

What is OVERSEER?

OVERSEER® Nutrient Budgets (commonly referred to just as OVERSEER) is a freely available software application that generates information about the flow of nutrients on and off a farm. This information is provided as a *nutrient budget*. OVERSEER also produces reports on greenhouse gas emissions.

An OVERSEER budget report captures the current state of nutrient flows within a farm. This tells a farmer or grower how well they are using the available nutrients, what fertiliser is needed to maintain soil fertility and the impact of practices on losses to the environment. This supports farmers and growers to be better informed when they develop their nutrient management plans and farm management plans.

OVERSEER's development started in the 1990s and it will continue to evolve as scientific understanding evolves and to meet users' needs.

- It is farm specific, and aims to be a practical tool by relying on easily obtainable input data to model a representation of that farm,
- It is a strategic management tool – not a tactical in real time tool,
- It covers most farm enterprises and captures the effects of a wide range of management practices,
- It is calibrated against research trials where the data is available.

Data Quality

Like all models OVERSEER must include simplifications of complex processes and the predictions that such models make will always involve uncertainties. OVERSEER was designed to give the best estimates based on the data that is available by using the most appropriate modelling techniques; but like all models, understanding the information entered into the model is critical to producing reliable results. Data quality is the greatest source of uncertainty in the model.

What input variables are the model outputs most sensitive to?

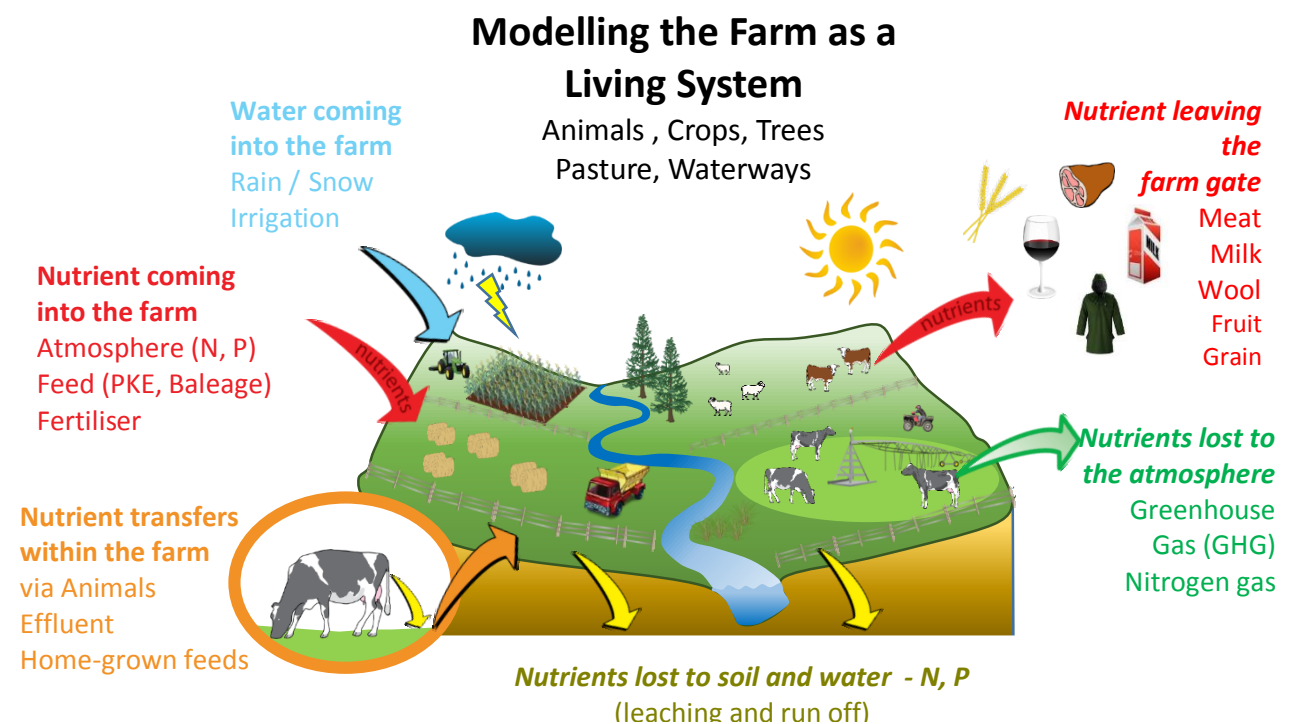
In general, the main inputs that have the most influence on nutrient loss estimates are:

- those that influence the size of **source** of a nutrient (e.g., stocking rate, fertiliser inputs), and
- those that influence the **transport** of a nutrient (e.g., soil, drainage, slope for P).

Animals, effluent, fertiliser, feed and drainage are five key factors influence N leaching from a farm. Because drainage is a key factor it is therefore important to recognise that the OVERSEER calculations of drainage are sensitive to:

- climate inputs, predominately rainfall, potential evapotranspiration,
- soil characteristics that affect potential available water such as soil order, texture, sand or stony subsoil's, and the depth to those subsoil's, and
- irrigation rate and method, and (less important) crop cover.

Because OVERSEER outputs are sensitive to the input information, the quality of the input data is really important.



Measuring versus modelling

OVERSEER estimates whole farm N and P losses averaged over a year. There is no practicable way to accurately measure annual nutrient losses from individual farms at the whole-farm scale.

