*NOTE: This is **milk solids sold** to the processor and does not include whole milk fed to calves on-farm.*

- Select appropriate option for once a day milking from the drop down list.
- OVERSEER provides defaults for lactation length, milk volume yield and fat yield. Leave milk volume yield and milk fat yield as OVERSEER default.

JUSTIFICATION:

Milk solids are a critical input to the energy calculations of the metabolic model. The energy requirements then dictate all aspects of nutrient cycling in the model.

Dry Stock

Wool

RECOMMENDATION:

1. Enter wool production (greasy weight per year) based on-farm records.
2. Leave as default.

Antler and Velvet

RECOMMENDATION:

1. Enter antler and velvet annual production if based on records.
2. Leave as default.

Goats

RECOMMENDATION:

Depending on purpose of modelling:

- Enter current year's milk yield production data based on-farm records.
- OVERSEER provides defaults for lactation length; adjust if actual differs from these values.

JUSTIFICATION:

Milk solids are a critical input to the energy calculations of the metabolic model. The energy requirements then dictate all aspects of nutrient cycling in the model.

2.3 HEALTH SUPPLEMENTS

All enterprises

Magnesium, Salt and Lime Flour

RECOMMENDATION:

1. Enter the total amount of all inputs if known for:
 - Magnesium Oxide, Magnesium Sulphate, Magnesium Chloride, Salt, Lime Flour, Phosphorus.
2. Enter drenching and pasture dusting regimes for magnesium, salt and lime.
 - For salt blocks select the product from the drop down list and enter the number of blocks put out on-farm per year.

2.4 MILKING SHED FEEDING

Dairy and Dairy Goats

RECOMMENDATION:

Enter the percentage of animals fed in the shed by month during lactation as appropriate.

NOTE: The percentage value is actually the proportion of animal days within a month that are fed in the shed i.e. if 100% of the animals are feed for only 1/2 the month in the shed enter 50%.

2.5 LEFT-OVER FEEDING

Dairy Goats

OVERSEER assumes that 40% of all supplements fed is unutilised. This default value can be adjusted by the user. If other enterprises are on-farm, the tab **left-over feeding** will become available and the user can then assign the unutilised feed to other stock classes.

2.6 OUTDOOR PIGS

2.6.1 Housing

IMPACT:

The use of a farrowing village, barn or shed facilitates recycling or export of nutrients within or off-farm. If and when these are used, the treatment and management of effluent all impact on the movement of nutrients within and from the farm.

Farrowing village

RECOMMENDATION:

If used, select the farrowing village and enter the number of days sows spend there before and after farrowing.

NOTE: A farrowing village is a purpose-built facility used to remove sows off paddocks, enabling effluent to be contained and managed. It does not refer to huts in paddocks used to house individual sows when lactating or communal huts used to house gestating sows.

Shed and barns

RECOMMENDATION:

Enter for each class of pig using the barn/shed each month, the percentage of pigs using the barn/shed.

2.6.2 Housing Effluent

IMPACT:

Only displayed if the farrowing village and/or the shed/barn are in use. Entering the correct management system is critical because this determines the fate of effluent nutrients.

Management system

RECOMMENDATION:

When a farrowing village and/or shed or barn without bedding material is in use, select the most appropriate options describing the management system from the drop down boxes.

- If spray from sump or other (exported) is selected, nothing further is required.
- If 2 pond + discharge or holding pond is selected, further information is required to describe pond solid management, i.e. either spread on selected blocks or exported.

Bedding management

RECOMMENDATION:

When a barn/shed is used with bedding material, select the most appropriate option describing management of pigs' straw compost.

- If other (exported) is selected, nothing further is required.
- If spread on selected blocks is chosen, further information is required to describe the composting method (covered, open to rain) and time in storage, if stored.

JUSTIFICATION:

Effluent management systems and the fate of solids and liquid effluent should be easily identified on-farm or from farm records.

2.6.3 Feeding System

IMPACT:

Brought in feed is an important source of nutrients coming into an outdoor pig farm system. An accurate description of the amount of feed offered and feed method used for each pig class is critical to determine nutrient cycling on farm and ultimately nutrient losses. Feeding method affects utilisation, increasing or decreasing intake and the amount of feed wasted.

Outdoor pig feeding method

RECOMMENDATION:

Select the feed method that is most appropriate for each class of pig. If the feed is in pellet form (not meal) then tick the **Use pellets** check box.

No bird loss

RECOMMENDATION:

Select the **No bird loss occurs** check box when the feed cannot be accessed by birds. If left un-ticked, the model will assume that loss due to bird occurs.

NOTE: If loss due to birds occurs when feeding some pig classes and an electronic sow feeder preventing loss to birds is used for others, then the feeding amount (see below) will need to be manually adjusted to compensate for the increased feed available to stock.

Creep feed supplied

RECOMMENDATION:

Tick this check box if creep feed is offered to piglets and specify the amount and composition of creep feed offered on the **Feeding-amount** and **Feeding-composition** pages.

2.6.4 Feeding Amount

RECOMMENDATION:

1. Enter feed amount (weight) offered to each class of stock obtained from farm records.
2. Replace missing feed data with typical values.

NOTE: Do not include feed offered to weaners, growers and finishers (porkers and baconers) when raised in sheds and barns.

2.6.5 Feed composition

RECOMMENDATION:

1. Enter feed composition for each of the components for each class of stock. This information is usually readily available from the farm's nutritionist.
2. Where feed composition data is missing, use typical values supplied by OVERSEER.

2.6.6 Straw Disposal

Straw per sow in huts

RECOMMENDATION:

1. Enter the average quantity (weight) of straw provided to a sow in a hut during the year.
2. Use the default value.

Straw management

RECOMMENDATION:

Select the best method used to manage straw removed from huts in the paddock.

- If **other (exported)** is selected, nothing further is required.
- If **spread on selected blocks** is chosen, further information is required to describe the composting method (covered, open to rain) and time in storage, if stored.

If a second method is used to manage straw, tick the **Use second management option** check box, enter the percentage of straw managed using the second method and select the most appropriate options describing the method used.



3

Structures

3. Structures

3.1 FEED PADS

General

Feed pad details

Manure removal method

RECOMMENDATION:

Select manure removal method from drop down list.

- If it is known that solids are separated (i.e. scraping or by a weeping wall) check the **solids are separated** box.
- If the solids are NOT separated, check **scraped material is added to farm dairy effluent system**.

Solids Management

RECOMMENDATION:

Solids management method

- Select solids management method from drop down list.

Storage method before solids are disposed of

1. Select the best option from the drop down list.
2. Unless good information is provided, select open to rain and set the time in storage to 3 months.

Management

Time animals are on the feed pad

RECOMMENDATION:

Enter percentage of cows that are using the feed pad by month and enter hours per day on average that those cows are on the feed pad.

3.2 WINTER STANDOFF OR LOAFING PADS

General

Winter standoff pad construction and maintenance

RECOMMENDATION:

1. Select the best option for pad surface from the drop down list.
2. The optional default is **inert**.
 - Check **lined, concrete floor or subsurface drained and effluent captured** if effluent is effectively captured.
 - If the surface is scraped regularly, check the relevant box.

Management of scraped surface solids

RECOMMENDATION:

Scraped surface solids management method

1. Select the best option from the drop down list.

Storage method before top layer is disposed of

1. Select the best option from the drop down list.
2. Select **open to rain** where no other information is available with the time in storage set to **3 months**.

Management

Winter standoff usage

RECOMMENDATION:

Enter percentage of animals that are using the winter standoff by month and either enter hours per day on average, or days per month that those animals are on the standoff pad.

- Pads may only be used for short periods e.g. 1 or 2 days per month and entering hours per day overstates the pad use. If this is the case, calculate the total number of hours a pad is used per month and pro rata this across 30 days.

3.3 WINTERING PADS/ANIMAL SHELTER/BARN/HOUSING

General

Wintering pad, animal shelter or housing details

RECOMMENDATION:

Select most appropriate option for pad type from the drop down list

- **Covered wintering pad** or **animal shelter** will activate options for **bunker cleaning method** and **concrete feeding apron**.
- **Uncovered wintering pad** will activate options for **bedding pad, concrete feeding apron, and solids management**.

Bunker cleaning method

Bunker is defined as a concrete pit in which effluent accumulates. Lining is the material added to the bunker to contain the effluent.

RECOMMENDATION:

Select most appropriate bunker lining material from the drop down list.

- If **carbon rich** or **soil** is selected: enter in the **time between first adding animals and cleaning out of bunker** (months), and whether the liquid effluent is drained away (added to liquid effluent).
- If **no lining material** is selected then select the most appropriate concrete apron cleaning method.

Bedding pad

RECOMMENDATION:

1. Select the best option for pad surface from the drop down list.
2. The optional default is **inert**.
 - Check **lined, subsurface drained** and **effluent captured** if applicable
 - If the surface is scraped regularly check the relevant box.

Concrete feeding apron

This is a separate area of concrete used for feeding animals only, similar in concept to a feed pad. Because it is used for feeding only, effluent is sometimes managed separately to the sleeping/resting area. If this is the case, check the box and enter details of how effluent/solids are dealt with.

RECOMMENDATION:

If an apron is present check the box.

- For the concrete apron cleaning method select appropriate option from the drop down list.
- If it is known that solids are separated tick the **solids are separated** box.
- If the solids are not separated then select **scraped material is added to farm dairy effluent system**.

Solids management

RECOMMENDATION:

Scraped surface solids management method

1. Select the best option from the drop down list.

Storage method before top layer is disposed of

1. Select the best option from the drop down list.
2. Unless good information is provided, select **open to rain** where no other information is available with the time in storage set to **3 months**.

Liquid effluent (bunker or concrete) or effluent from lining (liquid) or concrete

RECOMMENDATION:

1. Check the box if the effluent is treated the same as the farm dairy effluent.
2. If not, then select treatment method and pond solids management method.

Management

Wintering pad, animal shelter or housing usage

RECOMMENDATION:

Select the appropriate feeding regime from the drop down list.

- If most of the farm is grazed out before the animals move onto the pad – check the appropriate box.

Time spent on pad

RECOMMENDATION:

Enter percentage of animals that are using the pad by month and enter hours per day grazing on average if they are using both the pad and grazing pasture.



4

**Block
Data**

4. Block Data

4.1 GENERAL

IMPACT:

Topography affects drainage, runoff and animal transfer, which will affect nutrient cycling and losses. Distance from the coast drives nutrient inputs from rainfall, which has the biggest effect on the sulphur model.

Topography

RECOMMENDATION:

Topography should be entered based on the average slope for the block, based on the table below:

TOPOGRAPHY CLASS	ACCESS DESCRIPTION	SLOPE
Flat		0° - 7°
Rolling	Area mostly navigable by tractor	8° - 15°
Easy Hill	> 50% area navigable by tractor	16° - 25°
Steep Hill	< 50% area navigable by tractor	> 26°

Distance from coast

RECOMMENDATION:

1. Estimate distance from the coast in the direction of the prevailing wind (use online map if necessary).
2. If prevailing wind direction is unknown assume westerly winds occur.
 - If fodder crop or fallow area rotates through this block, select box.
 - Leave box unchecked **Cultivated in last 5 years.**

Fodder Crop Block-specific

Rotation area

RECOMMENDATION:

Enter the area of the fodder crop grown or proposed to be grown to one decimal place (e.g. 7.5 ha).

Low mineralisation capacity

IMPACT:

The capacity or potential of a soil to mineralise N will have an impact on the amount of N cycling within the farm and ultimately on N losses to water.

RECOMMENDATION:

Do not check this check box.

JUSTIFICATION:

There is little field trial data to assess which sites are likely to have low mineralisation capacity.

Month resown in pasture

RECOMMENDATION:

Enter the month that the fodder crop is resown into pasture; this automatically becomes the final month on the rotation grid and is populated by OVERSEER as **sown to grass and grazed**. If not sown back into pasture then do not use a fodder crop block but use a crop block instead.

*WARNING: Changing the grid final month will irreversibly clear all crop management, irrigation and fertiliser inputs in the grid on the **crop rotation** data pane.*

Crop Block-specific

Block land use

RECOMMENDATION:

1. Enter the percentage of cultivated area, headland and tracks and non-cultivated (other areas) in the relevant boxes.
 - All three must add up to 100%, with headlands and tracks (0–20%) and other areas (0–20%).
2. Optional default is 100% cultivated.

Crop rotation

RECOMMENDATION:

1. With multiple rotations and crops it is recommended that the same final month of March be used for all crop blocks. This automatically becomes the final month on the rotation grid.
2. If March is not the most suitable month to represent the farm crop rotation; for example a winter grazed fodder crop, enter the most appropriate month for the farm system being modelled.

WARNING: Changing the grid final month will irreversibly clear all crop management, irrigation and fertiliser inputs in the grid on the 'Crop rotation' data pane.

JUSTIFICATION:

Recommendation 1 ensures that all land uses are accounted for and increases the ease of use of the crop rotation page.

Wetland Block-specific

Fenced wetland block

Effective wetland area

RECOMMENDATION:

Wetland blocks/areas to be counted for as a 'riparian block'.

Cut and Carry Block-specific

Perennial crop

RECOMMENDATION:

Select appropriate crop from the drop down list.

Fruit Crops Specific

Crop details

RECOMMENDATION:

Select appropriate **crop type** and **pruning disposal method** from the drop down list and enter the appropriate **product yield** and **age of current trees**.

- If your crop type is not represented choose the most similar crop type.

Foliar sprays

RECOMMENDATION:

If known, enter the number of times the specified foliar sprays are applied.

Sward management

RECOMMENDATION:

Select the appropriate sward type from the drop down list.

- If **full pasture** or **herbicide strip** are selected and animals graze the sward then check the check box **Animals graze sward**. Further information is required about **animal source** and **type**.
- Most fruit crop blocks are likely to be grazed **by non-farm animals**.

Outdoor Pig Specific

Area allocation

RECOMMENDATION:

Enter the percentage of block area occupied by each class of pig.

1. All percentages must add to 100%.
2. Lanes and other areas must be 1% or greater.

Trees and Scrub Specific

Bush Type

RECOMMENDATION:

Select appropriate **bush type** from the drop down list.

Riparian Specific

RECOMMENDATION:

Do not select **specify riparian strip P model input** unless you are an expert in riparian systems. However, retain the riparian block, as this allows you to account for the riparian area.

JUSTIFICATION:

Much of the data required is very complex and difficult to determine to make the strip P model accurate enough to be worthwhile.

House Block Specific

RECOMMENDATION:

Enter the average number of people on the property, sewage disposal method and the percentage of block area in flower and vegetable gardens.

4.2 CLIMATE

IMPACT:

Climatic variables such as rainfall and evaporation are critical inputs, which affect drainage and therefore nutrient losses.

Daily Rainfall Pattern Settings

RECOMMENDATION:

1. Select appropriate daily rainfall pattern setting from the map provided and users/farmers knowledge of daily rainfall pattern setting.
2. Use the OVERSEER default. This is displayed on saving the Climate page or transferring information from the Climate Station Tool.

Climate Station

RECOMMENDATION:

Select **climate station tool** and enter latitude and longitude to at least 3 decimal places from the property for each block.

- If farm is the milking platform, use latitude and longitude data from the farm dairy, enter to at least 3 decimal places.
- GPS or Google Maps can be used to determine latitude and longitude if not known.
 - Select **retrieve climate data** and **use these values**. This will automatically populate **your climate data** fields.

