Code of Practice for Nutrient Management

(With Emphasis on Fertiliser Use)

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OVERVIEW

Fert Research's *Code of Practice for Nutrient Management* (2007) considers fertiliser use within the broader context of nutrient management. With this approach, a nutrient budget is the basis for developing a nutrient management plan. This Code assists in achieving that, placing the planning within the context of a farm management system.

While it is mainly intended as a guide for nutrient advisers and consultants, this Code is also useful for land managers (farmers and growers) who want to know more about nutrient management planning and the best nutrient management practices for their production system.

Wise nutrient management planning will enable land managers to demonstrate environmental care as they undertake production activities and aim to run a profitable business. Additionally, this Code will help land managers, consultants, Regional Councils and the public to have confidence in nutrient management practices throughout New Zealand's primary production sector.

It is not intended to be read from beginning to end. Users can select sections relevant to them, depending on their needs, farming systems and current level of nutrient management planning.

1. GENERAL

1.1 OBJECTIVES

This *Code of Practice for Nutrient Management* provides a framework for the overall management of nutrients on arable and pastoral farms, horticulture and viticulture blocks, market gardens and forest plantations, and places special emphasis on the use of manufactured fertilisers. In particular the Code aims to ensure that such fertilisers are used safely, responsibly and effectively, while avoiding or minimising adverse environmental effects.

The Code objectives are:

- to provide a simple yet effective process for nutrient management,
- to promote practices that ensure sustainable and economically viable use of fertiliser, and
- to provide users with information on sustainable nutrient management.
- to help support business owners (farmers and growers) to achieve their production and environmental goals for nutrient management.

Use of the Code will give users, regulatory authorities and markets the assurance they require that the nutrients used in New Zealand primary production are well managed to avoid or minimise adverse environmental impacts.

1.2 Scope

The Code sets out an overall process for the management of all deliberately applied nutrients but places special emphasis on the use of manufactured fertiliser products in primary production systems including arable, pastoral, horticultural and forestry production. The Code has been designed to help users comply with the acts and regulations that affect nutrient management activities in primary production.

For the purposes of this Code, fertiliser is considered to be essentially any manufactured product that is specifically produced to be applied to land to increase plant or animal performance, whether by increasing plant growth or overcoming nutrient deficiencies or imbalances. This means the Code covers products used to provide major nutrients (such as nitrogen, phosphorus, sulphur and potassium) plus products used to supply trace elements of importance to plants or animals (such as copper, boron, cobalt and selenium).

It is important to recognise that the deliberate application of manufactured fertiliser is not the sole source of nutrients added to New Zealand soils. This Code encourages all land managers (including farmers, growers and foresters) to understand the role of fertiliser in balancing overall nutrient inputs and outputs in their production system to achieve their production and profit objectives while managing effects on the environment.

1.3 How to use this Code

This Code is arranged to:

- set the scene for adopting nutrient management planning, explaining the background to this process and the key concepts involved (Chapter 2, page 11 – Setting the Scene)
- explain how this Code's approach assists land managers to manage nutrients in farm production systems (Chapter 3, page 15 – Guiding Principles)
- give detailed instructions on preparing a nutrient management plan for arable, pastoral, horticultural, and forestry production (Chapter 4, page 17 – Nutrient Management Planning)

- provide best management practices to manage environmental risks from nutrient management activities (Chapter 5, page 29 – Best Management Practices and Considerations – fertilizer)
- provide more detailed explanations of technical or legal topics (Appendix 1)
- give detailed information about a wide range of topics, including how nutrients behave in the soil and the processes involved, different fertiliser types, and application methods, view Fact Sheets.

Refer to definitions on page 7 for any unknown terms.

If you want…

- *a full understanding of the reasons for using nutrient management plans* – read Chapters 2, page 11 and 3, page 15
- *to prepare a nutrient management plan* – go to Chapter 4, page 17 for the nutrient management planning process; use Chapter 5, page 29 to select the best management practices for your situation
- *to check that present management is suitable* – see Chapter 5, page 29
- *more detail about nutrients and nutrient management topics* – see the Fact Sheets

To get the most out of the nutrient management planning template:

- First write a management plan – follow the template
- Implement the plan and keep records
- Monitor the results
- Use the results to review progress and decide on any plan revisions

1.4 Checking Best Management Practices

This Code can be used to check best management practices for nutrient budgeting and nutrient management planning are being followed. Requirements for each process may be set by a Regional Council. For example, where fertiliser application over a certain level requires a nutrient budget and/or nutrient management plan to be undertaken.

This Code assists land managers, alone or with the help of a fertiliser consultant, to follow the steps that may be required by a Regional Council in a specific situation.

Requirements may include:
Nutrient Management Plan specific objectives (see page 19)
evidence that environmental risks have been assessed (see page 21)
a list of the legal and industry requirements which are relevant to the identified nutrient management activities undertaken on the property (see page 24)
an appropriate nutrient budget (to determine your specific nutrient situation and next steps)

1.5 Definitions

Applicator	A user with specific responsibility for application of fertiliser.
Accredited nutrient advisor	A person who, by recognised accepted qualification (such as Massey University's Certificates in Sustainable Nutrient Management) or experience, is held accountable by their peers to be suitable to provide nutrient management advice that is consistent with this Code of Practice.
Best management practice	Application of the best available demonstrated control, technology, processes, measures and operating methods that are socially, economically, and technically feasible for minimising or avoiding contamination from non point sources.
Capital application	A fertiliser input additional to maintenance requirements which aims to raise soil nutrient status as measured by soil testing.
Carrier	A person/item that provides services for moving items from one place to another.
Certification	Authorisation that the item, practice or service is what it is stated to be.
Coefficient of variation (CV)	The deviation of the item from a reference value. A statistical measurement which is expressed as a percentage of the reference value.
Consequence	The result of an action. In nutrient management planning, the environmental consequences of nutrient management activities are particularly relevant.
Consultant	A person who operates in the field of providing advice generally on a fee paid basis.
Contaminant	Includes any substance (including gases, liquids, solids and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat – (a) When discharged into water, changes or is likely to change the physical, chemical or biological condition of water; or (b) When discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged (s2 RMA).
District Plan	An operative plan approved by a territorial authority under the first schedule (to the RMA) and includes all operative changes to such a plan (whether arising from a review or otherwise).
Fact Sheet	A paper which summarises key information relevant to a specific topic and which indicates where further information may be found.
Fertiliser	Any substance (whether solid or fluid in form) which is described as or held out to be for, or suitable for, sustaining or increasing the growth, productivity, or quality of plants or animals through the application of essential nutrients to plants or soils.

Fertiliser blend	A product obtained by dry mixing of relatively homogenous fertiliser materials.
Fertiliser user	A person who takes delivery of fertiliser materials for the purposes of applying them to the land.
Fine particle application	A term commonly used to describe application of a suspension fertiliser.
Foliar analysis	A direct measurement of the level of nutrients contained within the plant tissue at the time of sampling.
GIS (Geographical Information System)	Computer system for mapping and displaying geographical information.
GPS (Global Positioning System)	Satellite and associated ground station system that allows a user to accurately determine their location (longitude, latitude and altitude) in any weather, day or night, anywhere on earth.
Groundwater	Any subsurface body of natural water.
Indicator	A parameter or value derived from data, which points to, provides information about, or describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value.
Inherent risk	Background risk due to a particular combination of natural characteristics. Inherent risk does not consider best management practices applied to reduce any potential adverse impacts of the activity.
Iterative	A repeated process of re-evaluation to achieve best results.
Land manager	Farmer, grower, viticulturalist, forester – anyone managing a growing system which requires nutrient management
Land management unit	An area of land that can be farmed or managed in a similar way, due to the soil type, capabilities and function, and strategic importance to the farming system.
Likelihood	The probability of an event occurring. In nutrient management planning, the likelihood of adverse environmental effects arising from nutrient management activities is particularly relevant.
Maintenance application	A fertiliser input that maintains the balance between input and output of nutrients as measured by soil nutrient status from a soil test.
Nitrification-inhibitor	A product which slows the first stage of nitrification in the soil and reduces the rate at which ammonium is converted into nitrate, thus reducing the potential for N leaching losses and nitrous oxide gas emissions.