Research projects can measure losses on small plots or, occasionally, paddocks.

An alternative approach to measuring nutrient losses from farms is to model nutrient flows, using equations to represent biological processes.

There will always be a tension between having the model 'accurate', adequately capturing complex farm systems and ease of use.

What is a 'nutrient budget' and how is it useful....

Much like a financial budget, a nutrient budget tells you how much is coming in and how much is going out and to where.

This information can be used to judge how efficient a farm system is in its use of available nutrients. OVERSEER calculates nutrient budgets for seven major farm nutrients - Nitrogen (N), Phosphorus (P), Potassium (K), Sulfur (S), Calcium (Ca), Magnesium (Mg) and Sodium (Na) as well as acidity for pastoral blocks.

This information is important for developing nutrient management plans and farm management plans.

What is a management block?

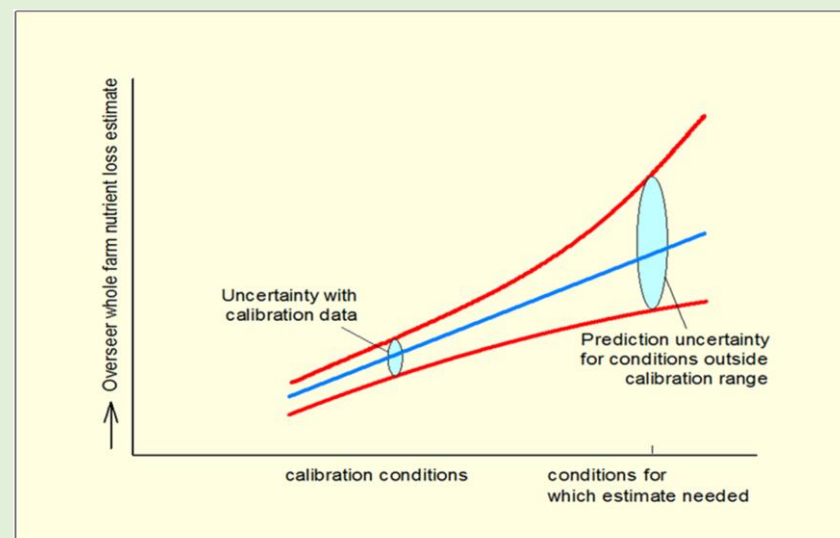
A block is an area of the farm, not necessarily contiguous (one paddock), with the same site and management characteristics. Initially blocks are identified because of differences in soil type and primary land use (block type). The reason for identifying different blocks varies. On a pastoral block, a block may be identified due to one or more reasons (e.g. but not limited to): different fertiliser application rates, animal stocking rates, stock species grazing (e.g. deer only, beef only etc.), pasture species, slope, aspect, dairy effluent application, soil test results, supplement removal or feeding on this block only. Different fodder crop blocks may be identified due to different crop types.

What soil types, climates and farm management practices/systems/land uses are not validated in the model and why? What are the implications of this?

It is inevitable that because OVERSEER is a model that represents most enterprises across a wide range of environments in NZ, that there will be gaps in data to adequately set up (calibrate) and test (to validate) aspects of the model for all conditions. More calibration and/or validation is required, in particular for:

- Cropping farms
- Beef & sheep farms
- All farm-types with rainfall >1400 mm /yr.
- Clay soils, shallow soils

The implication of this is that where a farm is outside the known calibration conditions then there is potential for the uncertainty in the estimate to be greater. While this means the absolute values for a nutrient budget have some level of uncertainty – the relative values (comparisons between farms with the same conditions, or different scenarios within the same farm) have much less uncertainty.



(Shepherd et al. 2013)

What good management practices can be included in each farm system and what current and upcoming management options are not (yet) incorporated into the model?

Many current mitigations in the farm systems are covered by the model.

These include, but are not limited to:

- Varying timing and amount of N fertiliser applications
- Varying timing and amount of supplements fed to animals
- Varying stock type, animal numbers and stock performance, including grazing off
- Use of wintering pads and/or animals shelters
- Adding wetlands or riparian strips
- Changing effluent application area or methods and timing of application
- Irrigation types and improved efficiencies

Why do the numbers keep changing whenever there is a new version of OVERSEER? What does this mean for individual farm outputs?

Some OVERSEER outputs change when a new version is released for the following reasons:

- Bug and problem fixes that have stopped the model including all required calculations in an output value.
- Inclusion of new data (such as validation trials or new science information) that changes a calculation within the model.
- The introduction of new calculations to include newly understood aspects of nutrient cycling or farm systems.

What is important to note is that while the nutrient budget estimates will change, they are only changing to better reflect what is happening within the farm system in reality, based on what we currently know from science. Farm systems that have not changed their set-up or management regime will not have changed the amount of nutrients they are losing to the environment.

What are OVERSEER's limitations?

OVERSEER provides a long-term picture of the nutrient balances on a farm. OVERSEER doesn't:

- Predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving water body. A catchment model is needed to estimate the effects of the nutrient losses from farms on groundwater, river or lake water quality.
- Calculate outcomes from extreme events (floods and droughts), but provides a typical years result based on a long-term average.
- Calculate the impacts of a conversion process, rather it predicts the long-term annual average nutrient budgets for changed landuse.

OVERSEER models nutrient transport through the plant root zone