NOTE: The user must be on the internet to be able to use the climate station tool.

NOTE: Latitude and longitude entered into the climate station page are not saved. It is recommended that you record this data elsewhere for future reference.

Climate Data

NOTE: The monthly data input facility has been included for research purposes and is not yet suitable for use on-farm, therefore do not enter monthly climate data at this point.

Precipitation (Mean Annual Rainfall)

RECOMMENDATION:

1. **Climate station** tool.
2. Farmer records (long-term data 30 years+).
3. Off the map supplied in OVERSEER.

Temperature (Mean Annual Temperature)

RECOMMENDATION:

1. **Climate station** tool.
2. Farmer records (long-term data 30 years+).
3. Estimate using latitude and altitude.
4. Use **default** – estimate base on **nearest town** or **region**.

PET (Potential Evapotranspiration (Annual PET))

RECOMMENDATION:

1. **Climate station** tool.
2. Off the map supplied in OVERSEER.
3. Use **default**.

PET seasonal variation

RECOMMENDATION:

1. Use the map to determine seasonal variation e.g. **low, moderate or high**.
2. Use **default**.

JUSTIFICATION:

The best data source is the NIWA climate station data.

4.3 SOIL DESCRIPTION

IMPACT:

The soil description is a key driver of soil nutrient losses, particularly nutrient leaching due to the impact of the Profile Available Water (PAW). Where available, S-map sibling data (as sourced from S-map) is the preferred input to use, rather than semi-quantitative or descriptive soil information.

Link to S-map, soil series, soil order, soil group

RECOMMENDATION:

1. Use farm-specific soil map (enter specific soil moisture values or a sibling name) as identified by a trained soil pedologist. <http://nzsss.science.org.nz/professional.html>
2. Link to S-map: Obtain the soil sibling name from S-map Online. Enter soil sibling name into OVERSEER and click **Get S-map data**. This will automatically populate the soil information that is available for the given soil sibling. Two levels of information will be provided; 1) soil descriptor information or 2) soil descriptor information and water holding capacity information. This is a reflection of the amount of data available for the given soil sibling.
3. **Soil Series** – sourced from Fundamental Soil Layer (FSL) or legacy maps and accompanying bulletins.

NOTE: Values for soil properties based on the selected series name are shown, other soil values will be based on soil order. If using soil series you still must enter top and lower profile soil characteristics.

4. **Soil Order** – sourced from national scale soil map (Fundamental Soil Layer (FSL)).
5. **Soil Group** – choose from drop down list.

NOTE: If the soil is a true sand – choose soil group 'Sand high P loss'.

NOTE: If entering soil order or soil group you should still enter top and lower profile characteristics.

- Additional information can be sourced from the OVERSEER HELP files, the Landcare Research website (landcareresearch.co.nz) and Appendix 4.

JUSTIFICATION:

- A detailed soil map of the property (i.e. 1:10,000 scale or better) will provide the best description of soils possible, but most farms are unlikely to have a detailed soil map.
- S-map (<http://smap.landcareresearch.co.nz>), where available, will be the next most accurate source of soil survey data. Use the predominant sibling in a map unit (unless a soil expert believes a sub-dominant sibling is more representative). Enter the predominant sibling name into OVERSEER and by selecting **Get S-map data**, this will automatically populate the soil information that is available for the given soil sibling. However, S-map is not available for all areas. Other soil properties if not provided by S-map are then based on the default values associated with the soil order of that soil sibling.
- In which case the next step in the hierarchy is to choose the soil series name (from either FSL or legacy maps and accompanying bulletins). If the series name is listed in S-map Online – then enter the associated soil sibling into OVERSEER ‘Link to S-map’, otherwise use the series name itself.
- Alternatively use New Zealand Soil Classification (NZSC) soil order (can be obtained online at landcareresearch.co.nz).
- Lastly soil group can be used.

4.4 SOIL PROFILE

IMPACT:

Soil moisture and other properties are defined by soil profile characteristics entered below.

This information is NOT required if S-map level 2 (soil descriptor and water holding capacity) information has been provided and this page will not be displayed. In all other situations this page will be available. If S-map level 1 (soil descriptor) information has been provided entering data on this page will overwrite the corresponding fields in the S-map data (on the soil description page).

Profile drainage class

Profile drainage class in its natural state i.e. without artificial drainage.

RECOMMENDATION:

1. Use farm-specific soil map, produced by a trained soil pedologist to determine profile drainage class.
2. Obtain this information from S-map Online.
3. Obtain from the Fundamental Soil Layers.
4. Obtain from farmer knowledge.
5. OVERSEER default (this will be determined from soil information).

JUSTIFICATION:

- Where farm-specific data is not available, the next best data set will be in resources such as S-map.
- However, OVERSEER will select a suitable default value based on the user defined soil description.

NOTE: There is considerable variability of drainage class within most Soil Orders.

Top soil (0–10 cm)

IMPACT:

Top soil texture, stony and compacted soils affect runoff, infiltration rate and water holding capacity (refer to Appendix 5 for additional information).

Top soil texture

RECOMMENDATION:

1. Use farm-specific soil map, produced by a trained soil pedologist to determine top soil texture.
2. Obtain topsoil texture from S-map Online.
3. Topsoil texture information may be available from legacy maps and accompanying bulletins.
4. Default texture **unknown** can be selected.

JUSTIFICATION:

Generally lowest importance of soil profile inputs.



Is stony

RECOMMENDATION:

1. Use farm-specific soil map, produced by a trained soil pedologist to determine if top soil is stony (if the stone content in 0–10cm layer is >35% stones).
2. Obtain this information from S-map Online.
3. Obtain from legacy maps and accompanying bulletins.
4. Obtain from the Fundamental Soil Layers.

JUSTIFICATION:

- User discretion is required because even 35% stones will affect PAW.
- 35% stones accords with soils identified as very stony soils on soil maps.

Lower profile (10–60 cm pasture and cropping)

IMPACT:

Choices will critically affect PAW and therefore drainage, and hence nutrient losses (refer to Appendix 5 for additional information).

Soil texture group

Refers to the fine material (including between the stones) down to 60 cm for pasture cropping or until the shallowest non-standard layer, if present. When soil order is used for selection, this input is only available for Brown and Recent soils. If soil group is used then this input is only available for Sedimentary and Recent soil groups.

The definitions are:

- Light = predominantly sand or loamy sand,
- Heavy = predominantly clay (clay content >35%),
- Medium = everything else.

RECOMMENDATION:

1. Use farm-specific soil map, produced by a trained soil pedologist to determine soil texture group of the lower profile.
2. Obtain from legacy maps and accompanying bulletins.
3. Obtain from farmer knowledge.

JUSTIFICATION:

- The intent of light, medium and heavy is to differentiate between the subsoil's ability to hold soil moisture.
- This information is not currently available from the Fundamental Soil Layer.

Maximum rooting depth and depth to impeded drainage layer**RECOMMENDATION:**

1. Use farm-specific soil map, produced by a trained soil pedologist to determine maximum rooting depth and depth to impeded drainage layer if present.
2. Obtain from legacy maps and accompanying bulletins.
3. Leave blank and OVERSEER will assume that there is no impeded layer or restrictions to rooting depth.

Non-standard layer

Non-standard layer is entered when there is a texture group in the lower profile that affects the water holding capacity of the soil. If multiple non-standard layers occur, choose the dominant non-standard layer. The definitions are:

- Select **stony** – where subsoil profile contains $\geq 50\%$ stones and the fine material is sandy.
- Select **stony matrix** – where subsoil profile contains $\geq 50\%$ stones and the fine material is loamy or clayey.
- Select **sandy** – where subsoil profile is sandy e.g. sand dunes and plains. Note that this option does NOT apply to Pumice soils.
- Where none of the above apply leave blank.

RECOMMENDATION:

1. Use farm-specific soil map, produced by a trained soil pedologist to determine if a non-standard layer is present.
2. Obtain from S-map Online.
3. Obtain from legacy maps and accompanying bulletins.
4. Obtain from farmer knowledge.

JUSTIFICATION:

- Details for selection obtained from OVERSEER HELP file.
- This information is not currently available from the Fundamental Soil Layers.

Depth to non-standard layer**RECOMMENDATION:**

1. Use farm-specific soil map, produced by a trained soil pedologist to determine depth to non-standard layer.
2. Obtain this information from S-map Online.
3. Obtain from farmer knowledge.

JUSTIFICATION:

This information is not currently available from the Fundamental Soil Layer.

4.5 SOIL PROPERTIES

K leaching potential

RECOMMENDATION:

Do not change (leave as default).

Do you want to enter more detail about soil properties?

RECOMMENDATION:

Ensure all boxes are unchecked.

JUSTIFICATION:

- Changing these values will overwrite data that has been determined from more readily available data, such as soil texture and non-standard layers and will have a large impact on leaching losses.
- Currently there is no reliable method to determine sites with low or high N immobilisation and K leaching potential is based on soil description and rainfall information previously entered.

4.6 SOIL TESTS

IMPACT:

Soil test data is required to generate a nutrient budget and to determine maintenance nutrient requirements. Individual soil test data, such as Olsen P, Slow release K and ASC affect recommendations and losses.

Soil tests

RECOMMENDATION:

Depending on use:

1. Use the most recent soil test results (depth 0–7.5 cm).
2. Where available, enter long-term average (e.g. rolling 3-year average) soil test data.
3. Default soil test values should ONLY be used if the interest is solely on N or greenhouse gas emissions.

JUSTIFICATION:

- Every farmer should have a recent soil test (within 1–2 years).
- Using a 3-year rolling average deals with year-to-year variability and possibly reflects the 'true' fertility status better.

Anion storage capacity (ASC) or phosphate retention (PR)

RECOMMENDATION:

1. Automatically populated through the choice of soil description.
2. Change only when you have a measured ASC for the soils on that property or can obtain a value from S-map.

Slow release K

RECOMMENDATION:

1. Automatically populated through the choice of soil description.
 2. Change only when you have a measured TBK for the soils on that property.
- Do not use **specify K reserve status**.

4.7 DRAINAGE/RUNOFF

Soil drainage and run-off characteristics

IMPACT:

Hydrophobicity and pugging will both affect water movement through the soil by reducing drainage, leading to ponding and runoff and thereby affecting nutrient loss processes.

Hydrophobic conditions

RECOMMENDATION:

Use **default**.

JUSTIFICATION:

It will be practically impossible to determine in the field, and is mostly a within-paddock, rather than whole block, phenomenon.

NOTE: This is only available for pastoral blocks.

Susceptibility to pugging or treading damage

RECOMMENDATION:

1. Use **rare** for well-drained soils, and **occasional** on heavier soils (this is assuming drains are working very well), **winter** if heavy soils and drains are suspect and **winter or rain** on soils where pugging can occur after periods of prolonged rainfall throughout the year.

DAIRY INDUSTRY

Select **Occasionally** for all soil types.

2. User or farmer knowledge of the susceptibility of pugging soils.

JUSTIFICATION:

Pugging tends to be a within-year paddock phenomenon, rather than whole block or farm occurrence.

Is compacted

RECOMMENDATION:

Leave unchecked.

JUSTIFICATION:

The major effect of compaction is usually a temporary within-year phenomenon, and will not be equal over entire blocks.

Artificial drainage system

IMPACT:

Will improve the drainage characteristics of poorly drained soils and therefore affects nutrient losses.

Drainage method

RECOMMENDATION:

Select from drop down list the most relevant option.

Percentage of block drained

RECOMMENDATION:

The area drained is usually the paddock and should be calculated as a percentage of the block area.

NOTE: This is usually less than 100%, unless the whole block is drained.

- If **other** is selected the user can provide specific drainage placements – depth to drains and spacing between drains if known, otherwise leave box unselected.

NOTE: Leave box unchecked All of the drainage from the block is captured by an artificial wetland.

NOTE: Leave box unchecked Run-off is intercepted by grass filter strip.

NOTE: This is only available for pastoral blocks.

4.8 PASTURE

IMPACT:

The pasture type affects both energy (metabolisable energy) and the nitrogen concentration, which will impact on nutrient losses.

Pasture type

RECOMMENDATION:

Select the dominant pasture type in the block from the drop down list.

- For example, well developed downland pastures will predominantly be **ryegrass/white clover**, except in Northland, where it could be **C4 Kikuyu pastures** and hill country sheep and beef farms will predominantly be **browntop**, except possibly for the re-grassed flats.

*NOTE: If your pasture sward is grazed and is not represented on the drop down list enter **ryegrass/white clover**.*

Other pasture inputs

RECOMMENDATION:

Leave as OVERSEER **default** values.

JUSTIFICATION:

There needs to be 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.

4.9 SUPPLEMENTS MADE

IMPACT:

Supplements made on the farm will move nutrients between blocks or off-farm if sold.

RECOMMENDATION:

User and farmer knowledge of category, weight (WW or DM), cutting method (silage) and destination will be required to populate the data for this page.

- Additional information e.g. **supplement is wrapped**, can be provided if known.
- Select **average** utilisation and storage conditions (see supplements imported for comments on timing, storage and utilisation).

*NOTE: Select **specify timing of feeding** if timing is concentrated around certain times of the year e.g. maize silage in autumn. This should be based on-farm records. Note that the feed balance needs to be more precise when timing is selected. If an error occurs around too much or too little feed, sometimes unchecking **specify timing of feeding** will resolve this.*

NOTE: When specifying the amount of supplement made on crop blocks, include only supplements made during the reporting year.

JUSTIFICATION:

Much of this information should be based on good records but in many cases it will be estimated and is difficult to specify. In the future, better record keeping will be required to track supplement production.

4.10 FERTILISER

IMPACT:

Fertiliser nutrients are one of the major sources of nutrients coming into farm systems and consequently have a large impact on nutrient cycling and losses.

RECOMMENDATION:

Fertiliser and lime information must be entered based on the month(s) of application. OVERSEER provides fertiliser and lime product lists from drop down menus.

1. Enter the most recent fertiliser nutrient and lime data.
2. Enter long-term average (e.g. rolling 3-year average) fertiliser nutrient and lime data.

NOTE: The 3 methods of entering fertiliser (soluble fertiliser, fertiliser product or fertiliser form) are equivalent – select the one that is most appropriate for your data. Take care to ensure that there is no double counting. This section covers inorganic fertiliser of all types, lime and organic materials, such as imported industrial effluent e.g. dairy factory waste and any fertiliser applied through fertigation.

NOTE: Fertiliser applied to the pastoral block that is also applied to the fodder crop block or crop block before it is sown into the crop and after it is resown to pasture should be entered in the fodder crop or crop block fertiliser page.

JUSTIFICATION:

There are a range of sources of information from fertiliser and lime purchase orders, transport and spreading invoices to proof of placement information, so this section can be filled out accurately.

4.11 IRRIGATION

IMPACT:

Irrigation in addition to rainfall drives plant production but also affects soil drainage and thus has a critical influence on drainage (leaching) and runoff nutrient losses.

JUSTIFICATION:

The selected order of inputs for the upgraded irrigation module better reflect actual long-term practices (Irrigation New Zealand has been involved in developing this module).

NOTE: Appendix 12 provides an example of an optional irrigation questionnaire that could be used to help gather the information required for entering irrigation into OVERSEER.