Nutrients	Essential elements required for normal growth and development of plants and/or animals.
Nutrient audit	The process of examining and assessing a nutrient budget.
Nutrient management activities	Activities associated with the design and implementation of a nutrient management plan.
Nutrient budget	Statement of the total nutrient balance for a specific area or production system, taking into account all the nutrient inputs and all the outputs.
Nutrient management plan	A nutrient management plan (NMP) is a written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur and potassium, and any others of importance to specialist crops) will be managed annually on a particular area or property. This plan will be implemented to optimise productivity, to reduce nutrient losses and to avoid, remedy or mitigate adverse effects on the environment. See page 19 for the Nutrient Management Planning Process.
Organic fertiliser	Carbonaceous materials mainly of vegetable and/or animal origin added to the soil specifically for the nutrition of plants and which contain nutrients as per the definition of a fertiliser.
Point of sale	The place where the ownership of an item moves from one person to another.
Regional plan	A Regional Council document produced under the RMA on behalf of the local community, which sets out objectives, policies, and methods, (including rules), for the sustainable management of natural and physical resources.
Regional policy statement	A policy framework prepared by a Regional Council under the first schedule to the RMA.
Soil sample	For pasture, typically a set of 15 or more soil cores of 7.5cm depth which are bulked for analysis as a sample. For crops/horticulture, depth of sample taken varies as can minimum number of cores.
Soil test	A procedure to estimate the nutrient status of the soil at the time of sampling.
Segregation	The separation of physical materials. The tendency of a uniform mixture containing a range of different particle sizes or densities to separate into classes.
Soil quality	A qualitative term referring to the physical, chemical and biological attributes of a soil.
Standards	Technical specifications representing a reliable and consistent guideline, rule or definition.

Surface water	Any above-ground body of water including streams, rivers, wetlands, ponds, drains, dams and harbours.
Sustainable management	Managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while: a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment (s5 (2) RMA)
Urease inhibitor	Products which slow the conversion of urea to ammonium while the nitrogen fertiliser is on the soil surface, thus reducing the potential for N loss as ammonia gas.

2. SETTING THE SCENE

This chapter explains the key ideas behind the nutrient management concept required under this Code. If you prefer to go straight to nutrient management planning, see chapter 4, page 17.

2.1 Sustainability

The term 'sustainability' implies the ability to keep doing a particular activity indefinitely, without unacceptable impact on people, land or other natural resources. This Code recognises three key principles of sustainability that can be summarised as:

- *environmental issues*
  Environmentally sustainable land use practices must manage any potential adverse effects to avoid unacceptable degradation of land, air and water resources. Ideal management practices will enhance resources and boost productive potential.
- *financial issues*
  Sustainable farming keeps management activities economically viable and holds any variation in profit (and the risk of poor returns) to an acceptable level.
- *social issues*
  Production practices must be acceptable to local communities and to final product markets.

Assessing sustainability is a balancing act that compares impacts across these three areas. Sustainable nutrient management helps avoid serious adverse effects on the environment while achieving economically viable levels of production, profit and risk, both nationally and on individual farms.

2.2 The Resource Management Act

The Resource Management Act 1991 (RMA) was introduced "to promote the sustainable management of natural and physical resources." It requires every person to recognise their duty to avoid, remedy, or mitigate any adverse effect on the environment that could arise from their activity. The Act focuses on the effects of activities rather than the activities themselves and does not itself provide any mechanisms for measuring or assessing sustainability.

The RMA is given effect through regional and district plans – e.g. regional air quality plans, water quality plans and land (soil) management plans. In particular, Regional Councils have responsibility for controlling discharges to land, water, and air. This has implications for fertiliser handling and use, as well as overall loss of nutrients from land use activities.

Nutrient management activities often include fertiliser use and the disposal of animal waste products. It is important to realise that nutrient management activities that are classed as 'permitted activities' (i.e. that can be practiced without resource consent so long as management complies with certain conditions) in one region may have different conditions imposed or even require resource consent in another. It is up to each landowner or manager to make sure they know their regional plan requirements and meet these.

Some Regional Council rules many list fertiliser use applied in accordance with this Code as a permitted activity, but they may also list other permitted activity conditions that the land owner or manager will need to be aware of.

2.3 Market requirements

Given that most of New Zealand's produce is exported, it is essential that land managers understand the requirements of their customers, locally and internationally. Environmental protection is important to many international markets and may also be used as a non-tariff trade barrier to restrict the import of New Zealand goods.

Internationally, the regulatory environment includes standards and restrictions that could pose threats to New Zealand's primary producers. Using this Code should give international markets the assurance they require that there is an effective process in place for the management of soil nutrients.

Some specific QA schemes and programmes that land managers should be aware of are:

New Zealand GAP
http://www.newzealandgap.co.nz/

EUREPGAP
http://www.eurepgap.org/Languages/English/index_html

Global Food Safety Initiative
http://www.ciesnet.com/2-wwedo/2.2-programmes/2.2.foodsafety.gfsi.description.asp

2.4 Nutrient management

'Nutrient management' is a very important concept in ensuring efficient nutrient use and avoiding or minimising adverse environmental impacts. It combines production and environmental aspects of nutrient input and output management, rather than considering manufactured fertiliser use in isolation. Complete nutrient management looks more widely at all sources of nutrient input and output and considers manufactured fertiliser use as part of the mix.

Nutrient input sources could include those:

- supplied through breakdown of organic matter (including applied compost or naturally occurring organic matter) and continued weathering of soil materials
- applied in fertiliser use
- deposited in urine and dung
- returned through the irrigation of dairy effluent
- added through the importing of supplementary feed
- nitrogen fixed from the atmosphere by clovers and other legumes
- deposited aerially

Nutrient outputs could include:

- nutrients taken off in products (e.g. fruit, vegetables, grain, logs, meat, wool, milk)
- crop residues removed from the paddock or burnt on site
- losses through erosion, leaching, surface flow and return to the atmosphere
- hay and silage sold off farm
- transfers to unproductive areas (e.g. raceways, stock camps)

Nutrients are essential for healthy plant and animal production, and deliberate nutrient inputs are often required to enhance productivity and address animal health issues. However, poor nutrient management can lead to consequences that are highly undesirable, environmentally, socially and economically.

Implementing nutrient management planning will help land managers to maximise the efficiency of their use of nutrients, which will in turn avoid or minimise adverse environmental impacts and increase overall production efficiency.

This Code provides a procedure for the management of all nutrients used in primary production systems, with special emphasis on the management of manufactured fertiliser inputs.

2.5 Adverse environmental impacts

'Adverse environmental impacts' refer to any harmful effects on the environment – for example, degradation of soil, water or air, changes that reduce flora or fauna habitat or make the local environment socially unacceptable.