NOTE: The irrigation data to use is the long-term irrigation information relevant to a 'normal' year as opposed to within year tactics based on a drier or wetter than normal year.

4.11.1 Irrigation system type

RECOMMENDATION:

1. Select irrigation system most applicable to your farm

- linear move and centre pivot
- travelling irrigator
- spraylines
- micro-irrigation (drip and sprinkler)
- solid set
- controlled flood
- border dyke

See Appendix 10, Table 1 for definitions of systems.

NOTE: Only one irrigation system type should be used per block. However, for expediency, irrigation systems with identical management characteristics and scheduling methods can be grouped together. For example, in the case of a centre pivot with spraylines in the corners, the centre pivot should be blocked separately from the spraylines, and each of the corners' sprayline system should then be grouped together provided they are on soil with similar drainage characteristics. However, consideration also needs to be given to effluent and fertigation applications when creating a block. For example if two of the sprayline systems above were used to apply effluent, the spraylines should be split into two blocks.

2. Select the typical months in which irrigation is applied.

- Typical means in an average year not a drought or high rainfall season. Most often this is October to April but there are regional variations.
- It is also important water supply restrictions are considered when entering in irrigation months e.g., if the water supply is typically not available in February due to river flow restrictions this should be reflected.
- Irrigation management should be entered on a month by month basis.
- The days that you are irrigating in the shoulder months are critical to N loss. When you select the shoulder months the model assumes irrigation occurs for the whole month. If this does not reflect what happens on your farm, it is recommended for the shoulder months you following the steps outlined below:
 1. Irrigation schedule to based on **Soil moisture sensors** (probes or tapes).
 2. Strategy to **Trigger point and fixed depth applied** or the most suitable option.
 3. Management system definition to **default**.

4.11.1.1 Nutrient concentrations in irrigation water

RECOMMENDATION:

1. Use OVERSEER default values.
2. Only enter block specific data when you have accurate, long-term average nutrient concentrations for irrigation water. Consider water source:
 - Groundwater depth (water supply from deep bores typically has much lower nutrient concentration than shallow ones)
 - Surface water type (alpine rivers typically have much lower concentration than lowland streams)

NOTE: Fertigation nutrients should be entered under the fertiliser section.

JUSTIFICATION:

The OVERSEER default settings should be used as most people will not have accurate long-term average nutrient concentration data.

4.11.2 Irrigation management options (rules)

There are two ways to enter irrigation. If your irrigation system characteristics and scheduling method do not change during the irrigation season then select the **set up irrigation** option. However if the system characteristics and scheduling method do change, for example your scheduling trigger points change from the shoulders to the peak season, then add irrigation using the month-by-month option.

The **application depth** option should not be used for irrigation unless the data entered is consistent (has been adjusted for) the long-term average climate data used by the model.

NOTE: Once an irrigation system type is selected, irrigation management rules for at least one month must be set. Irrigation management rules will vary depending on the system type entered.

NOTE: If irrigation management rules change you can go into individual months and change rules, for example, to reflect shoulder month irrigation.

*NOTE: These rules are your **general long-term rules** not tactical 'within' year rules.*

NOTE: OVERSEER default irrigation management inputs are shown in Appendix 11.

Border dyke

1. Select outwash management (**Outwash occurs** or **No outwash**)

Management system definition

RECOMMENDATION:

1. Select User-defined **depth per application** and **return period** based on system design (e.g., 80mm every 14 days) or your irrigation schemes shareholders' agreement.
2. Select default.

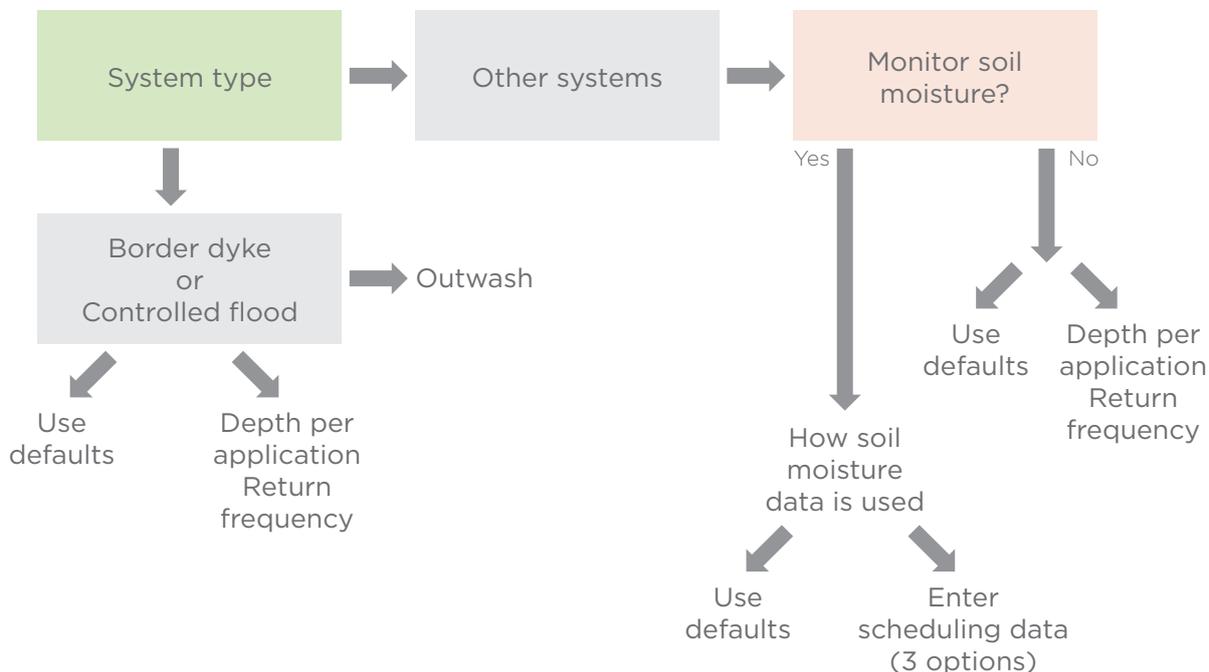
Controlled flood

RECOMMENDATION:

1. Select User-defined **depth per application** and **return period** based on system design or your irrigation schemes shareholders' agreement.
2. Select default.

QUICK GUIDE TO MANAGEMENT SYSTEM DEFINITION

(from Irrigation upgrade technical note 7.0 (D Wheeler AgResearch))



Linear move and centre pivot, travelling irrigator, spraylines, micro-irrigation (drip and sprinkler) and solid set

If individual irrigation months are selected: select [irrigation management options input method](#).

RECOMMENDATION:

- Select management options.
- Select frost protection (fruit crop block only).
- Select application depth.

1. Management options (only available if entering irrigation by multiple months)

a. Soil moisture assessment method (How do I schedule irrigation?)

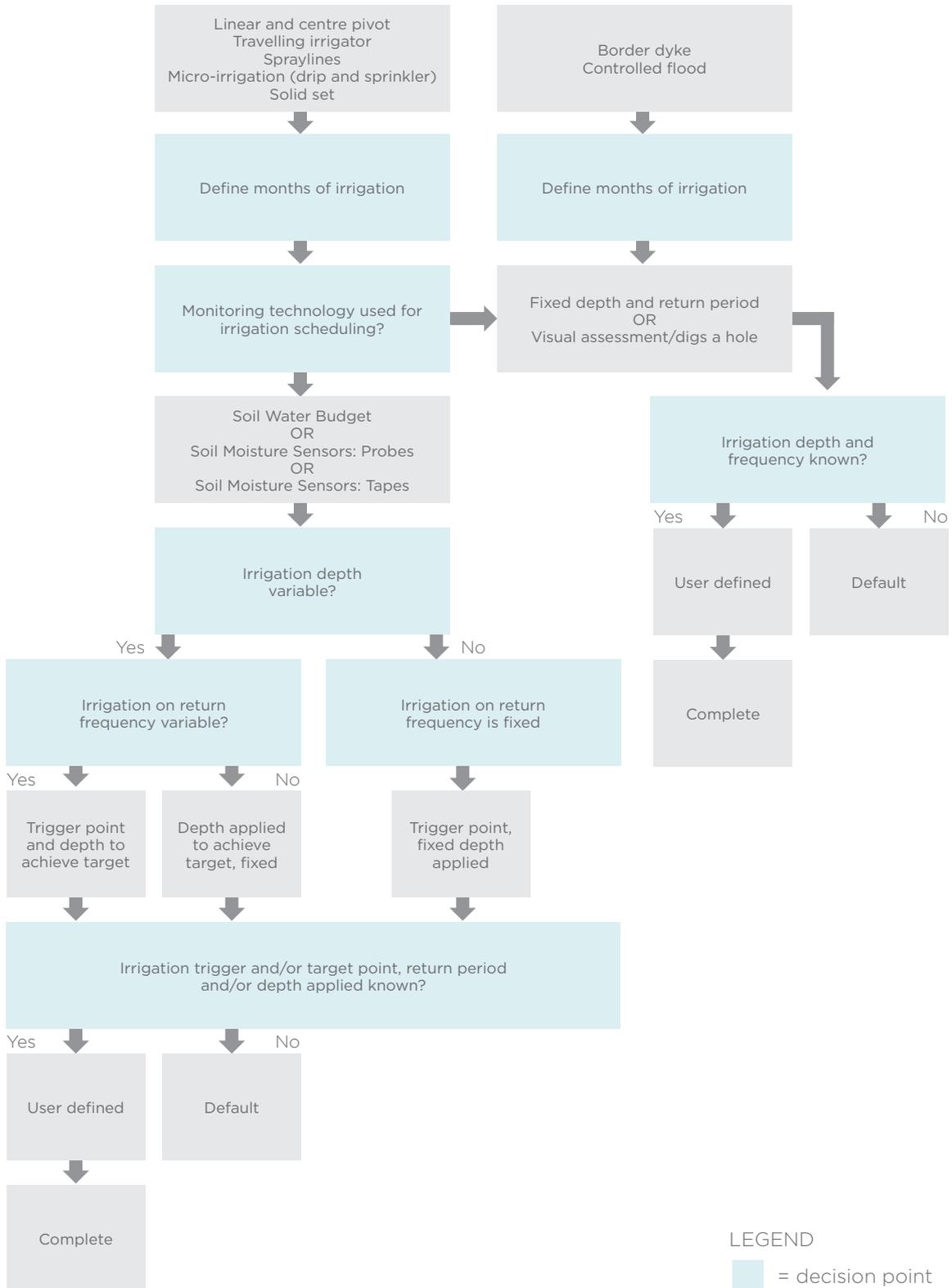
RECOMMENDATION:

1. Select most appropriate method that represents your system.

None: fixed depth and return period

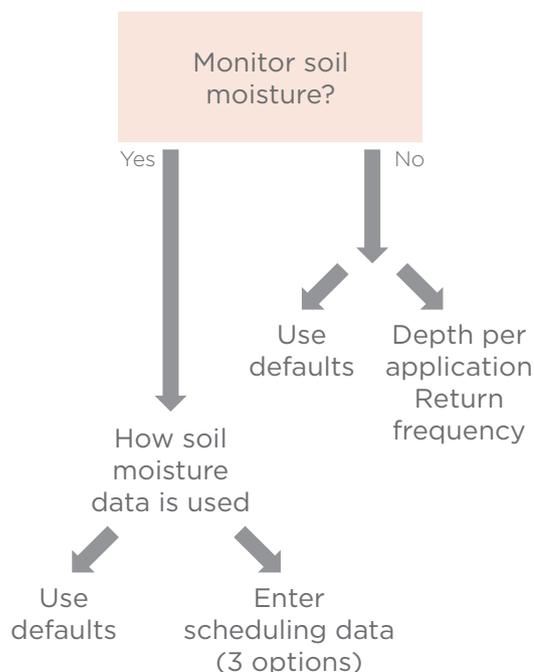
- This option should be selected if the irrigation is run on a set management regime with no scheduling. The return period and depth will differ from property-to-property, but the longer the rotation the higher the application depth. Typical examples:
 - a. Gun, fixed boom and rotary boom irrigation e.g., 10-14 day return period with a fixed depth of 40-60mm.
 - b. Sprayline (pod and long lateral) irrigation e.g., 8-10 day return period with a 24 hour fixed depth of 40-60mm.
 - c. Centre pivots and linear moves e.g., 3-4 day return period with a fixed depth of 10-15mm.

SCHEMATIC FLOW CHART OF THE DECISION POINTS AND PROCESS TO SETTING UP IRRIGATION IN OVERSEER



Soil moisture sensors – tapes;
 Soil moisture sensors – probes;
 Soil water budget:

For the three methods listed above, the following diagram helps explain the choices given and these are described below:



i. Trigger point; fixed depth applied

Typical of sprayline (pod or long lateral) irrigation systems when scheduling is used. Has a variable return period, with a fixed depth of irrigation applied as they are run for a fixed length of time e.g., 12–24 hours.

ii. Depth applied to achieve target; fixed return period

Typical of a travelling irrigator (gun, fixed boom and rotary boom) when scheduling is used. Has a fixed return period (time between irrigation applications) however a variable depth of irrigation can be applied e.g., 8–12 day rotation but apply between 20mm and 60mm through changing the speed of the irrigator.

iii. Trigger point and depth applied to achieve target

Typical of drip, microsprinkler, centre pivot, linear move and modern solid set irrigation systems. Modern low volume fixed boom irrigators can also be used in this way. Has a variable return period and a variable depth of irrigation can be applied.

For i to iii above, selecting the ‘user defined’ option under the ‘management systems definition’ enables the depth applied, a minimum return period (to be entered if the irrigation system has constraints and thus cannot operate on true variable return period) and the trigger point to be specified. The trigger point can be described as either percentage of PAW (Profile Available Water) or mm deficit.

Under the ‘management systems definition’ the ‘default’ option depicts common practice for most of these irrigation systems, assuming the soil profile is refilled each time irrigation is triggered. The default trigger point used is in OVERSEER Technical Note 7.

The ability to alter the trigger point and target is important as it allows a seasonal irrigation strategy to be entered on a month by month basis, for example a deficit irrigation strategy. Typically deficit irrigation strategies maximise rainfall in the shoulder season through the target soil moisture level at which irrigation stops being less than field capacity. Similarly if the irrigation strategy has different soil moisture levels targeted to different crop growth stages both the trigger point and target can be altered accordingly.

Visual assessment/dig a hole

- This is a common method used by irrigators although it gives no quantitative measure of soil moisture status and so trigger and target levels cannot be set. Often, irrigators will have an idea of application depth and return period. Due to this, this system is treated as Fixed depth, Fixed return (FF).

See Appendix 10, Table 2 for definitions.

b. Use soil moisture to determine (NOTE: only relevant if soil moisture sensors or manual water balance is used).

RECOMMENDATION:

1. Select the option relevant to your irrigation system (Trigger point and depth applied to achieve target or Trigger point; fixed depth applied or Depth applied to achieve target; fixed return period).

See Appendix 10, Table 3 for definitions.

c. Management systems definition (Irrigation system characteristics).

RECOMMENDATION:

1. Select User-defined depth of application, return period and critical values based on system characteristics.

See Appendix 10, Table 4 for definitions.

2. Select default.

- If travelling irrigator or spraylines irrigation system, select the most appropriate default based on your system (i.e. default 1 shift per day or default 2 shifts per day).