Adverse environmental effects associated with nutrient management can occur through one or more of the following mechanisms[1]:

Leaching = **occurs when water carrying dissolved nutrients moves beyond the plant root zone. Potential consequences include harmful contamination of groundwater or waterways, and poor performance of target crops if necessary nutrients are lost in leaching.**

Runoff = **storm water and surface water run-off carrying nutrients away from the target area. Potential consequences include algal blooms in waterways, water contamination making the water source unsuitable for farm or domestic supply, and reduced nutrients available to the crop or pasture on the target area.**

Airborne = **air quality effects associated with dust arising from fertiliser handling and application. Potential consequences include poor air quality (dust, odour), complaints from neighbours and contamination of water bodies and water supplies.**

Mine = **declining soil fertility due to net export of nutrients in product without replacement. Potential consequences include declining soil fertility, falling production, reduced feed value of pasture or crops and lower profit.**

Load = **the accumulation of nutrients and undesired substances, particularly on non-target areas. Potential consequences include imbalances of nutrients in soil and produce, and toxic levels of nutrient.**

Atmospheric = **greenhouse gas emissions that occur when nitrous oxide (N_2O) and nitric oxide (NO) are released from urine patches and as nitrogen fertiliser products are converted to nitrate. Potential consequences are increased emission of greenhouse gases.**

This Code provides a procedure for managing or avoiding the potential adverse environmental impacts associated with nutrient use on a range of farming systems.

[1] *Fertiliser Industry Federation of Australia (2001):* Cracking the Nutrient Code, Guidelines for developing a Nutrient Management Code of Practice for your industry, region or farm.

3. GUIDING PRINCIPLES

These guiding principles are built into the nutrient management approach in this Code. They are the underlying philosophies used in this Code that enable land managers to use this Code to manage nutrients practically and profitably in their production systems.

This Code's five guiding principles are:

1. Effective process

Nutrient management planning can improve results for land managers and the environment simultaneously.

Change for its own sake never makes sense – there must be a reason for it. The nutrient management process as outlined in this Code is a simple yet effective process that enables land managers to maximise the benefits of nutrient use while avoiding or minimising adverse effects on the environment. Widespread adoption of the process can be expected to aid production and profit while addressing community and market environmental concerns.

Although not all land managers face a requirement for external audit of their practices, this Code is set out so use of this Code can be audited. Keeping good records is an essential part of this process.

2. Ease of use

Nutrient management must be 'user friendly' – i.e. it allows the user to accept responsibility for their actions, is simple yet effective and allows the user some flexibility to choose and adapt practices to suit their situation.

Simplicity and flexibility do not mean 'dumbing down' to a system that does not achieve environmental objectives. Rather, the approach advocated through this Code encourages land managers to use their knowledge and skills to understand, choose and apply the most suitable practices for their individual situations. In practice, this can produce greater environmental benefit than can be achieved by prescribing practices for all land managers to follow regardless of situation.

3. Legal and industry compliance

As a minimum, this Code requires compliance with all legal and industry requirements relating to nutrient management. In reality many land managers will aim higher than this as they seek effective nutrient use and best value for money from their investment in nutrients.

While helping users meet legal requirements, this Code provides flexibility in how land managers choose to meet them, selecting practices that best suit their situation and production systems. It provides a framework of practices that should be followed to help meet legal requirements and defining practices that are strongly advised or recommended on a site specific basis.

4. Risk based

The basis of effective nutrient management is being aware of and understanding the actual and potential environmental risks associated with these activities. Once understood, these risks and impacts can be strategically managed.

The concept of 'environmental risk' is an important part of sustainable nutrient management. While there is potential to cause environmental harm when using nutrients, this need not happen in practice. Depending on conditions and practices, the risks can usually be managed.

Nutrient management risks refer to the chance of an unfavourable consequence resulting from nutrient inputs or outputs. This can be determined by undertaking a nutrient budget, which will indicate an excess or deficit of nutrients. This Code sets out a process for assessing environmental risks associated with nutrient management activities (see Chapter 4).

5. Continuous improvement

Continuous improvement implies that practices are considered more than once, in light of new information and the results of previous management. This leads to future practices reflecting things learned along the way. A cycle of planning, doing, monitoring and improving ('PDMI') ensures practices are continuously getting better.

The 'PDMI' process emphasises the use of past results when planning management and choosing the best practices for the future. Many managers already use continuous improvement approaches to problem solving and day to day management. Using the same process for nutrient management means the nutrient management plan is not just a static document but a vehicle for learning and improvement.

4. NUTRIENT MANAGEMENT PLANNING

This chapter explains how to create an individual nutrient management plan for a particular production system and location. A documented nutrient management plan may be required by Regional Councils, or a land manager's own interest. This Code sets out how this can be achieved.

In practice most land managers will use the services of an agribusiness professional (e.g. their fertiliser company representative or farm consultant) to help with this but it is also important for the land manager to understand what is involved and how the steps fit together.

4.1 What is a nutrient management plan?

A nutrient management plan (NMP) is a written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur and potassium, and any others of importance to specialist crops) will be managed. See fact sheets 7 & 8. The NMP applies only to that area of the property which is under the direct management oversight of the property manager. The nutrient management plan aims to optimise production and maximise profit value from nutrient inputs while avoiding or minimising adverse effects on the environment.

A good NMP:

- *ensures that nutrient management meets all legal and industry requirements,*
- *includes a nutrient budget which compares nutrient inputs from all sources with all nutrient outputs,*
- *achieves desired changes in nutrient levels and production (e.g. increasing soil fertility from a poor base to support a higher stock carrying capacity; altering soil nutrient status to suit future crops),*
- *minimises the cost of supplying nutrients and avoids wasted spending on unnecessary or unused nutrients,*
- *minimises the risk of damage to the environment, and*

considers the land manager's personal objectives.

The sample NMP template is provided in Appendix 4 of this document. This template which adheres to the objectives as outlined in the Code illustrates one type of plan that land managers can use or adapt to suit their circumstances.

Use of this particular template is not essential under the Code but users of alternative NMP templates must be able to demonstrate that their plan includes the following:

- the Code specific objectives (See page 19)
- evidence that environmental risks have been assessed and addressed (See page 21)
- a list of all legal and industry requirements which are relevant to the identified nutrient management activities undertaken on the property (see page 24)
- an appropriate nutrient budget

and must outline:

- the management practices adopted to avoid or reduce the environmental risks associated with the nutrient management activities undertaken on the property.

4.2 Preparing a nutrient management plan

Figure 1 below sets out the steps involved in preparing and using the nutrient management plan template as provided in Appendix 4 of this document.