NOTE: Always check the Block Other Values tab to sense check the annual irrigation supplied (mm/yy) and annual drainage (mm/yy).

NOTE: The 'mm deficit' unit should be used to interpret soil moisture traces and set site specific trigger point and target values within the OVERSEER irrigation module.

2. Frost protection

RECOMMENDATION:

1. Enter average frost (°C) for a given month and average duration (hours) for a given month and number of days of frost in month.

NOTE: Frost protection option is only shown for fruit crop blocks.

NOTE: Frost protection and depth of application are only available for individual monthly input (not for multiple months).

3. Application depth

RECOMMENDATION:

1. Enter application depth.

JUSTIFICATION:

Depth of application is not recommended as it is difficult to align rate and climate data. Depth of application is provided primarily for backwards compatibility when importing files (Version 6.1.3 or older).

*NOTE: Importing old files – management system will stay the same and if you have entered method only this will show up as **Trigger point and depth applied to achieve target**. If you have entered rates, this will show up as **Depth of application**. Choose management option **fixed depth and return period** or **default**.*

4.12 ANIMALS

Grazing management

IMPACT:

Entering data here allows you to specify the month's particular groups of animals are on specific blocks and the proportion of pasture eaten by each animal enterprise. This allows for areas that are not grazed for a period of greater than 3 months e.g. summer or winter grazing blocks or cut and carry.

RECOMMENDATION:

Leave grazing management unchanged as predominantly stock graze all blocks all year round.

- Where this does not apply e.g. summer or winter grazing blocks or cut and carry select appropriate **enterprise, pasture eaten** and **grazing months**.

Other information

IMPACT:

If cattle have access to streams they will excrete nutrients into the waterways and this is taken into account in the nutrient budget. On blocks grazing deer the user is required to indicate whether deer pace the fence line and whether wallows are visible. On those blocks grazing beef, dairy grazers or deer the user can select **finishing**, which results in higher beef/deer product removal from the block, more typical of finishing units.

RECOMMENDATION:

Select the relevant boxes that apply to the enterprise on-farm.

4.13 DCD (NITRIFICATION INHIBITOR)

IMPACT:

DCD can be used to mitigate some of the impacts of nitrogen losses.

RECOMMENDATION:

Do not fill in this section at all as DCD is not currently available on the market.

4.14 EFFLUENT

IMPACT:

Effluents (liquids and solids) generated by enterprises on-farm represent a major recycling or export of nutrients within or off-farm. The treatment, storage, application and timing of effluent all impact on nutrient management.

Liquid effluent applications

Source

If liquid effluent is generated on the farm dairy, select the liquid effluent source(s) that is applied on the block. This may include effluent from structures such as feed pads, wintering pads/ animal shelters and housed pigs.

Method

RECOMMENDATION:

1. Actual measured application rates must be used where known.
2. If unavailable choose application depth based on information in the table below.

EFFLUENT TREATMENT METHOD	APPLICATION DEPTH
Low rate type systems (pods)	Low application method
Metered pivot application systems	< 12 mm
Travelling irrigators	12-24 mm
Stationary irrigators, canons or contractor pumping	> 24 mm

*NOTE: DO NOT check the **actively managed** box (unless there is NO risk of effluent losses through runoff or by-pass flow), and there is no system losses due to ponding, overlap, or faulty equipment.*

*NOTE: On pastoral blocks, if **spraying infrequently from a holding pond** is specified, then the month effluent is applied can be specified (deferred irrigation method). The model assumes that the pond storage capacity is adequate.*

JUSTIFICATION:

- Ideally it is important to get the application depth as accurate as possible and this may require on-farm measurement.
- The table provided is a generalised indication only, for example it is possible to change the speed of a travelling irrigator to deliver a lower application depth.

Percentage of block areas receiving effluent

RECOMMENDATION:

Leave as 100%, unless effluent is not applied to the whole block.

Solid effluent applications

RECOMMENDATION:

Select source of solid material applied and month applied.

4.15 BLOCK HISTORY

Long-term paddock history

Years in pasture

RECOMMENDATION:

Enter the number of years in pasture in the ten year period before the Reporting year and Year 1.

- Several paddocks with different years in grazed pasture (including cut and carry) may be blocked together when other management factors are similar, Paddocks can be grouped when years in pasture is consistent with these groupings: 0-2, 3-5, 6-8, 9, 10 years in pasture.
- For clover seed and ryegrass seed blocks enter as years in pasture.
- Count as a year in pasture if the block is in pasture for 10 months or more, otherwise do not count as a year in grazed pasture.

JUSTIFICATION:

The years in pasture is used to modify the N mineralisation rate, which has significant consequences for N cycling.

Land use prior to crop rotation

Prior land use

RECOMMENDATION:

Select the appropriate prior land use in the month immediately prior to year 1 from the drop down list (Figure 1). This is the land use two years before the reporting year.

- If animals grazing an annual species then enter as **grazed pasture**.
- If prior land use doesn't fit any of the categories provided choose **crop**.



FIGURE 1: Select the appropriate land use in the month immediately prior to Year 1 (marked in red).

Animals grazing pasture

Source

If pasture is selected additional information will be required about the source, if the crops are grazed within the reporting year. When deciding which to use it is important to know how grazing animals interact with the rest of the farm. A large number of assumptions are made when entering stock as non-farm animals.

RECOMMENDATION:

1. Select **farm stock** as animal source and select **animal class pasture consumption equals ratio of intake on-farm** if any of the following criteria are true:

- Farm includes a pastoral block
- Livestock move between this block and the rest of the farm
- Livestock are on-farm all year
- Dairy-grazers over winter on this block
- Supplements are fed to livestock on this block

2. For crop systems that use imported animals to 'clean up' then **non-farm animals** option can be used. These non-farm animals are assumed to be separate from those entered on the stock number data sheet and:

- Animal intake is estimated and cannot be changed
- Non-farm animals cannot be fed supplement

JUSTIFICATION:

- Given that many arable properties also have livestock the preferred option is to select **farm stock** as a large number of assumptions are made when selecting **non-farm animals**.

Management

Pasture and Seed Crops

Additional information is required to describe management of the grazed pasture and seed crops on the block at the beginning of Year 1. This is required to account for harvesting of the pre-crop and supplements made from the pre-crop in the reporting year.

RECOMMENDATION:

1. Tick the **Supplement removed in current assessment year** check box when the pre-crop is cut and carried during the reporting year.
 - Enter supplements made during the reporting year on the block's Supplements made page (see section 4.9).
2. Enter the **month seed harvested** from the pre-crop seed crop (if known), otherwise leave blank.

All crops:

If lime has been applied 2–5 years ago check box **specify lime application in previous years** and select **type of lime material** applied from the drop down list and enter the amount applied.

4.16 FODDER CROP ROTATION AND CROP ROTATION

IMPACT:

It is important to capture the sequence of events, e.g. cultivation, sowing, harvesting, fertiliser applications and irrigation, as this will have an impact on nutrient cycling.

All management activities and events occurring during the reporting year and, if required, the year before, must be recorded month-by-month using the crop rotation table. This table uses icons to depict the sequence of events and the inferred crop status.

The type of the block used (Crop or Fodder crop) will depend on the crop(s) sown and the length of the crop rotation. See section 1.3 to determine which block type to use. For additional information on data entry into the crop rotation page, refer to Appendix 7 which provides examples of the data entry process.

Specify crop type

RECOMMENDATION:

1. All crops sown must be entered by selecting category, crop type, product yield and month and year sown.
 - Additional information may be required around cultivation practice at sowing and residual disposal method depending on the crop.
 - ONLY check **modify growth curve and harvesting** box if you have expert knowledge on crop physiology.
 - Enter specify soil test values if known, otherwise leave box unchecked.

- **Chicory (or similar):** Where this is planted as a single species crop within the assessment year using cultivation, enter as rape in the fodder drop down list. If the chicory has been sown prior to the assessment year, or is sown in a pasture mix, leave out of fodder crop model, and allow the model to treat it as pasture.
 - **Sorghum:** Enter sorghum into the model as maize with a default yield at “75” per cent of the model maize yield default.
2. The method used to defoliate seed crops, annual ryegrass and pasture crops for forage must be entered.
- Defoliation of pasture based crops have been integrated into the pasture based animal intake model. Monthly defoliations of these crops need not be entered on a monthly basis.
 - Select the defoliation method(s) used.
 - Enter the month of harvest of seed crops (if known) and the yield of annual ryegrass in the reporting year.
 - If the crop is cut and carried for forage, enter supplements made during the reporting year on the block’s Supplements made page (see section 4.9). If grazed in-situ, select the source of farm stock and enter the percentage of the crop eaten by each animal type.

Cultivate

RECOMMENDATION:

Only specify a cultivation event if cultivation occurs in any month other than the month of sowing.

JUSTIFICATION:

OVERSEER assumes that when you sow a crop, cultivation occurs in the same month.

Fertilise

RECOMMENDATION:

Enter fertiliser and lime product description, application rate and method applied on a monthly basis.

- Click on the symbol beside fertilise to create multiple fertiliser activities.
- Check the desired year(s), months required and add one or more applications as required.

NOTE: Fertiliser applied to the pastoral block that is also applied to the fodder crop block before it is sown into the crop and after it is resown to pasture should also be entered here.

Irrigate

RECOMMENDATION:

See section 4.11 and follow those instructions for irrigation entry for fodder crop and crop blocks.

Cut/Graze (excluding seed crops, annual ryegrass and pasture crops)

RECOMMENDATION:

Monthly defoliation of crops must be entered for crops other than seed crops, annual ryegrass and pasture.

Enter method of defoliation for each month it occurs:

- If method is cut and carry, specify the destination of the crop and enter the percentage of the crop eaten by each animal type.
 - » Cut and carry crop can only be sent to one destination each month, if more than one destination choose the dominant destination.
- If method is grazed in-situ, the source of farm stock should be selected and the percentage of the crop eaten by each animal type entered.
 - » If restricted grazing occurs, enter the hours/day the crop is grazed for.

NOTE: Ensure final harvest is selected for the month of the last defoliation of the crop.

NOTE: In the crop block, an option to add additional defoliations at final harvest for fodder or forage crops has been added. This option is only available in the final month of the reporting year. If no information is entered into the additional defoliation tab all the crop is fed during the month/s entered in the reporting year. If there are additional defoliations after the final month of the reporting year enter the number of additional defoliations.

NOTE: Cut/graze defoliation and crop harvest entries for permanent pasture, annual ryegrass and seed crops on fodder (crop) blocks entered using version 6.2.3 and earlier, are now redundant and should be cleared.

NOTE: In the crop block, an option to select 'crop stored prior to feeding out' may be available if the crop is cut and carry and the destination of the crop is 'on pastoral blocks'. By selecting this option you are spreading out the feeding of this crop over the whole year, i.e. a maize silage crop which is fed out over multiple months. If this is not selected, the assumption is that all the crop is fed in the month of harvest.

NOTE: Non-farm animals should not be selected when defoliating a fodder and forage crop. Non-farm animals are designed to be used when the animals are unknown. Typically they would represent animals brought in to clean up a crop where the crop farmer doesn't know anything about them. A large number of assumptions are made when selecting non-farm animals.

4.17 OUTDOOR PIG GREEN COVER

IMPACT:

Green cover can have a significant impact on N leaching.

RECOMMENDATION:

Enter the percentage of green cover for each season, for each class of pig. Estimate the average proportion of the block with growing (green) grass cover for each season.



Appendices

Appendix 1:

Factors to take into account when combining areas into blocks for arable farms

INPUTS	RECOMMENDATION
Soil description	Where multiple soils exist within a block, use the dominant soil type unless the soils differ markedly in drainage characteristics, in which case do not block the soils together.
Irrigation	Determine block according to method of irrigation – e.g. none vs. centre pivot vs. big gun.
Years in pasture	Areas can be grouped according to their long-term history (0–2, 3–5, 6–8, 9, 10 years in pasture). For long-term pasture (> 6 years), intensive cultivation will result in more mineralisation than minimum tillage and this should be taken into account when blocking.
Prior land use	Use the options listed in the drop down box to block. Where the block's land use is not listed in the drop down box, see Appendix 2 for suitable options and groupings of crops with similar N status.
Crop rotation	This is the main factor determining blocking on a cropping farm. Crops of similar N status can be grouped together as per Appendix 2. It is also important to consider canopy duration as the effects of canopy duration on the water balance are just as important as N status.
Animals grazing pasture	If animals graze pasture during the year immediately before the reporting year, this must be used as a blocking factor to divide an area into separate blocks. This is because the urine deposited by those animals is taken into account by the model.

Appendix 2:

Grouping options for crops of similar N status and canopy duration for specifying the previous crop

CROP	GROUPING CATEGORY	COMMENTS
Fodder		
Kale	Winter fodder	If appropriate yields and sowing times are provided kale, swedes and turnips could be grouped.
Swedes	Winter fodder	
Turnip bulbs	Winter fodder	
Rape	Summer fodder	If appropriate yields and sowing times are provided, leafy turnips and rape can be grouped.
Turnip leafy	Summer fodder	
Fodder beet	Don't group	It is best to leave fodder beet on its own due to it having a lower N content than the brassica crops.
Forages		
Annual ryegrass	Grass forage	
Forage barley (spring)	Spring cereal forage	The cereal forages can be grouped on Spring and Autumn sown types.
Forage oats (spring)	Spring cereal forage	
Rye corn (spring)	Spring cereal forage	
Triticale (spring)	Spring cereal forage	
Rye corn (autumn)	Autumn cereal forage	
Forage oats (autumn)	Autumn cereal forage	
Triticale (autumn)	Autumn cereal forage	
Maize silage	Maize	If appropriate harvest time is given maize silage is no different to grain maize.

CROP	GROUPING CATEGORY	COMMENTS
Grains		
Barley (spring)	Spring cereal	
Oats (spring)	Spring cereal	
Wheat (spring)	Spring cereal	
Wheat (autumn)	Autumn cereal	
Oats (autumn)	Autumn cereal	
Maize (short, medium and long)	Maize	The only difference between these maize's is the duration of their growth differs by about 2 months from short to long. If this loss of precision can be tolerated then a medium maize could be used to represent them all.
Green Manure		
Brassica	Green manure	
Mustard	Green manure	
Phacelia	Green manure	
Oats and rye	Autumn Cereal	
Lupins	Legume green manure	
Seed		
Clover seed	Don't group	
Ryegrass seed	Don't group	

Appendix 3:

Additional information around entering information to the enterprises

Entering Monthly Stock Numbers

In this example lambs are being finished and drafted and sold at 46 kg. The OVERSEER weight entry is the 25 kg weaning weight, and the end live weight of 46kg:

- 1200 lambs weaned 1 January
- 400 sold at 1 March
- 350 1 April
- 250 sold at 1 June
- 200 kept as replacements

In Table 1 below the mob is entered on one line. Using this data entry methodology OVERSEER will assume that the 1200 in January are 25 kg and the remaining 200 in June are 46 kg. The model will assume a weight gain of 3.5 kg per month in this case (21 kg gain over 6 months = 3.5 kg/month).

OVERSEER will assume that the 400 sold on 1 March are only 32 kg when sold, the 350 sold at 1 April are 35.5 kg, and the 250 sold at 1 June are 42.5 kg.

TABLE 1

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Lambs	1200	1200	800	450	450	200

AGE AT START

Select the month the animals are born from the row across the top →

Select the current month from the columns below - also using the animals R1, R2, or R3 year ↓

	JULY	AUG	SEPT	OCT	NOV	DEC	Approximate "R" Age
July	1						
August	2	1					
September	3	2	1				
October	4	3	2	1			
November	5	4	3	2	1		
December	6	5	4	3	2	1	R1
January	7	6	5	4	3	2	
February	8	7	6	5	4	3	
March	9	8	7	6	5	4	
April	10	9	8	7	6	5	
May	11	10	9	8	7	6	
June	12	11	10	9	8	7	

	JULY	AUG	SEPT	OCT	NOV	DEC	Approximate "R" Age
July	13	12	11	10	9	8	
August	14	13	12	11	10	9	
September	15	14	13	12	11	10	
October	16	15	14	13	12	11	
November	17	16	15	14	13	12	
December	18	17	16	15	14	13	R2
January	19	18	17	16	15	14	
February	20	19	18	17	16	15	
March	21	20	19	18	17	16	
April	22	21	20	19	18	17	
May	23	22	21	20	19	18	
June	24	23	22	21	20	19	
	JULY	AUG	SEPT	OCT	NOV	DEC	Approximate "R" Age
July	25	24	23	22	21	20	
August	26	25	24	23	22	21	
September	27	26	25	24	23	22	
October	28	27	26	25	24	23	
November	29	28	27	26	25	24	
December	30	29	28	27	26	25	R3
January	31	30	29	28	27	26	
February	32	31	30	29	28	27	
March	33	32	31	30	29	28	
April	34	33	32	31	30	29	
May	35	34	33	32	31	30	
June	36	35	34	33	32	31	

Appendix 4:

Description of New Zealand Soil Orders* in OVERSEER

*Descriptions adapted from Landcare Research website (landcareresearch.co.nz)

SOIL ORDER	KEY ATTRIBUTES	OTHER ATTRIBUTES
1. Allophanic <ul style="list-style-type: none"> • 5% NZ land area • Major: North Island – volcanic ash • Minor: South Island – high country 	<ul style="list-style-type: none"> » Phosphorus retention high or very high » Greasy feel between fingers (dry or wet) » Dark brown/black topsoil 	<ul style="list-style-type: none"> » Porous, low density, good rooting » Easy to dig, crumbles easily when crushed » Stable topsoil, low pugging/machinery damage » Well drained » Moist climate
2. Brown <ul style="list-style-type: none"> • 43% NZ land area • Most common soil 	<ul style="list-style-type: none"> » Phosphorus retention moderate to high » Good agricultural soil » Brown topsoil, yellow brown subsoil 	<ul style="list-style-type: none"> » Rarely droughty in summer or waterlogged in winter » Stable topsoil, good structure » Well drained » Moist climate
3. Gley <ul style="list-style-type: none"> • 3% NZ land area • Wetlands, unless artificially drained for agriculture 	<ul style="list-style-type: none"> » Winter and spring water-logging » Light grey subsoil colour commonly with red mottles 	<ul style="list-style-type: none"> » Drainage required for intensive agriculture » High organic matter » Sustain production into summer in dry areas
4. Granular <ul style="list-style-type: none"> • 1% NZ land area • Northern North Island 	<ul style="list-style-type: none"> » Highly productive long-term horticulture soils » Clayey (sticky when wet) 	<ul style="list-style-type: none"> » Highly weathered/old volcanic soils » Good structure » Limited workability and sticky when wet » Slow permeability in subsoil
5. Melanic <ul style="list-style-type: none"> • 1% NZ land area, scattered throughout • Formed from Basalt or Limestone rocks 	<ul style="list-style-type: none"> » Black to dark brown topsoil » Highly fertile 	<ul style="list-style-type: none"> » Good soil structure » High magnesium or calcium » Swell when wet, shrink when dry » Biologically-active » Well drained
6. Organic <ul style="list-style-type: none"> • 1% NZ land area • Wetland and peat 	<ul style="list-style-type: none"> » Wetlands, peat, forest litter » High water-holding capacity 	<ul style="list-style-type: none"> » High organic matter, slow turnover » Acidic » Low bulk density » High water table » Low bearing strength
7. Oxidic <ul style="list-style-type: none"> • < 1% NZ land area • Auckland and Northland 	<ul style="list-style-type: none"> » Phosphorus retention high » Very clayey soil, but good structure » Crushed easily, not very sticky when wet 	<ul style="list-style-type: none"> » Low fertility » Highly weathered and leached volcanic soil » Good structure overlies dense subsoils that limit root depth » Well drained

SOIL ORDER	KEY ATTRIBUTES	OTHER ATTRIBUTES
8. Pallic <ul style="list-style-type: none"> • 12% NZ land area • North and South Islands (seasonally dry, east) 	<ul style="list-style-type: none"> » Pale colour » Dense, weak structure, low rooting » Also called yellow-grey earth » Phosphorus retention low to moderate 	<ul style="list-style-type: none"> » Dry in summer, wet in winter » Older soils have high bulk density, low rooting depth » Low organic matter but good nutrient status » Prone to erosion » Pan or very firm horizons may be formed in subsoil » Variable drainage class
9. Podzol <ul style="list-style-type: none"> • 13% NZ land area • Forests, high country 	<ul style="list-style-type: none"> » High rainfall, usually ex-forest areas » Acidic with low fertility 	<ul style="list-style-type: none"> » Marked horizons e.g. bleached layer beneath topsoil over black or reddish horizon » Forest litter accumulation » Older soils have pans with limited rooting depth » Variable drainage class
10. Pumice <ul style="list-style-type: none"> • 7% NZ land area • Central North Island 	<ul style="list-style-type: none"> » Sandy (pumice), high porosity 	<ul style="list-style-type: none"> » Free drainage » Clay and trace elements low » Deep rooting » Disturbed by traffic but low treading damage » Easily eroded on hills
11. Raw <ul style="list-style-type: none"> • 3% NZ land area 	<ul style="list-style-type: none"> » Very young soils without distinct topsoil 	<ul style="list-style-type: none"> » Rivers, beaches, tidal, alpine areas
12. Recent <ul style="list-style-type: none"> • 6% NZ land area • Alluvial flood plains, steep slopes, young ash 	<ul style="list-style-type: none"> » On floodplains, have high spatial variability » Phosphorus retention low 	<ul style="list-style-type: none"> » Variable depth and texture with variable water holding capacity » Thin profile development » Good fertility » Well drained
13. Semiarid <ul style="list-style-type: none"> • 1% NZ land area • Otago and southern Canterbury inland 	<ul style="list-style-type: none"> » Very low rainfall (< 500 mm), dry soils » Phosphorus retention low 	<ul style="list-style-type: none"> » Nutrient levels high, but irrigation usually required » Low leaching » Some lime and salt accumulation » Low organic matter » Prone to wind erosion » Subsoil clay pans common
14. Ultic <ul style="list-style-type: none"> • 3% NZ land area • Northern North Island, Wellington, northern South Island 	<ul style="list-style-type: none"> » Low permeability » Low fertility » Acidic 	<ul style="list-style-type: none"> » Strongly weathered, topsoil prone to pugging » Clay subsoil below leached horizon » Impeded drainage » Old soils – long-term leaching » Wet in winter
15. Anthropic <ul style="list-style-type: none"> • < 1% NZ land area 	<ul style="list-style-type: none"> » Not included in OVERSEER (no agriculture) 	<ul style="list-style-type: none"> » Intensively mined areas e.g. Central Otago, Westland, crowded urban areas

Appendix 5:

Definition of soil profile inputs, soil water parameters and OVERSEER texture

Background

This technical note provides guidance for users of OVERSEER® Nutrient Budgets (OVERSEER) to interpret soil classes used to modify soil water input values. OVERSEER uses inputs on the soil profile page to set soil moisture contents at wilting point (WP), field capacity (FC) and saturation (Sat). These, in turn, drive the drainage model and hence N leaching.

Nitrogen leaching is sensitive to these input variables and hence consistency in use is important.

Landcare Research has undertaken an analysis of the data used in OVERSEER and made recommendations on how to define the terms on the soil profile page. These recommendations have been adopted and are included in “OVERSEER Best Practice Data Input Standards” and OVERSEER HELP files.

This technical note provides definition for the inputs on the soil profile web page for top soil stoniness, and subsoil soil texture group and non-standard layer.

Topsoil stoniness

Under top soil texture, there is an option to check ‘Is stony’. This should be checked when there are greater than 35% stones in the top soil (0-10 cm layer). This aligns with ‘very stony’ in soil descriptions.

Soil texture group

For some soil orders or soil groups, subsoil texture groups of light, medium or heavy must be selected.

The soil moisture contents used in the OVERSEER model were compared with those of soils in the New Zealand Soils Database (NSD).

Soils with similar soil moisture properties as used for OVERSEER soil texture groups typically aligned with texture classes such that:

- 'light' aligned with sand to loamy sand texture
- 'heavy' aligned with clayey texture
- 'medium' aligned with loamy textures

Table 1 presents soil moisture data for OVERSEER soil texture groups and the averaged data for NSD texture classes where the soil moisture data aligned with the soil moisture data for the OVERSEER soil texture group. The following data outliers were removed from the analysis – all Pumice soils, pumice horizons and horizons with total available water > 24% were removed from the sandy texture class, and all horizons with > 78% clay and/or < 18% wilting point were removed from clayey texture.

Based on this analysis, OVERSEER soil texture group classes are defined as:

- 'Light' = upper 60 cm predominantly sand or loamy sand (except Pumice soils)
- 'Heavy' = upper 60 cm predominantly clay (clay content > 35%)
- 'Medium' = everything else

Table 1 also presents the Pumice data. Sandy Pumice data has a closer association with 'medium' texture than with 'light' texture, especially for total soil available water (TAW).

TABLE 1. Soil moisture contents (mm/100mm soil horizon to 60 cm) at wilting point (WP), field capacity (FC), and saturation (Sat TP, TP total porosity) and total available soil water (TAW) data for OVERSEER texture classes and for averaged data for NSD texture classes (standard deviation in parenthesis. No. = number of samples).

TEXTURE	WP	FC	SAT (TP)	TAW	NO.
OVERSEER light	5	11	43	6	
NSD Sand, loamy sand	6 (5)	18 (8)	49 (7)	12 (5)	67
OVERSEER medium	15	31	50	16	
NSD silt loam, sandy loam, clay loam	18 (9)	41 (12)	56 (12)	23 (10)	1019
OVERSEER heavy	25	39	58	14	
NSD silty clay loam, silty clay, clay	30 (6)	47 (8)	59 (9)	17 (8)	292
OVERSEER medium	15	31	50	16	
NSD Sandy Pumice	8 (5)	26 (6)	57 (9)	18 (4)	25
NSD Loamy Pumice	15 (8)	42 (9)	65 (8)	26 (9)	196

Non-standard layers

The soil moisture contents for a stony non-standard layer align with a soil with high stone content (> 50%) and the dominant texture of the fine material in the very stony horizon is sandy. The stony matrix is similar, except the dominant texture of the fine material in the very stony horizon is loamy or clayey.

Field procedure for determining input values for shallow and stony soils

The recommended field procedure to determine soil input values for OVERSEER is:

- Dig a hole to 60 cm.
- Does the topsoil have > 35% stones? = stony topsoil.
- Is the texture in the top 60 cm dominantly sandy? (= Light), loamy? (= Medium) or clayey? (= Heavy).
- Is there a horizon with > 50 % stones?
 - » Is the predominant texture of the fine material in the very stony horizon sandy? Then non-standard layer = **stony**
 - » Is the predominant texture of the fine material in the very stony horizon loamy or clayey? Then non-standard layer = **stony matrix**
 - » Measure the depth to the top of the non-standard layer?

Examples for Canterbury

Feedback from users and Landcare Research has indicated that there has been varying interpretations of shallow stony soil classes in Canterbury. As a general guide for shallow and stony soils in Canterbury:

Glacial outwash (e.g. Lismore soils) have **Medium** texture group and **stony matrix** at 0.2–0.4 m. The very stony soils have stony topsoils and **stony matrix** at 0–0.2 m.

Younger alluvium (e.g. Eyre, Rakaia, Rangitata soils) have **Light** texture group and **stony** non-standard layers at 0.2–0.4 m. The very stony soils have stony topsoil's and **stony matrix** or **stony** horizons at 0–0.2 m.

Appendix 6:

Default entry inputs of crops and management options not supported by the OVERSEER Crop rotation page

CROP	RECOMMENDATION
Lucerne (Grazing)	Pasture - grazed
Lucerne (hay or seed)	Pasture - cut and carry
Chicory	1. Annual ryegrass 2. When established as a short-term crop under full cultivation enter rape
Sorghum	Maize silage (default yield 75% of maize silage default yield)
Barley (autumn)	Wheat (autumn)
Rape and kale seed	Fodder Rape or Kale
Oil seed rape	Fodder Rape or Wheat
Pasture seed crops	Ryegrass seed
Other seed crops	Use closest crop but extend growth period as much as possible
MANAGEMENT OPTION	RECOMMENDATION
Undersown crops	
Lucerne under barley	Select Barley and sow pasture when barley harvested
Clover under barley	Select Barley and sow Clover when barley harvested
Residue removal	
Bale then burn	Select bale
Graze then burn	Select graze
Bale then graze	Select bale

Appendix 7:

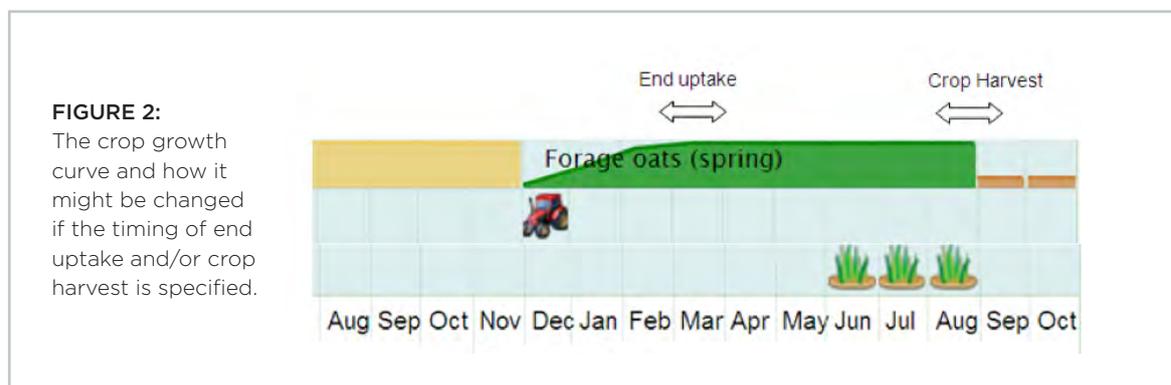
Additional information around data entry into the crop rotation page

The crop rotation table is a timeline with the following headings:

- **Month and Year:** displayed beneath the table these cannot be edited directly. The starting month of the grid will be based on the selected final month of the grid, set on the **Crop block/General** page.
- **Crop:** this cannot be edited directly. It depicts crops grown in terms of a generic crop profile. The profile is responsive to crop information supplied and associated management activities recorded in the following rows.
- **Cultivate:** depicts the timing of cultivation and crop sowing events.
- **Fertilise:** depicts the timing of fertiliser (including urea), lime, manures and organic material.
- **Irrigate:** depicts the timing of irrigation events.
- **Cut/Graze:** depicts the timing of defoliation events (grazed in-situ, cut and carry for use on-farm or elsewhere).
- Information describing a management activity or event is not entered directly into the table. Instead, each icon has an associated dialog into which information describing that event can be entered. Click on an existing icon to open the dialog and view or edit underlying information. A new crop can be specified by clicking on the add crop button. Other events can be added by clicking on the blank cell corresponding to the month the event occurs and the relevant row listed above. A dialog will open into which required additional information must be entered and saved. A crop or any management activity can be deleted using the delete button within the dialog. For more information including a description of icons used refer to OVERSEER Help files.