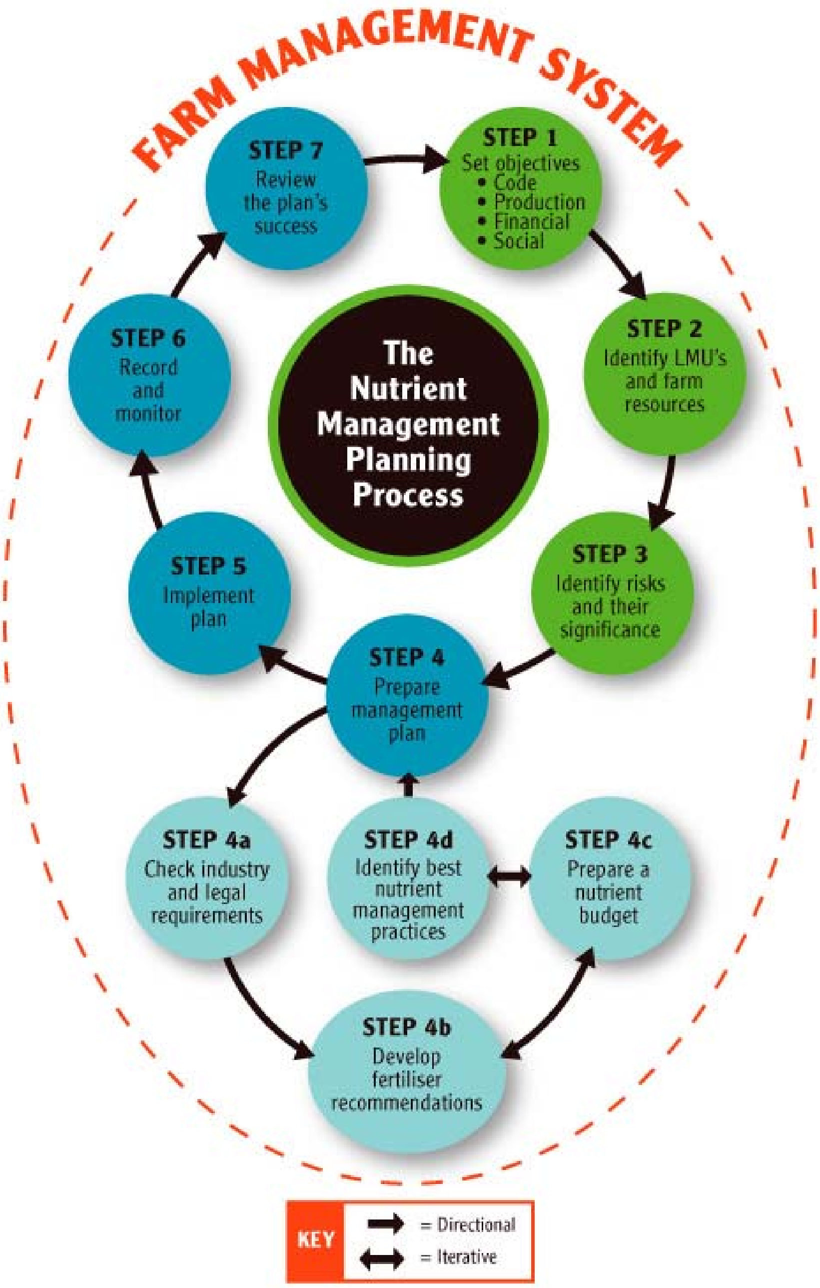


Figure 1: Steps to preparing a Nutrient Management Plan

Step 1: Set objectives for nutrient management

The NMP must include all of the Code specific objectives as listed below. It may also include additional property objectives. The objectives are the things the land manager wants to achieve, against which they will compare the final results of their nutrient management.

Code specific objectives

'Code specific' objectives apply to all users of this Code and primarily covers environmental management. Other aspects of this Code link these to production goals. These objectives should be used when following this Code. Not all of the objectives will apply to every property but all should be considered and adopted where they do. For example, all properties will have to meet objectives 1 and 2 but some will find that objective 5 is not relevant because the land does not have any significant (extensive, native) vegetation areas or wildlife habitat. Where a Code specific objective is not applied in the NMP, you should explain the reason for that decision.

The Code specific objectives

1. *To comply with all legal requirements related to nutrient management activities.*
   These include all national and regional legal requirements plus industry standards and requirements.

2. *To take all practicable steps to maintain or enhance the quality of the property's water resources.*
   This will be achieved by adopting management practices that minimise the risks of groundwater and/or surface water contamination.

3. *To take all practicable steps to ensure that there is an adequate supply of soil nutrients to meet plant needs.*
   Most land managers expect to optimise soil nutrient levels (this would be determined in consultation with the fertiliser company representative or farm consultant). This may require an increase or decrease in nutrient inputs.

4. *To take all practicable steps to contain nutrients within the property boundaries.*
   Best management practices must be adopted where there is any risk of nutrients applied on the property causing damage or nuisance beyond the boundary.

5. *To take all practicable steps to minimise the risk of nutrient contamination of any areas of significant vegetation and/or wildlife habitat.*
   Nutrient management activities must not degrade any areas identified in district or regional plans as 'outstanding' or 'significant' vegetation or wildlife habitat. Best management practices must be planned to minimise the risk of nutrient contamination to these areas.

Property management objectives

'Property management objectives' are part of a nutrient management plan. These typically have a production focus (e.g. "To grow an average of 15,000 kg DM/ha/year on irrigated pasture areas" or "To achieve Olsen P of minimum 25 in all tested paddocks") but may also include environmental perspectives (e.g. "To enhance Pukeko habitat along Wandery creek"), and social perspectives (e.g. "To take at least one month's holiday each year").

Appropriate fertiliser applications will depend on what the land manager is trying to achieve on the property. It is important to know what levels of performance are required before making fertiliser decisions. Is the manager attempting to hold or increase production? Will pasture or crops change in future? If so, do nutrient levels need to be altered over time to suit? The answers to these questions will help set the property management objectives.

Step 2: Identify land management units (LMUs) and farm resources

Under the Code the identification of land management units (LMU's) is optional. However, the concept is strongly recommended for pastoral and arable properties. Failure to identify LMU's and manage them differently could lead to some significant production losses and adverse environmental impacts. Understanding differences in the way parts of the property respond to nutrient management and different land management practices is an important step in achieving production goals as well as recognising and understanding the environmental risks associated with nutrient management activities. The risks associated with nutrient management activities may vary on different parts of the property, so we need to consider each of these areas separately.

The method described below is one means of assessing land management units. In some areas alternative methods such as land use capability mapping may be used. General background is provided in Fact Sheet 1.

A land management unit (LMU) is defined as:
"A *homogeneous block of land that responds in a similar way under similar management."*

Areas that need different management or that will show different responses need to be separated for good planning. For example, is all of the area managed in the same way? Will all parts of the property or block respond to nutrients in the same way? Do they share the same environmental risks?

LMUs are best assessed using a combination of physical factors (e.g. soil type, slope, aspect), major management factors (e.g. dryland versus irrigated areas, different arable or horticultural crops, dairy effluent disposal areas, etc.) and history of previous use and management. Some producers will find that their property has several land management units while others can treat their entire property as a single LMU.

Mark the different LMUs on a farm map, and the paddock number, with a note about what each unit represents – e.g. different soil types, aspect, flat and steep areas, different horticultural crops, etc.

Note also any significant environmental features within each LMU – e.g. waterways, wildlife habitat, wetlands, native bush or areas subject to frequent flooding. An example of a LMU map is shown below.