Specifying a crop

The presence of a crop is depicted in the crop row of the crop rotation table using an icon that illustrates its growth profile  , the bar indicates the proportion of growth that has been obtained. Sowing is depicted using the icon  in the cultivate row. To add a new crop, click the add crop button. To edit an existing crop, click on either one of its two icons. A dialog will open into which information can be entered and saved, such as the type of crop, yield, cultivation method, residue disposal. Information entered into this dialog and elsewhere in OVERSEER is used to estimate the crop's growth curve. This curve can be modified either by specifying the time at which the crop is harvested and/or when the crop reaches maturity at which time nutrient uptake ceases. This is illustrated by Figure 2.



Further information describing how to specify crop details is outlined in the table over (page 55).



Cultivate

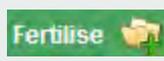
Cultivation events may occur at the time of sowing and at other times. The Cultivate symbol; denotes a cultivation event which is additional to the cultivation that occurs when sowing the crop. The Crop sown event includes the cultivation event which occurs at sowing. If a cultivation event occurs that is additional to the event at sowing then a cultivation event should be added providing it occurs during a month other than the month during which the crop is sown.



Fertiliser

Fertiliser nutrients are one of the major sources of nutrients coming into farm systems and consequently have a large impact on nutrient cycling and losses. Fertiliser includes inorganic fertiliser, lime, and organic manures such as imported industrial effluent and farm dairy effluent (FDE).

Fertiliser is entered based on the month of application. One or more applications can be added by clicking on a cell in the Fertilise row corresponding to the month and year during which the application(s) occurred. Applications saved earlier can be added to or edited by clicking on their specific icon.  refers to a single application,  to more than one. A dialog will open, into which details describing the application of fertiliser, lime and organic material can be entered or updated before saving and closing the dialog.



Fertiliser applications may often be applied over several months. These can be entered by using the  button to open the “create multiple fertilise” activities dialog. Check the desired year(s), months required, and add one or more applications as required. Pre-existing fertiliser applications will not be changed or removed.

Where a special mix (custom fertiliser) or product not included in the OVERSEER fertiliser database has been applied, this can be entered by specifying the product’s name, nutrient composition and the amount applied. This is a two stage process. First the product must be entered into your personal fertiliser database accessible from the Options tab. Go to **Options | Databases | Fertilisers** to add, edit, or delete fertilisers in your user database. Once a fertiliser has been recorded in your fertiliser database it can be accessed as a user-defined fertiliser product.

NOTE: The model does not assume that fertiliser applied to the pastoral block that a fodder crop rotates through is also applied to the fodder crop block.

Therefore any fertilisers that are applied to the pastoral block that the crop rotates through and to the fodder crop block while it was still in pasture must be applied to both the pastoral block and the fodder crop block.



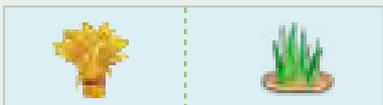
Irrigate

Irrigation in addition to rainfall drives soil drainage and thus has a critically important influence on drainage and hence nutrient leaching.

Irrigation can be entered by clicking on the cell in the Irrigate row corresponding to the month and year during which the irrigation event occurred. Existing irrigation events can be edited by clicking on the icon . A dialog will open into which details such as irrigation method and rate can be entered or updated.



Irrigation events spread over several months may often have the same **Method of irrigation and Irrigation rate**. These can be entered by using the  button to open the Create multiple irrigate activities dialog. Check the desired year(s), months required, and then select **Soil moisture assessment method** and enter **Management systems definition** if required. On saving the dialog, these entries will be replicated over the months and years you selected overwriting any previous entries.



Specifying defoliation Cut/Graze

Timing and intensity of grazing can influence dung and urine return and hence nutrient leaching. Harvesting of crops will remove nutrient from the block and reduce the amount available for leaching and runoff.

Defoliation is depicted using one of two icons.  indicates the crop was grazed in-situ by livestock,  indicates that the crop was cut and then fed out elsewhere on the farm during the year or exported from the farm. To record a defoliation, click the cell on the Cut/Graze row corresponding to the month the defoliation occurred. A dialog will open into which information can be entered specifying whether or not the crop was grazed in-situ or cut and carried. Depending on your selection you will be required to specify information such as, livestock to which the crop was fed, restricted grazing policies in place, whether or not any crop cut was stored, or if it was exported before you save the dialog. Defoliations may be spread over several months. The last defoliation of the crop must be specified by checking Final harvest. Information describing the crop is outlined below and in the OVERSEER Help files.

Specifying defoliation

PRIMARY INPUT	DESCRIPTION
<p>Defoliation</p>  	<p>The standing crop is removed but crop re-growth occurs. This option is limited to crops such as winter oats and wheat, seed crops, cut and carry of permanent pasture, forages, and fodder crops. For fodder crops, subsequent months can be selected to represent grazing over extended periods. Using the dialog box Method of defoliation, i.e. either cut and carried or grazed in-situ, can be selected and Final harvest checked to indicate the last defoliation event of the crop at which time regrowth ceases.</p>

Specifying crop details

PRIMARY INPUT	SECONDARY INPUT ¹	DEFINITION
Crop sow  		<p>This initiates cultivation and sowing and starts the crop's growth. Entering this event when a previous crop exists, i.e. if harvest, cultivation or final defoliation has not occurred earlier, will stop the previous crop's growth. Harvest of the previous crop is assumed if appropriate, and residues removed as specified in its dialog. Consequently non-harvested tops and roots become residues in the month the new crop is sown. A crop grows according to a typical relationship between stage of growth and accumulated thermal degree days, with the growth period extended if the month the crop ends or is harvested is two months following crop maturity. Exceptions to this rule are pasture, seed crops after the first harvest and annual ryegrass forages, where the growth rate is based on estimated monthly growth rates.</p>
	Category and Crop type	<p>Selecting a crop category from the drop down list determines the list of crop options available in the drop down list under crop type. For crops not covered see Appendix 2 for alternative options.</p>
	Product yield	<p>Enter the crop yield as at DM/ha. For most crops a 'typical' yield is provided below the data entry box for guidance.</p>
	Cultivation practice at sowing	<p>From the drop down list box select the best option out of minimum till, direct drilled or conventional.</p>
	Method of residue disposal	<p>This dialogue box appears only for crop options that are likely to leave a residue in the paddock. From the drop down list box select an option:</p> <ul style="list-style-type: none"> • Retained – incorporated into the soil with next cultivation. • Grazed • Burnt • Removed – baled and removed from farm. <p>Note that multiple options such as baling then burning or grazing then burning are not supported. It is recommended that the option which removed the greatest amount of the residue be selected (Appendix 6).</p>
	Modify growth curve and harvesting	<p>Check this box to modify the default growth curve and the timing of harvest estimated by OVERSEER. The crop growth profile can be modified by specifying the month the crop reaches maturity and nutrient uptake stops, the month of harvest, or both. Three options are presented for crops other than fodder, forage, green manure crops or pasture:</p> <ol style="list-style-type: none"> 1. No end date – Assume the crop is harvested at a time estimated by OVERSEER. 2. Select harvest date – The crop is harvested at the end of the specified month. 3. Select the month crop ends – The crop is pulled or sprayed out at the end of the month.

PRIMARY INPUT	SECONDARY INPUT ¹	DEFINITION
	<ul style="list-style-type: none"> • End uptake on 	Use to specify the month the crop reaches maturity after which no nutrient uptake occurs. This is an optional input. Unless there is good reason, leave blank to use the OVERSEER default value. The time a crop reaches maturity can be ascertained using the crop growth profile this being the time at which the standing crop reaches its maximum. To change this, check the box Modify growth curve and harvesting and select the year and month. One example where End uptake might be specified is when the harvest of a mature vegetable crop such as potatoes or carrots is delayed a month to meet market demands.
	<ul style="list-style-type: none"> • No end date 	This is the default option. Select this to specify that the crop be harvested at a time estimated by OVERSEER.
	<ul style="list-style-type: none"> • Select harvest date 	Use this option to specify the year and the month the crop is harvested. The existing crop growth is stopped at the end of the month. Product is exported from the farm.
	<ul style="list-style-type: none"> • Select month crop ends 	Use this option to specify the year and the month the crop ends. The growth of the existing crop is stopped at the end of the month and non-harvested tops and roots become residues but no product is removed. This option represents management options such as spraying or crop pulling. Using this option may also extend the crop growth period if specified within two months following crop maturity, a period during which there is no nutrient uptake. Use this option with caution as no checks are made on the validity of the resultant crop growth curves.
	Soil tests	Completing this part of the data entry is optional. Check the box Specify soil tests and enter the soil test data. If no soil data is entered i.e. the field is blank or zero, the model will use default values.

¹Fields preceded by a bullet are located in the Modify growth curve and harvesting drop down panel.

Examples illustrating how to enter data into the crop rotation page

Below are examples of how to enter data into the crop rotation page, depending on whether you have a fodder crop block (Example 1.) or a crop block (Example 2.).

Example 1: Crop rotations that fall within a 12 month period and are less than 25% of the pastoral area

On a farm where fodder or forage crops rotate through selected pastoral blocks and are no more than 25% of the area of pastoral blocks being cropped, use the fodder crop block type, when setting up the farm's blocks.

A winter fodder crop, which is part of a pasture renovation program

A 9 ha kale crop was sown shortly after cultivation of permanent pasture in November on a 55 ha effective dairy runoff in Canterbury. 250 kg/ha of Cropmaster DAP was applied at sowing and urea applied at 120 kg/ha in December and 100 kg/ha in January. The crop yielded 14 t DM/ha and was grazed by dairy cows in June and July. Permanent pasture was resown in September.

Data Entry Process

To set up a fodder crop block on your farm, go into the farm blocks page, select a fodder crop block and add it to your farm. Enter the block name as Kale.

PAGE	ITEM	PROCESS	INPUT EXAMPLE
Farm > Blocks			
	Type	Select Fodder crop	Fodder crop
	Name	Enter block name	Kale

To enter the fodder crop block details, click on the Kale block and enter data into the general, irrigation and crop rotation pages as described below.

PAGE	ITEM	PROCESS	INPUT EXAMPLE
Kale > General			
	Rotation area	Enter the block's cultivated area	9.0
	Month resown in pasture	Enter the month the block is resown into permanent pasture	September
Kale > Irrigation			
	Irrigation system type	Select the most appropriate method from options provided to describe method of irrigation	None applied

The re-sowing of grazed pasture is automatically entered into the last month of the crop rotation table. This example does not include any applications of liquid and/or solid effluent, but these can be entered on the block’s effluent page, if applied.

To record the sowing of a crop, click the **Add crop** button to open the Crop detail pop up, enter the crop details and save. To add irrigation, fertiliser and defoliation (cut/graze) events, select the appropriate row and month to open a dialog, then enter data and save.

POPUP	ITEM	PROCESS	INPUT EXAMPLE
Kale > Fodder crop rotation			
Crop details	Category	Select the appropriate category	Fodder
	Crop type	Select the best option describing the crop	Kale
	Crop sown in	Select the month when the crop is sown	November
	Product yield	Enter the yield of the crop. The optional default is typical yield.	14.0
	Cultivation practice	Select the best option describing the method used The optional default is Conventional	Conventional
	Modify growth curve	Not a compulsory input	Unticked
	Soil tests	Not a compulsory input	Unticked
Fertilise	Each application	Fertiliser applied to the crop area must be entered against the month applied. This includes fertiliser applied before a crop was cultivated out of pasture and fertiliser applied in the last month of the crop rotation.	250 kg/ha Cropmaster DAP in Nov 120 kg/ha urea in Dec 100 kg/ha urea in Jan
	Application > N type	Enter the best option if known. If not, select Incorporated if applied in month of sowing, otherwise Surface applied.	Incorporated, Surface applied, Surface applied
Irrigate	Each monthly application	Irrigation can only be specified if the system type is specified on the block’s Irrigation page. Enter the irrigation practices that apply to the fodder crop block. Select the most appropriate options describing how irrigation is scheduled, including assessment of Soil moisture. To enter detailed information describing the management strategy, select User defined. If unknown, select the optional default, Default.	<blank> (n/a)

POPUP	ITEM	PROCESS	INPUT EXAMPLE
Cut/Graze	Each defoliation	<p>Select the most appropriate method from the list provided:</p> <p>Cut and carry: Enter the destination of the crop from the list provided, and if required, the Percentage of the crop eaten by each animal type.</p> <p>Select Crop stored prior to feeding unless all feed is consumed that month.</p> <p>Grazed in-situ: Select Farm stock as the source. Do not select Non-farm animals. Enter the percentage of the crop produced that is eaten by each animal type on the block (these must add up to 100 per cent).</p> <p>Enter Restricted grazing hours if known, otherwise leave blank.</p>	<p>Defoliations in June and July</p> <p>Grazed in-situ by Farm stock > Dairy consuming 100% of crop production</p>
	Defoliations > Final harvest	In the pop-up of the last defoliation of each crop tick Final harvest to indicate regrowth has ceased	Tick in July

Example 2: Fodder and forage crop rotations that are 12 months or longer or larger than 25% of pastoral blocks through which they rotate

Use a crop type block for each of the fodder or forage crops on the farm when one or more of the following occur:

1. The fodder (or forage) crop area is greater than 25 per cent of the block(s) that it rotates through.
2. The crop is grown on the same area each year.
3. The time in crop is greater than the 12 month reporting year, i.e. the block is not resown back into permanent pasture within 12 months.

Block history and crop activities occurring in the year preceding the reporting year (Year 1) must be recorded for crop type blocks.

A fodder crop rotation, with 2 consecutive crops grown for in-situ grazing and/or cut and carry.

On a 235 ha North Island dairy farm, in Year 1 of the crop rotation, 11.5 ha of Maize silage (crop 1), was sown in October after 3 years of permanent pasture. The crop yielded 18 t DM/ha and was ensiled in April for feeding out to cows on the feed pad. 200 kg/ha DAP was applied at sowing and 150 kg/ha urea in December and January. Pivot irrigation (variable depth, fixed return period) was applied from October to March each year.

Following the maize crop, a fodder beet crop (crop 2) was sown in September. 200 kg/ha DAP was applied at sowing and 150 kg/ha urea in December and January. The crop yielded 22 t DM/ha and was grazed by dairy cows from April until August before being re-sown to pasture in September.

General information for the Crop blocks

1. Enter the name and area of the crop block on the farm's Block page - Maize-FB.
2. Specify the month the rotation ends on the block's General page - July.
3. The irrigation system, if used, must be specified - Linear and centre pivot.
4. Specify on the Block History page, the years in pasture - 3.
5. Specify Prior land use - Grazed pasture.