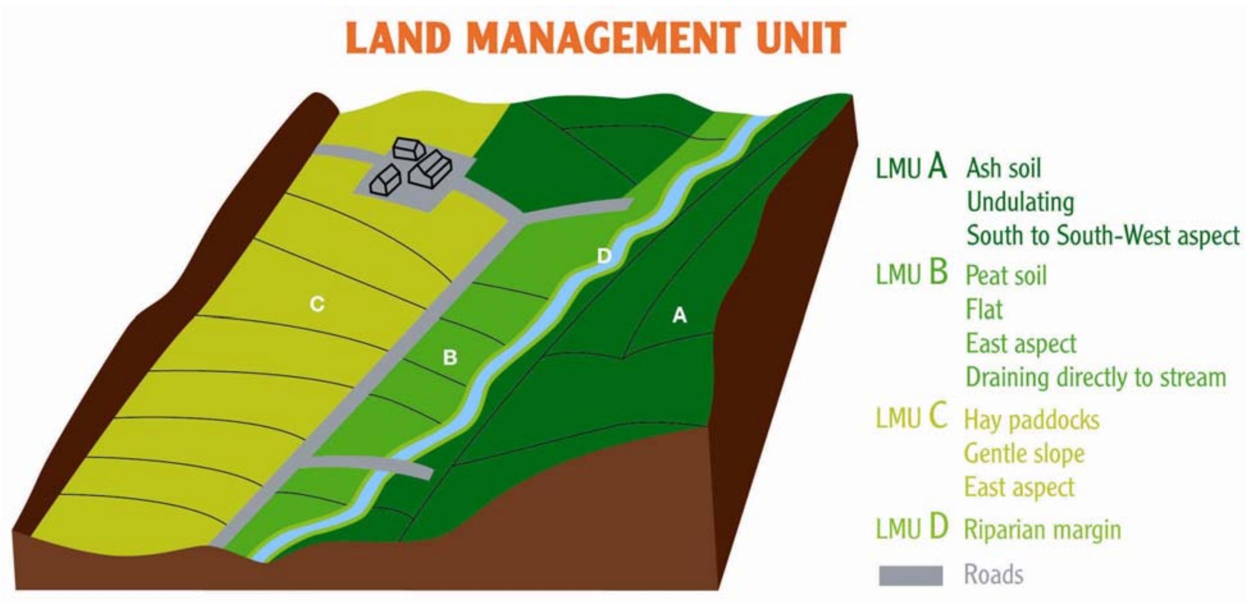


Figure 2: Example of Land Management Unit map

Collect information about the LMUs that will influence nutrient management decisions. Some things to think about:

- Do you have soil or herbage test results for these areas? What is the current soil nutrient status? If there are no recent test results then you should consider testing to establish background soil nutrient levels.
- Are nutrients other than fertiliser applied? For example, is dairy effluent spread on the land? Is conserved feed brought in from other land?
- Do you have information about factors that may alter the environmental risk in any of these areas? For example, are there any irrigated areas where the water table is naturally high?

Mark on your LMU map all potential nutrient 'hot spot' sites. (e.g. silage pits, offal pits, stock handling facilities, feedpads, effluent ponds, effluent spray areas, fertiliser storage areas etc)

Farm resources are interlinked and will influence the nutrient management plan.

Step 3: Identify environmental risks and assess their significance

You need to identify the risks of environmental harm that might arise from nutrient management activities **(e.g. fertiliser use, dairy effluent irrigation and cropping)** and to decide which of these are important enough to need management to avoid, reduce, or mitigate them. There are several different approaches to assessing environmental risks. Most land managers can use a simple system of assessing risks themselves but some may need more formal risk assessment if their industry organisation or Regional Council requires this.

The approach provided here will help you recognise and understand the inherent environmental risks associated with the main nutrient management activities. In some situations you may need a higher standard of proof that you have assessed risks more scientifically – e.g. regulatory authorities may require a more detailed assessment if nutrient management activities do not fit within the 'permitted activity' category and require resource consent.

Identifying 'inherent risks'

For each land management unit you must assess the inherent environmental risks associated with the main nutrient management activities. Inherent risk means any risk that arises because of the activity and the location. If you have not divided the property into its respective LMUs then assess the inherent environmental risk for the property as a whole. *Do not* ignore an environmental risk because the land manager already uses good management to reduce it. This *does not* remove the inherent risk, it only shows that they have recognised it and responded to it.

Typical risks arising from nutrient management activities include:

- contamination of ground and surface waters
- undesired changes in soil nutrient status (i.e. increasing or decreasing beyond target levels)
- fertiliser application to non-target land (i.e. spread beyond the target area, blown off target, etc.)
- accumulation of non-nutrient impurities in the soil profile. See fact sheet 12

Some land managers may need to consider environmental risk in special detail – e.g. when applying for resource consent to apply fertiliser in a way that is not a 'permitted activity' in their region. Such detailed risk assessments should usually be prepared by a consultant with specialist knowledge of nutrient management and environmental risks.

Inherent risks are largely governed by site factors and the amount of nutrient applied (i.e. risks increase as the level of nutrient inputs increases). A list of site factors to consider in evaluating inherent risk is provided in Table 1 below:

Table 1: Site features that affect inherent environmental risks from nutrient use/application:

Site features	**Factors to consider in evaluating risks**
Groundwater	• depth to groundwater and direction of flow • the type and thickness of underlying sediments • potential for nutrients to reach and affect groundwater
Surface water bodies (e.g. streams, rivers, wetlands, lakes and dams)	• distance from areas intended for fertiliser storage, handling and application • density of stream and drainage network • any places where stock can directly enter • susceptibility to frequent flooding • susceptibility to run off or leaching of nutrients • erosion
Soils	• current nutrient status • soil structure, including susceptibility to compaction • current compaction status • presence or absence of soil pans • drainage characteristics, including artificial sub soil drainage • current heavy metal status • water holding capacity • organic matter content
Altitude	• altitude range
Aspect	• direction of slope e.g. north versus south facing
Climate	• susceptibility to heavy rainfall or drought or other unfavourable weather event
Slope	• steep, rolling or flat (increasing slope generally increases the potential for nutrient run-off) • natural drainage courses
Nutrient sources	• single or multiple nutrient sources • current nutrient load status in waterways (streams, rivers, lakes and groundwater) • form of nutrient used
Neighbouring crops and land owners	• proximity of sensitive crops on neighbouring properties • proximity of adjoining landholders • prevailing wind direction, strength and frequency
Biodiversity – native fauna and flora	• proximity of target areas for fertiliser to any areas of native vegetation • sensitivity of those areas to the fertiliser being considered

Assessing significance

Having identified the environmental risks on the land, you need to decide on the significance of these risks.

In many cases the significance will be fairly obvious. For example, land managers applying nitrogen fertiliser regularly on highly permeable soils with a high water table are likely to be well aware that there is a significant risk of groundwater contamination. Land managers applying similar rates of nitrogen to impermeable soils with little groundwater do not need to be so concerned with groundwater contamination but may need to be aware of the risk of surface water contamination if heavy rain falls soon after fertiliser application.

For each risk identified on the property, think about the potential adverse effects and the likelihood that they will occur in the short (up to 1 year) to medium (3-5 years) term given the conditions on each of the LMUs. Are the adverse effects highly likely or quite unlikely? You could think about it like this:

Likelihood

- If there is little chance of the effect happening (i.e. it is possible but not aware of it happening on this property) then the likelihood is **low**.
- If there is some chance of the effect happening (i.e. it has happened in the past, but not often), then the likelihood is **medium**.
- If there is a strong chance that the effect will happen (i.e. it happens regularly), then the likelihood is **high**.

Think also about the environmental consequences in the context of Regional Council and/or local community expectations. If the adverse effect happens, will the effects be major or minor? Will they be very localised or widespread? Will neighbours be affected? Will the effects be easy to fix or irreversible? You could think about it like this:

Consequences

- If the effect is unlikely to cause real environmental damage, has minimal potential to affect other properties and/or would be easy to reverse, then you can call the consequence **low**.
- If the effect has some potential to cause damage or harm, is reversible but could cause adverse effects in the surrounding environment (i.e. could affect neighbouring or downstream properties), then the consequence is **medium**.
- If the effect has the potential to cause significant environmental damage or harm, both in the immediate area and surrounding environment, is difficult to reverse and likely to concern the community, then you must consider the consequence **high**.

At this stage, think only of the overall practice of the activities proposed – e.g. nitrogen or phosphate fertiliser use. *Do not* downplay the likelihood or consequence because the land manager will practice good management. You will allow for good management and risk mitigating measures, such as applying split dressings of nitrogen, at a later stage in the planning process.

Now you can decide whether the overall risks of nutrient management activities are highly significant or less important. Figure 3 below combines likelihood and consequence to decide the overall significance of any environmental risk.

Figure 3: Assessing environmental risk

		Environmental Consequence		
		Low	*Medium*	*High*
Likelihood	*Low*	Low significance	Low significance	Medium significance
	Medium	Low significance	Medium significance	High significance
	High	Medium significance	High significance	High significance

In other words, if the likelihood, consequences or both are low, then the risk is generally low. As the likelihood of adverse effects and/or the seriousness of these effects increases, the risk becomes more significant.

Any environmental risk with a combination of high or medium likelihood and high or medium consequences *must* be addressed in the NMP with best management practices chosen to minimise the risk.

Getting advice on activities and their risks
In many cases, you will already be aware of the environmental risks associated with production activities. If you are making major changes to production operations and you are not sure about the inherent risks, seek further advice. Sources of information and advice include:

- Regional Council staff (or equivalent)
- industry organisations – these may have their own standards, separate to any set or recommended by Regional Council
- fertiliser company staff
- other agribusiness consultants (e.g. agricultural, horticultural or forestry professionals)
- other land managers – look for experience with similar production systems to the management under consideration

Step 4: Prepare the management plan

Step 4a: Check industry and legal requirements

Compliance with the law is essential, both legally and to meet the terms of this Code. You must comply with the legal requirements which apply to the particular nutrient management activities undertaken on the property. These include those contained in the applicable Regional Council's plans, enacted through resource consent conditions or through the conditions applying to permitted activities. Some industries have additional requirements.

Ask the relevant industry organisations and/or Regional Council to supply a list of their requirements to ensure that you are fully aware of what applies to local operations. These requirements may not have changed since last year's NMP was drawn up but it is good practice to check.

Knowledgeable staff will be available for all of these bodies. It is much easier to discuss the options before completing or implementing the plan than to fix a mistake later.

Step 4b: Develop fertiliser recommendations

Fertiliser type, application rates and timing are key management factors that can be greatly varied to meet NMP objectives, balancing information about the environmental risks, present nutrient levels, capital or maintenance dressings, and the objectives for the property. Fertiliser recommendations must take into account the environmental risks and best management practices presented in this Code and the results of nutrient budgets. Many land managers use their fertiliser company representative or consultant to assist in fertiliser planning.

Good records of results achieved from previous fertiliser applications will help. Where problems have been encountered (e.g. dry matter production targets have not been met, nitrate leaching to groundwater) then planned management practices need to prevent or remedy these when future fertiliser is applied.

This phase of planning may identify several different fertiliser types that could be used to supply the required nutrients in suitable forms and proportions while managing environmental risks. Decisions on the best types and application rates to meet the plan's objectives will then be based on financial and physical compatibility factors. Many consultants use computer software to select the least cost fertiliser combination (types and application rates) to meet nutrient application objectives.

Step 4c: Prepare a nutrient budget

Nutrient management activities associated with this Code require preparation of a nutrient budget. The nutrient budget is done to assess the cumulative effects of nutrient use. This will allow adjustment of inputs, such as fertiliser, if necessary.

There are several ways to prepare a nutrient budget. One popular approach is to use the nutrient budgeting software, 'OVERSEER™'.

Typically the nutrient budget will use historical fertiliser applications (e.g. in a 'maintenance' fertiliser programme) and the latest soil test results. For other situations – e.g. where increased fertiliser and increased production are expected – then the nutrient budget should be prepared to evaluate these objectives. This situation may require several nutrient budgets to compare alternative scenarios. This is easily achieved with OVERSEER™ once base farm information has been entered.

A nutrient budget compares inputs and outputs to establish changes in soil nutrient levels. Inputs include nutrient:

- in mineral fertilisers
- in organic fertiliser, soil amendments, feedlot waste, other imported manures or by-products
- in dairy and pig effluent
- in purchased feed (such as grain, hay, silage, brewer's grain, palm kernel extract, other feeds)
- contained in stock returns from stock grazing regularly on the land
- released from soil fixation sites or mineralised from organic matter
- in irrigation water and rainfall
- in clover/lucerne nitrogen fixation

Nutrient outputs and losses occur in:

- produce leaving the block (such as fruit, vegetables, grain, hay, silage, milk, meat, wool, timber)
- nutrient leaching below the root zone
- losses in run-off, including nutrients associated with eroded soil particles
- loss through soil fixation (P, K) or immobilisation (N, S)
- loss to the atmosphere from volatilisation and denitrification
- transfer in dung or urine to stock camps, yards or laneways.

It is important to realise that a 'balanced budget' is not always desirable. Keeping the nutrient budget in balance will, in the long term, maintain soil fertility at its current level but this is not always the best result. For example, if present soil nutrient status for, say, phosphorus (P) is low, then the land manager may want greater P inputs than outputs so that soil P rises – i.e. they will apply capital P dressings. Conversely, if the soil has very high P levels then greater outputs than inputs (or even no P fertiliser inputs at all) could be appropriate.

A nutrient budget is not a fertiliser recommendation.

A nutrient budget can be used as a modelling tool to test different nutrient scenarios providing a feedback loop to fertiliser recommendations.

Some land managers may wish to prepare their own nutrient budget or alternatively seek the services of a fertiliser company representative or consultant who should be an accredited nutrient management advisor. Regardless of who prepares it, accurate input information is required if the nutrient budget is to have credibility and be of use as a management guide. Nutrient budgets can be difficult to interpret and guidance on what the output data means may be necessary in situations where a land manager has prepared their own budget.

More information on soil testing and nutrient budgeting is provided in Fact Sheets 2 and 7.

Step 4d: Identify best nutrient management practices

Chapter 5 sets out considerations and best management practices for fertiliser handling, use and application to overcome any significant environmental risks identified in Step 3. The NMP must list the best management practices selected to reduce the risks on the property. The best management practices listed in Chapter 5 are written in such a way that they can be directly transferred into the NMP to provide a definite statement of management intent. Actual practice can then be compared with the planned practices and improvements can be made if they are needed.

The environmental risks identified as important for the situation will prompt selection of practices or products to avoid or minimise these risks. However, there may be further practices that are important to overcoming the risk of adverse environmental effects, which are specific to the area and operation. It is important to include these as part of the listed best management practices.

Some land managers might also set additional preferred management practices to meet personal objectives – e.g. annual soil testing or a limit on total nitrogen applied, independent of any Regional Council or industry specification.

This Code addresses in detail best management practices for fertiliser handling, use and application. Other best management practices to be considered include riparian management, wetlands, winter grazing, herd homes and nitrification inhibitors.

When including nutrient management activities such as dairy effluent disposal, in the NMP it may be useful to contact the local Regional Council or industry advisor for the best practices appropriate to the activities and area.

NOTE**: If you have assessed the environmental risks from a nutrient management activity (e.g. fertiliser use, dairy effluent irrigation and cropping) as being of medium to high significance a separate management guide should be prepared for those that are medium to high.** The management guide(s) should address all identified LMU's.

The management guide needs to include reference to all legal and industry requirements and the identified best management practices relating to the particular activity. If the management guide relates to a specific fertiliser nutrient (e.g nitrogen) then it should also include the fertiliser type and amount recommended for that nutrient plus any supporting information such as nutrient budget results.

Step 5: Implement plan

Having planned for success, the plan must be communicated and implemented. Putting it into action includes making sure that all people involved (e.g. staff and/or contractors) understand the plan and can do their part. For example, if there are areas to avoid when spreading fertiliser, then these need to be understood by staff or contractors doing the work. Good communication, staff training, and contractor certification all have roles in successful plan implementation.