Data Entry Process

PAGE	ITEM	PROCESS	INPUT EXAMPLE
Farm > Blocks			
	Type	Select crop	Crop
	Name	Enter block name	Maize-FB
	Effective area	Enter the effective area.	11.5
Maize-FB > General			
	Crop rotation final month	Enter the month the crop rotation ends	June
Maize-FB > Irrigation			
	Irrigation system type	Select the most appropriate system type from the options provided	Linear and centre pivot
	Source of nutrient data	Select the best option describing the source of nutrient data in irrigation water	OVERSEER default
Maize-FB > Block history			
	Years in pasture	Enter the number of years in pasture during the 10 year period before the previous year.	3
	Prior land use	Select the best option describing land use at the beginning of the previous year	Grazed pasture
	Animals grazing pasture	Source	<blank> (n/a)

To add each crop, click the **Add crop** button to open the Crop detail pop-up, enter details and save. Specify fertiliser and irrigation for each month applied.

Liquid and/or solid effluent generated on-farm can be entered on the block's Effluent page.

Data Entry for Crop 1 in the rotation

POPUP	ITEM	PROCESS	INPUT EXAMPLE
Add the first crop (Maize silage)			
Crop details	Category	Select the appropriate category	Forages
	Crop type	Select the best option describing the crop	Maize silage
	Crop sown in	Select the month and year when the crop is sown	October of Year 1
	Product yield	Enter the yield of the crop The optional default is typical yield	18.0
	Cultivation practice	Select the best option describing the method used The optional default is Conventional	Conventional
	Modify growth curve	Not a compulsory input	Unticked
	Soil tests	Not a compulsory input	Unticked
Fertiliser	Each application	Fertiliser applied to the crop area must be entered against the month applied. This includes fertiliser applied before a crop was cultivated out of pasture and fertiliser applied in the last month of the crop rotation.	250 kg/ha Cropmaster DAP in Nov 100 kg/ha urea in Dec 100 kg/ha urea in Jan
	Application > N type	Enter the best option if known. If not, select Incorporated if applied in month of sowing, otherwise Surface applied.	Incorporated, Surface applied, Surface applied
Defoliations	Each defoliation	For each month the crop is defoliated enter a defoliation event	April
	Method of defoliation	Select the best option describing the method used	Cut and carry
	Destination of crop	Select the best option describing where the crop is to be fed out	Feed pad
	% of crop eaten	Specify the percentage of crop eaten by each animal enterprise (these must add up to 100%)	Dairy = 100%
	Crop stored prior to feeding out	Tick if harvested feed is not all consumed in the month it was harvested Optional default: Ticked	Ticked
	Final harvest	In the pop-up of the last defoliation tick Final harvest to indicate regrowth has ceased	Ticked in April

Data Entry for Crop 2 in the rotation

POPUP	ITEM	PROCESS	INPUT EXAMPLE
Add the second crop (Fodder beet)			
Crop details	Category	Select the appropriate category	Fodder
	Crop type	Select the best option describing the crop	Fodder beet
	Crop sown in	Select the month and year when the crop is sown	September of Reporting year
	Product yield	Enter the yield of the crop The optional default is typical yield	22.0
	Cultivation practice	Select the best option describing the method used The optional default is Conventional	Conventional
	Modify growth curve	Not a compulsory input	Unticked
	Soil tests	Not a compulsory input	Unticked
Fertiliser	Each application	Fertiliser applied to the crop area must be entered against the month applied. This includes fertiliser applied before a crop was cultivated out of pasture and fertiliser applied in the last month of the crop rotation.	250 kg/ha Cropmaster DAP in Sep 100 kg/ha urea in Dec 100 kg/ha urea in Jan
	Application > N type	Enter the best option if known. If not, select Incorporated if applied in month of sowing, otherwise Surface applied.	Incorporated, Surface applied, Surface applied
Defoliations	Each defoliation	For each month the crop is defoliated enter a defoliation event.	Apr-Jun
	Method of defoliation	Select the best option describing the method used.	Grazed in-situ
	Source	Select Farm stock as the source. Do not select Non-farm animals.	Farm stock
	% of crop eaten	Specify the percentage of crop produced that is eaten by each animal enterprise (these must add up to 100%).	Dairy = 100%
	Restricted grazing	Enter only if known, otherwise leave blank	<blank> (n/a)
	The last defoliation	The last defoliation of the year is in	Jun
	Final harvest	If the last defoliation is not the final defoliation of the crop leave unticked	Unticked
	Additional defoliations	Enter the number of months the crop is defoliated after the last month in crop rotation table	2

The second crop concludes in August after the end of the reporting year which finishes in June. To account for growth after the reporting year, Final harvest for the June defoliation is unticked and two additional defoliations are recorded.

POPUP	ITEM	PROCESS	INPUT EXAMPLE
Enter irrigation applied during both reporting year and Year 1			
Irrigation	Each monthly irrigation event	For each month irrigation water is applied, enter an irrigation event	Oct-Mar of both years
	Method	Select the most appropriate method from options provided.	Management options
	Scheduling based on	Select the most appropriate method used when scheduling from options provided	Soil moisture sensors: Tapes
	Strategy	Select the most appropriate method from options provided	Depth applied to achieve target, fixed return period
	Management systems definition	To specify further details of the strategy used, select User defined, otherwise select Default Optional default is Default	Default

Appendix 8:

Terminology used in the nutrient budget scenario reports

TERM	DEFINITION
Net transfer by animals	<p>Transfer by animals represents the movement of nutrients through animals. It occurs when feed is eaten (nutrients ingested) in one place on the farm, and excreta is deposited in another place on the farm.</p> <p>For blocks, transfer out of a block (nutrients removed from the block) is positive, and into a block (nutrients added to the block) is negative.</p> <p>Net transfer is the sum of all the removals and additions, and hence can be negative. Four transfers are reported:</p> <ul style="list-style-type: none"> • From block to effluent, lane – this is where nutrients are ingested on the paddock from pasture or supplements fed on blocks, and excreta deposited on lanes and in the farm dairy. • To block – this is where nutrients are ingested from supplements fed on the feed pad, and excreta deposited on the block. This is a negative transfer. • Wintering pad pasture eaten – this is where nutrients are ingested on the paddock from pasture or supplements fed on blocks, and excreta deposited on the wintering pad. This is a positive transfer (nutrients leave the block). • Wintering pad excreta return – this is where nutrients are ingested on the wintering pad as supplements, and excreta deposited on the block when animals are grazing. This is a negative transfer (nutrients are added to the block). <p>The last two options have values when the wintering pad plus grazing option is selected.</p> <p>They describe the transfer of nutrients by animals on-farm moving between blocks, structures (e.g. wintering pads) and laneways.</p>
To atmosphere	
Volatilisation – fertiliser	The loss of ammonia to the atmosphere as a consequence of the application of nitrogen based fertilisers.
Volatilisation – other	The loss of ammonia to the atmosphere as a consequence of nitrogen sources other than fertiliser or urine applied/deposited on the soil.
Volatilisation – from urine	The loss of ammonia to the atmosphere as a consequence of urine deposited on the soil.
Denitrification – background	The loss of dinitrogen gas to the atmosphere as a consequence of nitrogen sources other than urine deposited on the soil.
Denitrification – from urine	The loss of dinitrogen gas to the atmosphere as a consequence of urine deposited on the soil.

TERM	DEFINITION
To water	
Leaching - urine patches	The leaching of nutrients from animals' urine patches.
Leaching - other	The leaching of nutrients from inter-urine areas (incorporates the effects of soil fertiliser, effluent and other nutrient input sources). For P this includes the P loss from farm structures e.g. feed pads.
Runoff	The removal of nutrients from the land via overland flow.
Direct (animals, drains)	Nutrients deposited directly by animals into streams and/or drains i.e. when stock are not excluded from waterways and discharge from mole tile drainage systems.
Direct pond discharge	Nutrients discharged directly from effluent ponds into waterways.
Border dyke outwash	Nutrients discharged from the border dyke outwash.
Septic tank outflow	Nutrients discharged from the septic tank outflow.
Changes in pools	
Standing plant material	Difference in nutrient amount between the beginning and end of the year in the standing crop. The nutrient level is the total nutrients in the product removed, residues and roots multiplied by the proportion of total growth that has occurred. A negative value indicates that the nutrient in the standing crop was higher at the beginning than the end of the year (crop block nutrient budget only).
Root and stover residues	Difference in nutrient amount between the beginning and end of the year in stolons and roots added as residues. A negative value indicates that the nutrient in the residues was higher at the beginning than the end of the year (crop block nutrient budget only).
Crop framework	Gain of nutrients in the framework above and below ground of perennial fruit crops as the result of annual tree growth.
Organic pool	For crop and fodder crop blocks, organic pool for N is divided into estimated mineralisation from soil organic matter and decomposition from residues, and Net immobilisation (change in soil organic matter levels excluding the mineralisation and decomposition modelled, and includes the balancing error*). In other blocks, the organic pool is the net change in nutrients (N, P and S) in soil organic matter and the balancing error*. A negative value indicates an addition (net mineralisation) whereas a positive term indicates a removal (net immobilisation). In the farm nutrient budget, the Organic pool includes net immobilisation, including balancing errors* (shown as Organic pool sub-item), and accumulation in effluent storage ponds if they are emptied less frequently than once a year is included in the farm nutrient budget.

TERM	DEFINITION
Inorganic mineral	Nutrients adsorbed on clay minerals or released by weathering or slow release mechanisms. This also includes the undissolved portion of lime in the year of application, or the portion that dissolves in the year after application, which is negative.
Inorganic soil pool	Change in the conceptual plant available pool for the block. This pool is the pool related to soil test levels. Note that this is for the whole block (camp and non-camp areas) and hence should not be used to estimate maintenance or change in soil tests. A negative value indicates a net loss from the plant available pool. For nutrients other than N or S, blocks, the balancing error is including in the inorganic plant available pool.

***Balancing error:** For a block nutrient budget, the model assumes that inputs equal outputs (nutrients removed and changes in long-term storage pools due to changes in soil organic matter, weathering, adsorption, etc.).

The Balancing error is the difference between initial estimated inputs and outputs and includes any errors associated with entered data or the estimation of terms in the nutrient budget, and unaccounted nutrients.

To balance the budget i.e. to reduce the balancing error to zero, the 'balancing error' is allocated to items within the nutrient budget.

Appendix 9:

Technical Note: Using annual or average climate and production data

Background

OVERSEER® Nutrient Budgets (OVERSEER) is being used in two distinct modes:

1. Predictive mode, where the user is trying to predict annual average losses based on a predicted farm management system. This mode should typically be used when OVERSEER is used in conjunction with catchment and groundwater models to estimate the effect of land use on catchment nutrient loads.
2. Annual mode, where the user is basing the model on current year's management activities. This is typically being used to monitor farms over time, which forms part of the dairy industry's audited self-management programme.

This duality of use then raises the question of whether annual or average climate and production data should be entered.

N leaching sub-model

The N leaching model was validated using average rainfall and N leaching from a range of trials using the following process:

- Setting up farms so that the validation trial was represented appropriately in a block.
- Adjusting rainfall and soil properties inputs so that drainage was similar to measured drainage.
- Comparing modelled and measured average N leaching for the validation block(s).

Thus, OVERSEER is validated against field trials where the management practices are reasonably constant. This and the quasi-equilibrium assumption mean that we are predicting N leaching losses as if management was relatively constant.

The pattern of rainfall, temperature, and PET use 30-year norms. These are clearly long-term averages. These patterns are also used in the validation process.

Annual rainfall (mm/yr) is a compulsory input. In the validation process, rainfall and soil properties are adjusted within bounds so that a similar drainage to that measured is obtained. This in effect means that a 1-3 year average rainfall input has been used, the typical duration of most field trials.

The default temperature and PET is also based on 30-year climate norms. Temperature does have an effect via N removal mechanisms, as noticed by some users when switching location inputs between Region (Canterbury) and Town (Christchurch) which gave different results.

OVERSEER is calibrated against average outputs over the trial duration, typically 1-3 years. Thus, OVERSEER does not attempt to model the year-to-year variations caused largely by climate. As inputs (rainfall and soil properties) are adjusted so that measured and modelled drainage are similar, the validation process indicates that if drainage is modelled well, N leaching is also modelled well.

When using the model in a predictive mode, using long-term climate data and climate data patterns, and long-term average production is the logical approach. When used in annual mode, production is annual. However, should annual or long-term climate data be used, particularly given that currently the long-term climate pattern cannot be varied?

A comparison was made between modelled and measured N leaching from dairy farmlet trials centred around Ruakura, Hamilton, using an early version of OVERSEER (unpublished data). The results indicated that using annual rainfall and production gave a similar validation line to

the line for all trials used to calibrate the model, where annual average rainfall and production data was used. Both methods used the long-term climate pattern, and the management and production data between years was not large. The increased variation was partly due to a 1-in-7 year event when N leaching was high following certain conditions in autumn. The management was relatively constant over this period and hence production was relatively constant.

Work is required to understand the relationships between using OVERSEER in predictive mode or annual mode. Thus, we are not sure that the resultant outputs of using long-term climate and annual production is the same as using long-term climate and long-term average production. Work is also required to understand the effects of real practice, whereby management is changed annually due to climate variation and economic conditions. In addition, these relationships need to be understood when site-specific monthly climate, annual or average patterns are used, and when improved soil data is included.

A full recalibration of the model for the two modes of operation is required, and the relationships between annual and predictive modes of use determined before definitive recommendations are made. Based on the limited data available, when using the model in an annual mode (annual management and production data), we are currently recommending using long-term climate data and patterns. In addition, we recommend that the interpretation of the output should apply to multiple years, for example, using a rolling average, trend analysis, and not be based on a single years output.