Changes may have to be made for practical reasons – e.g. if a chosen fertiliser is not available or conditions are not suitable for application (e.g. weather and soil conditions) at the desired time. Keep a note of these changes alongside the NMP, with comments about the reasons and any further implications (e.g. changes to other fertiliser applications to achieve the correct overall nutrient applications, changes to the next fertiliser application timing, etc.).

Step 6: Record and monitor

Recording and monitoring are essential for assessing whether the land manager has achieved their nutrient management plan goals and how well the planned activities went. It also helps identify areas where management could be improved. Remember the old saying, "you cannot manage what you do not measure."

Good records for different areas and LMU's are valuable for assessing success, and should give details of all aspects of the nutrient management plan put into practice, covering:

- fertiliser types
- application rates
- timing of application
- application methods
- nutrients added by methods other than fertiliser – e.g. conserved feed from another area brought onto the block, dairy effluent applied to land
- stocking rates and animal type
- notes on special considerations – e.g. buffer zones not treated
- new soil or herbage test results
- any environmental measurements – e.g. groundwater nitrate levels
- records of risk factors that may affect environmental effects from nutrients – e.g. rainfall records, irrigation records, effluent applications, etc.
- extent to which production goals were met
- Resource Consent and conditions

A property map with LMU's marked can be a good way to record fertiliser applications (manually or by GPS), with details noted in the appropriate paddocks or blocks. In this way a series of maps covers the year's fertiliser treatments.

Record keeping serves many purposes but key uses include:

- a systematic approach to identifying and solving ongoing problems
- a reminder of the influences of seasonal variations
- as a means of measuring progress or lack of it, over time
- to serve as a tool that might unlock additional information when required at some point in the future
- as a tool to undertake a regular critique of management practices
- as a tool to demonstrate that the land manager has taken steps to overcome various problems by implementing their stated best management practices
- a means of determining returns on fertiliser and other nutrient investments

Good paddock records help in calculating nutrient budgets, calculating nutrient and water use efficiency, identifying areas of a paddock with varying productivity, refining production targets and predicting future nutrient requirements. They can also be used to demonstrate that nutrients have been managed for the best production and environmental outcomes.

Accuracy and attention to detail pay off. For example, accurate records of the position of soil sample sites will aid in interpreting the results against yields, soil types, incidence of frosts, water logging, etc. These records also allow future sampling in the same positions. GPS technology is increasingly used for accurate positioning but good records using paddock landmarks and measurement from the landmarks allow relocation of the sites within a few metres. Permanent markers and an established soil sampling routine also help.

Soil testing will commonly be used to check changes in soil nutrient levels and some land managers will also use herbage tests. As long as nutrient applications go as planned, most land managers will *not* monitor actual environmental indicators (e.g. water quality measures) on their property. Those who apply special nutrients – e.g. those requiring resource consent for particularly high nutrient applications or because of sensitive areas or catchments– may be required to do specific monitoring as a condition of their resource consent.

On dairy farms with high rates of supplements going into the system, effluent sampling for nutrient content is highly recommended.

Most land managers keep fertiliser use records for their own information - to know how their fertiliser programme is going, to assess pasture and crop responses and to relate these results to future fertiliser planning. In addition, by following this Code and keeping accurate records of compliance, regional authorities can have confidence that this Code is being followed. Given that authorities have limited contact with most land managers, proof of good management depends on good records.
Sample templates for recording are provided in Appendix 5.

Step 7: Review the plan's success

Check performance with a 'self assessment'
Making the NMP work means that it must be followed, not just filed – and this requires checking. 'Self assessment' simply means the land manager checking that they or their staff did the things they said they planned to do and also checking that this management had the desired effects. It either confirms that the plans were successful or identifies areas for future improvement.

The self-assessment checklist in the NMP template provides spaces to show:
1. whether the plan was carried out as set out,
2. to explain any changes made along the way (and the reasons for these),
3. whether the land manager achieved the objectives set, and
4. management improvements planned for the future to meet any objectives that were not achieved this year.

Monitoring actual performance is an essential part of achieving continuous improvement. It is not enough to plan carefully and follow the plan – land managers and their advisers need to check that the actions really achieved the plan's objectives and did not cause unexpected harm to the environment, and determine if production goals have been met.

Failing to meet objectives does not necessarily mean that the plan itself failed. It is important, however, to learn any lessons from the results and identify improvements for the future.

Nutrient budgets can be re-done (using the season's actual nutrient inputs and production) to check the sustainability of fertiliser use, particularly in intensive land use systems. Success in meeting production and environmental objectives should support future nutrient management planning – the property now has some history of suitable management.

If any adverse event was measured or noticed, good records should help identify the actions and risk factors that led to the event and allow better management practices to be adopted for the future. Having completed the monitoring and assessed the plan's success, the process begins again with planning for the following year.

External audit can verify nutrient management performance
Regional Councils and some industry organisations, or market bodies may ask to see land management records to prove environmentally responsible nutrient management. Completing the NMP and self-assessment provides the evidence to demonstrate sound nutrient management to third parties.

5. BEST MANAGEMENT PRACTICES AND CONSIDERATIONS - FERTILISER

This chapter describes 'best management practices' (BMPs) for land managers applying nutrients – i.e. practices recommended for practical use to reduce the risks of adverse environmental effects and gain maximum benefits from nutrients applied.

These practices:

- combine the practical experience of land users with scientific development,
- provide generic recommendations that can be adapted to suit local conditions,
- may require changes to the way some nutrient management activities are carried out, and
- provide the means for continuous improvement in nutrient management on the property.

Be very careful when adapting BMPs to suit a particular situation. Changes must be based on good scientific evidence for the alterations, not just a return to 'what we've always done'. It is essential that you can justify why you have made the alterations to the listed best practices.

This chapter is divided into three sections, dealing with

1. fertiliser handling
2. fertiliser use – including choice of fertiliser type, application rate, timing
3. fertiliser application – the mechanics of applying nutrient

5.1 Fertiliser handling

Fertiliser handling, transport, or storage should aim for containment of the product until it is applied. This means that no fertiliser should be lost to the environment during transport, storage and any other handling operations, thus avoiding any possible adverse environmental effects. Contamination arising from handling, transport, or storage problems is a point source (i.e. highly localised) contamination, which can be effectively managed and contained if appropriate actions are taken immediately.

Transporting fertiliser

Users will comply with the requirements of the Transport Act 1987 and Transport Law Reform Act 1991 and Traffic Regulations or the appropriate legislation of the time, when transporting fertiliser by road. Under this Act, it is the driver's responsibility to ensure that:

- all freight is correctly restrained,
- any hazardous substances are segregated correctly,
- the driver's licence has the appropriate endorsements, and
- any safety equipment required, which is provided by the carrier, is used.

The carrier (freight operator) is responsible for ensuring that their drivers meet these requirements.

Fertiliser products need to be kept free of any foreign material throughout all transport, storage, and handling. Loading and unloading procedures should be designed to minimise segregation of fertiliser components (i.e. fertiliser mixes and blends separating out into their various component products) and to prevent changes to the particle size and size range of the fertiliser.

General requirements for the transport of fertilisers are:

- vehicle decks shall be such that fertiliser cannot spill during transport,
- vehicle decks shall be cleaned so that no contamination or chemical reaction of fertilisers carried can occur. The wash down shall occur on areas where there is no runoff into a waterway or a storm water system.
- all loads of fertiliser products shall be securely covered to prevent dust blowing from the truck and to prevent moisture uptake by the product, and
- when unloading fertiliser the driver should ensure that all fertiliser is removed from the vehicle decks.