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Appendix 10:

Definition of irrigation terms used in OVERSEER

Table 1: Definitions of irrigation management systems (modification of the definitions in Irrigation New Zealand, 2014)

IRRIGATION MANAGEMENT SYSTEM	DEFINITION
Centre pivot/ Linear move	<p>Laterals (linears) and pivots have a main pipeline supported above the field by a series of A-frame towers, each having two driven wheels at the base that keep the machines travelling in a straight formation. Water is discharged under pressure from sprinklers or sprayers mounted along the pipeline.</p> <p>Laterals traverse the field in a straight path creating a rectangular wetted area. Water is supplied from a drag hose connected to a series of hydrants off a mainline.</p> <p>A centre pivot consists of a lateral circulating around a fixed pivot point. Depending on field layout, the pivot may complete a full circle or only part segments. The inside of the pivot covers less area than the outside of the pivot. The sprinkler package is tailored accordingly to ensure the same amount is applied along the length of the pivot.</p>
Travelling irrigator	<p>There are three categories of travellers; gun, fixed boom and rotating boom. Each consists of two parts:</p> <ol style="list-style-type: none"> winch mechanism and a reel or spool gun-cart carrying the water distribution system. <p>A travelling irrigator moves across a field sequentially, strip by strip drawing the gun-cart. They are connected to successive hydrants along a buried mainline. Travelling irrigators are characterised by either a soft hose or hard hose.</p> <p>Soft hose travelling irrigators have a wire rope anchored at the end of the run. The water distribution system and a winch are mounted on the gun-cart. The winch pulls the guncart along by coiling the rope on to the reel. The hose, pulled by the guncart, drags behind. At the end of each run the hose is flattened and coiled onto a drum to move positions.</p> <p>Hard hose travellers have a large stationary reel anchored at the run end. The reel acts as a winch, coiling a delivery tube that both supplies water to the distribution system and drags the gun-cart along the field.</p>

IRRIGATION MANAGEMENT SYSTEM	DEFINITION
Spraylines	<p>A sprayline irrigation system irrigates a field by sequentially moving a static line of sprinklers to predetermined parallel locations across a field. Water is discharged under pressure from the sprinklers which are set at even intervals along a lateral pipeline. There are 4 basic types, Hand-move pipes, side-roll systems, towable systems (pods) and long lateral systems.</p> <p>Hand-move pipes are typically aluminium lengths that clip together with quick couplings to fit field dimensions. Shifting is manual, with pipe sections separated, moved and rejoined at each position. A sprinkler is mounted on a riser at one end of each pipe section, so the sprinkler spacing is set.</p> <p>Side-roll systems consist of sprinklers mounted on aluminium or steel pipeline sections. Each section acts as the spindle of a centrally fitted wheel. Repeating units are joined to form the sprayline to fit field dimensions. The sprinklers are mounted on rotating couplings to ensure horizontal alignment regardless of spindle position. Sprinklers are mounted at pipeline height, and spacing is essentially set. Shifting is done by rolling the complete line sideways to the next position in the irrigation sequence.</p> <p>Towable spraylines (k-line) consist of smaller sized impact sprinklers fitted at set intervals on an alkathene pipe. The laterals are connected to hydrants off buried mainlines. The sprayline length is set. Shifting is by towing the complete sprayline by one end to the next position in the field. Each lateral is moved manually around 6-14 positions.</p> <p>Long-lateral systems have medium sized impact sprinklers mounted on a moveable stand on the end of a length of alkathene pipe. The pipe is connected to hydrants off buried mainlines. The pipe length is typically 60-80 metres long and each sprinkler is moved manually usually by motorbike around 6-10 positions to cover an average 0.8 ha.</p> <p>Sprayline irrigation systems are typically arranged so successive shifts create a grid pattern of sprinkler positions. The spacing between sprinklers may vary considerably. The sprinkler layout pattern that is achieved in practice may be either square, triangular or somewhere in between. Multiple shifts over time overlap to water all of the area.</p>
Micro-irrigation (drip and micro-sprinkler)	<p>A micro-irrigation system consists of a network of lateral pipelines fitted with low discharge emitters or sprinklers. It encompasses a number of methods; drip, subsurface, bubbler and micro-spray irrigation.</p> <p>In a drip system, water is discharged under low pressure from emitters mounted on or built into the laterals which may lie on or above the soil surface, or be buried below the ground in the crop root zone. These systems are distinguished by the fact that water is delivered by the system to some point, for distribution laterally (and vertically) by the soil medium. Discharge rates are generally less than 8 litres/hour for point-source emitters and 12 litres/hour per metre for line-source emitters.</p> <p>Micro-sprayer (micro-jet) and mini-sprinkler systems rely on aerial spread of water droplets to achieve significant lateral displacement before water enters the soil. There may be further lateral spread within the soil itself. Discharge rates are typically less than 60 L/h.</p>

IRRIGATION MANAGEMENT SYSTEM	DEFINITION
Solid set	<p>Solid set irrigation systems are characterised by permanently fixed sprinklers on rigid supports. They are typically arranged in a triangular or rectangular grid pattern with spacing dependent on sprinkler throw capacity.</p> <p>Solid set sprinkler systems are commonly used for over-head frost protection and undertree orchard irrigation. They are also used for nurseries and amenity irrigation including sports grounds and golf courses. Pastoral applications are increasing.</p>
Controlled flood	<p>Water is directed to areas of land via a network of channels and ditches. They utilise the natural contours and fall of the land to distribute the water. It is common only in older Central Otago schemes. Furrow irrigation is practically unknown in New Zealand but if practice it should be included under controlled flood.</p>
Border dyke	<p>Water is carried by canal and race networks to head-races on-farm. A series of gates in the head-race progressively hold water back, raising its level until it spills over a sill and on to graded land contained within borders. The gates are controlled by clocks connected to a release mechanism and they fall at set intervals along the race.</p>

Table 2: Definition of soil moisture assessment methods

SOIL MOISTURE ASSESSMENT METHOD - HOW DO I SCHEDULE IRRIGATION	DEFINITION
Probes (soil moisture sensor)	<p>Soil moisture sensors are used to measure the water content of the soil. There are a variety of sensors available. They fall into two categories - volumetric (measure the water in the soil - how much is available for use by plants) or tension (measure how tightly water is held by the soil - how hard a plant has to work to get it). They are used as trigger points for irrigation.</p>
Soil moisture tapes (soil moisture sensor)	As above.
Manual water balance (soil water budget)	<p>Soil water budgets predict the amount of available water stored in the plant root zone. Plant water use, rainfall and irrigation applications are recorded on a daily basis. Together with the soil water holding properties the inputs and outputs are used to schedule irrigation.</p>
None: fixed depth and return period	<p>The irrigation system is operated using a predetermined irrigation strategy - a set amount of irrigation is applied at regular intervals. Spraylines and travelling irrigators are commonly used in this way.</p>
Visual assessment/dig a hole	<p>Visual observations of the crop and/or soil are made to schedule irrigation.</p>

Table 3: Parameters for the irrigation scheduling options

SOIL MOISTURE ASSESSMENT METHOD	DEFINITION
Trigger point and depth applied to achieve target (VV)	A soil moisture trigger point is used to start and stop irrigation.
Trigger point; fixed depth applied (FV)	A soil moisture trigger point is used to start irrigation but a fixed depth is applied.
Depth applied to achieve target; fixed return period (VF)	A soil moisture sensor is used to vary the amount of irrigation applied, however a fixed rotation length is used.

Table 4: Management system definition

SOIL MOISTURE ASSESSMENT METHOD	DEFINITION
Application depth	The rainfall equivalent depth of water applied to the soil surface during a single irrigation event. It is the depth of water that would be caught in a rain gauge, not the depth of soil that is wetted.
Return period	The typical period between one irrigation event and the next. It is usually calculated for the most demanding period so that the irrigation system can meet water demand most of the time.
Critical values - Trigger	The soil water content (mm deficit) or %PAW at which irrigation is deemed necessary to avoid plant stress.
Critical values - Target	The soil water content irrigation is applied to achieve (mm deficit or %PAW). It will normally be less than the soil moisture deficit at the time of application to allow space for any subsequent rainfall. It may be increased to account for non-uniform application.

Appendix 11:

OVERSEER irrigation defaults

1. Default management option inputs

The default values are based on industry experience gained across a number of modelling studies and related reading.

1.1 Depth per application and return period

The default depth per application and return period as shown in Table 1. These were based on typical values for a 'Depth applied to achieve target; fixed return period'.

Table 1. Default depth per application and return period

IRRIGATOR SYSTEM TYPE	CONDITION	DEPTH PER APPLICATION (MM/APPLICATION)	RETURN PERIOD (DAYS)
Linear and centre pivot	PAW ¹ < 55	15	3
	55 ≤ PAW < 75	22	4
	PAW ≥ 75	25	5
Travelling irrigator ²	PAW < 65	45	6
	65 ≤ PAW < 75	50	7
	75 ≤ PAW < 85	50	8
	85 ≤ PAW < 95	55	9
	95 ≤ PAW < 110	55	10
	PAW ≥ 110	60	12
Spraylines	2 Shifts per day	33	7
	1 Shift per day	65	14
Micro-irrigation (drip and sprinkler)		65	7
Solid set		65	7
Controlled flood		85	14
Border-dyke dyke		85	14

¹ PAW is the Profile available water to 600 mm depth

² Values are for default option of '1 shift per day'. For the option '2 shifts per day', the values are the integer value of half the '1 shift per day' values.

1.2 Minimum return period

The default minimum return periods are shown in Table 2. Minimum return periods is not a parameter for controlled flood or border dyke systems and hence were not set.

Table 2. Default minimum return period

IRRIGATION SYSTEM TYPE	MINIMUM RETURN PERIOD (DAYS)
Linear and centre pivots	3
Travelling irrigator	5
Spraylines	3
Micro-irrigation (drip and sprinkler)	5
Solid set	5
Controlled flood	n/a
Border dyke	n/a

1.3 Minimum depth per application

The default minimum depth per application is shown in Table 3. Minimum depths per application is not a parameter for controlled flood or border dyke systems (section 2.7.4.1) and hence were not set.

Table 3. Default minimum depth per application

IRRIGATION SYSTEM TYPE	MINIMUM DEPTH PER APPLICATION (MM/APPLICATION)
Linear and centre pivots	5
Travelling irrigator	10
Spraylines	5
Micro-irrigation (drip and sprinkler)	10
Solid set	10
Controlled flood	n/a
Border dyke	n/a

1.4 Maximum depth per application

The default maximum depth per application is shown in Table 4. Maximum depth per application is not a parameter for controlled flood or border dyke systems (section 2.7.4.1) and hence were not set.

Table 4. Default maximum depth per application

IRRIGATION SYSTEM TYPE	MAXIMUM DEPTH PER APPLICATION (MM/APPLICATION)
Linear and centre pivots	40
Travelling irrigator	60
Spraylines	40
Micro-irrigation (drip and sprinkler)	60
Solid set	60
Controlled flood	n/a
Border dyke	n/a

1.5 Trigger point

The trigger point is the soil water content that triggers an irrigation event and default values are shown in Table 5. Trigger point is not a parameter for controlled flood or border dyke systems and hence values were not set.

Table 5. Default trigger point values

IRRIGATION SYSTEM TYPE	CONDITION	TRIGGER POINT (% OF PAW)
Linear and centre pivot	PAW ¹ < 65	50
	65 ≤ PAW < 75	53
	75 ≤ PAW < 85	56
	85 ≤ PAW < 95	61
	95 ≤ PAW < 110	63
	110 ≤ PAW < 130	67
	130 ≤ PAW < 150	70
	PAW ≥ 150	71
Travelling irrigator	PAW < 105	50
	105 ≤ PAW < 125	62
	125 ≤ PAW < 145	67
	PAW ≥ 145	72
Spraylines	2 Shifts per day: PAW < 45	50
	45 ≤ PAW < 55	55
	PAW ≥ 55	60
	1 Shift per day: PAW < 125	50
	125 ≤ PAW < 145	55
	PAW ≥ 145	60
Micro-irrigation (drip and sprinkler)	PAW < 45	50
	45 ≤ PAW < 55	55
	PAW ≥ 55	60
Solid set	PAW < 45	50
	45 ≤ PAW < 55	55
	PAW ≥ 55	60
Controlled flood	n/a	n/a
Border dyke	n/a	n/a

¹ PAW is the Profile available water to 600 mm depth.

1.6 Target

The target is the soil water content irrigation is applied to achieve, and default target values are shown in Table 6. Target is not a parameter for controlled flood or border dyke systems and hence were not set.

Table 6. Default target values

IRRIGATION SYSTEM TYPE	TARGET (% PAW)
Linear and centre pivot	95
Travelling irrigator	95
Spraylines	95
Micro-irrigation (drip and sprinkler)	95
Solid set	95
Controlled flood	n/a
Border dyke	n/a

Interpreting Soil Moisture Traces & Water Budgets

Soil moisture traces are typically expressed in % volume or mm of water contained in the soil profile. For tension based soil traces a calibration is required to equate them to a % volume or mm of water contained in the soil profile.

A % volume reflects the mm of water held in in the soil per 100mm slice. For example 38% volume means there are 38mm of water held per 100mm slice of soil. It should be noted that texture and organic matter (topsoil – subsoil) differences occur down through the soil profile and the % volume will change accordingly.

The ‘mm deficit’ unit should be used to interpret soil moisture traces and set site specific trigger point and target values within the OVERSEER irrigation module.

Example

The crop rooting depth actively managed for irrigation is 300mm, the field capacity is 35% and the trigger point is 25%. Field capacity for the 300mm depth of soil is 105mm (35% x3 100mm slices) and the trigger (refill) point for irrigation is 75mm (25% x3 100mm slices). From this a 30mm deficit (105mm–75mm) would be used as the trigger point.

Soil water budgets are a record of water inputs (irrigation and rainfall) and outputs (plant water use and drainage) based on a given soil PAW and defined irrigation trigger point(s). From these a daily soil water balance can be calculated and is expressed as an mm deficit. The ‘mm deficit’ unit should therefore be used to set site-specific trigger point and target values in the OVERSEER irrigation module.

Appendix 12:

Optional irrigator questionnaire (to be completed per block)

Block name

(split on - soil/irrigation system/fertigation/effluent)

Method of irrigation

- Linear/centre pivot
 Travelling irrigator
 Spraylines
 Solid set
 Borderdyke
 Controlled flood
 None

Month irrigated

- September
 December
 March
 October
 January
 April
 November
 February
 May

How is irrigation scheduled? (circle 1 of the 5 options below)

Note: scheduling may be different between blocks and irrigation types

1. Fixed depth and return period = mm/application
- = Return period (days)
2. Soil water budget
3. Soil moisture probes
4. Soil Moisture tapes
5. Visual Assessment/dig a hole = mm/application
- = Return period (days)

If options 3, 4 or 5 selected chose a management strategy below and complete critical value inputs

TRIGGER POINT, FIXED DEPTH APPLIED		DEPTH APPLIED TO ACHIEVE TARGET, FIXED RETURN PERIOD		TRIGGER POINT AND DEPTH APPLIED TO ACHIEVE TARGET	
(A soil moisture trigger point is used to start irrigation but a fixed depth is applied)		(A soil moisture sensor is used to vary the amount of irrigation applied; however a fixed rotation length is used)		(A soil moisture trigger point is used to start and stop irrigation)	
Depth applied (mm/application)		Min depth applied (mm/application)		Refill point/trigger point (%)	
Spraylines (mm/hr and number of shifts per day)		Max depth applied (mm/application)			
Minimum Return period (days)		Return period (days)			
Trigger point (mm deficit)				Trigger point (mm deficit)	
		Targets (mm deficit)		Targets (mm deficit)	

Appendix 13:

Seed crops

Ryegrass seed crops

Ryegrass seed crops may be in the arable rotation for one or more years. During the rotation they may be grazed during autumn and winter with farm stock, then closed up in spring for seed production. Seed is harvested in summer with a combine harvester and crop residue is usually baled and exported off the farm.

Data for the crop should be entered in the following way:

In the Add Crop menu:

Enter the seed yield.

Select **removed** for residual management method.

Select the harvest month (if known).

Select the method used to defoliate for forage. If not defoliated select Pasture fallow.

If grazed, select the source of stock and enter the percentage of crop production eaten by each animal type during the reporting year if this differs from the farm's intake ratio.

If cut and carried, enter what supplements were made during the reporting year, and where they were fed out, on the Supplements made page (Section 4.9).

Harvesting ryegrass seed crops

The default harvest month for the ryegrass seed and pre-crop seed crops is set as December.

The default harvest month for clover seed crop is set as January. If the harvest month is different, this can be over-ridden by selecting the month seed is harvested in the crop dialog.

Defoliation management of a seed crop refers to the crop being grazed or cut and carried. It does not describe removal of seed stock.

For ryegrass seed crops that are established before Year 1 in the grid:

In the block history menu, select 1st or 2nd year seed crop and tick the check box if the pre-crop extends into the reporting year and supplements are removed that year.