All carriers shall be aware of the requirements of the Operators Handbook for the Transport of Hazardous Substances by Road (Land Transport Safety Authority)

Fertiliser storage

Location
Storage conditions shall ensure that fertiliser is never contaminated with other chemicals or chemical products, and that fertiliser does not escape from the storage facility. Some stores may also need to provide appropriate signage.

Fertiliser storage buildings shall be sited to minimise any risk of environmental contamination. In particular, storage sites must not present a risk of direct water contact with stored fertiliser. This includes the entry of storm water or runoff from surrounding areas. See the best management practices at the end of this chapter.

Construction
Fertiliser buildings shall be constructed so that stored fertiliser remains in a useable condition. In particular, fertiliser should stay dry and free from contamination by other fertiliser types or any foreign material. Bulk fertiliser shall be stored in a manner that preserves the physical properties of the fertiliser and allows the fertiliser to be retrieved from storage and used without contamination. The fertiliser shall be stored on an impermeable surface to prevent leaching to groundwater and to prevent the localised accumulation of contaminants in the soil.

Note:
a) Fertiliser storage buildings may be subject to approval and issue of the necessary consents from the local authority concerned.

b) Temporary storage sites should comply with local council requirements.

c) Bagged fertiliser should be protected from direct sunlight, rainfall and contamination by chemical products.

Compatibility of fertilisers
Fertiliser blends or physical mixtures shall only be used if there is no risk of chemical or physical (e.g. moisture absorption) reaction between fertilisers in the blend or mixture that may reduce application accuracy. The blend or mixture should be such that there is little or no physical segregation (separating out or settling) of the blended or mixed components in transport and handling operations. Expert advice should be sought before creating a blend as some fertilisers are not compatible.

Fertiliser disposal

Under no circumstances shall any fertiliser be disposed of in a way that risks adverse environmental effects. The best practical option for the disposal of any surplus or unwanted fertiliser is application onto suitable land or crops in accordance with this Code or finding a neighbouring farmer who may have a use for it.

While most fertiliser materials are handled in bulk, some products are provided in bags of varying sizes and some as liquids. Re-usable or recyclable containers should be used if available. For all other situations, containers should be disposed of in a manner that minimises any risk to human health and the environment.

Disposal options may include:

- Alternative use - the container must be completely empty. Liquid fertiliser containers should be triple rinsed and the washings applied to land
- Recycling
- Sanitary landfills - check with the local Regional Council or unitary authority to confirm that packaging material for fertilisers are accepted at landfills in your region.
- Burning - regional air quality plans for *some* areas permit controlled incineration of packaging material.

Fertiliser spills

Fertiliser spilled during transport, storage and handling can have significant adverse environmental effects. The Resource Management Act states that every person has a duty to avoid, remedy or mitigate such adverse effects on the environment.

In the event of any spillage of fertiliser products, the driver must take immediate steps to prevent any further loss, risk to other people and/or any contamination of land or waterways. The driver must:

- Notify the appropriate authority (call 111) if there is a large spill
- Minimise any hazard to other road users
- Ensure that no residual product remains that could pose any immediate or future threat to the environment.

Note: *At the earliest opportunity, the regional authority must be advised of any spillage risks to waterways, ponds, lakes or ground water.*

Best management practices for fertiliser handling and storage

Activity	Best management practices	Fact sheet
Fertiliser transport	• All freight is correctly constrained • Hazardous substances are segregated and correctly labelled • All fertiliser products are covered during transport to prevent dust blow • All transport equipment is cleaned after use. Wastewater is prevented from entering any surface water or stormwater system	
Fertiliser storage	• Nitrogen, phosphorus and soluble fertilisers are contained within the storage area on an impervious floor and protected from rain • Storage facilities are at least 50 metres from open waterways, avoiding areas subject to slope failure or significant flood risk • All storm water discharges are collected and diverted away from the storage area • The storage facility is designed to effectively contain stored fertiliser	6 6
Fertiliser loading	• Fertiliser loading sites are at least 50 metres from any open waterway on areas that are not susceptible to flooding • Wind shelters are used around the loading site to contain fertiliser • Fertiliser spillage is minimised when loading into or out of storage or into application equipment • Fertiliser spills on the loading area are collected and returned to the storage facility	4, 6
Fertiliser disposal	• Excess or unwanted fertiliser is spread onto suitable land or crops • Surplus containers are reused, recycled or delivered to a resource recovery site or suitable landfill • Contact supplier for possible return	- -

5.2 FERTILISER USE

It is the fertiliser user's responsibility to ensure they have adequate information about any fertiliser product they intend to use and the potential risks its use may pose to the environment. Fertiliser companies have safety data sheets available.

Information required for good understanding of potential environmental risks arising from the use of any fertiliser product includes:

- name of the fertiliser material
- nutrient content (including N, P, K, S, Mg proportions)
- physical characteristics (e.g. liquid, solid, particle size range, blended/compound)
- particular hazards associated with the product – e.g. chemical compatibility (also with reference to storage requirements), hygroscopic characteristics, solubility and dust.

C.R.A.F.T.

'C.R.A.F.T.' is an easily remembered acronym that highlights the fertiliser use factors that land managers can readily control. It stands for:

- **C**hoice of fertiliser product
- **R**ate of application
- **A**pplication technique
- **F**requency of application
- **T**iming of application

Carefully considering each of the C.R.A.F.T. elements allows fertiliser application practices to be planned to meet production and environmental objectives. Managing the product, rate, application technique, frequency and timing of application should ensure that nutrients are available in the right amounts at the right location and at the right time to meet plant needs. This will improve the efficiency of nutrient use and minimise the potential for nutrient loss.

Choice of fertiliser product

There are a vast range of fertiliser products in the marketplace. Fertilisers chosen should be Fertmark registered, appropriate for use in New Zealand and meet production needs without unacceptable environmental effects.

Aim to select fertilisers that best meet identified nutrient needs while minimising environmental risks.

The suitability of a product is determined by:

- product specification (which nutrients are present, their concentration and mobility)
- the form or chemical species of the nutrients in the product (i.e. liquid, fluid suspension, solid, physical or chemical mixture)
- particle size (including droplet size for liquid fertilisers) and other physical properties
- solubility or release rate of the product and nutrient availability to plants
- any effects on other products (e.g. can it be blended or tank mixed?) or equipment (e.g. is it corrosive?)
- impurities which may be present in the product
- application and handling equipment required
- spreading characteristics
- required application rate to meet nutrient requirement
- cost
- *Fertmark* registration.

More information in fact sheet 6.

Rate of application

The rate of fertiliser application for a particular situation should be based on the rate of nutrient required by the plants.

fertiliser rate (kg/ha) = required nutrient rate (kg/ha) ÷ (% of the nutrient in the fertiliser ÷ 100)
For example, suppose we have a product containing 46% nitrogen and the desired nitrogen application is 50 kg N/ha.

fertiliser rate (kg/ha) = 50 kg N/ha ÷ (46% N ÷ 100) = 50 kg N/ha ÷ 0.46 N = 109 kg product/ha

In determining nutrient rates to apply, consider:

- soil and plant tissue analysis results
- nutrient budget reports
- crop type, yield/quality/stocking rate targets
- the need for maintenance or capital applications (i.e. goals for soil fertility and production results from fertiliser. Is the land manager trying to maintain present soil fertility and productive performance or increase nutrient levels to support higher production or different pastures/crops?)
- water availability and expected future weather patterns
- local fertiliser trials and local land manager experience
- previous crop and fertiliser history on the site
- different LMU requirements

Any application of fertiliser should be made on the basis of required present and/or future production level. If calculated fertiliser application rates exceed crop uptake as suggested by nutrient budget results this should be recognised and managed accordingly through a nutrient management plan, to reduce losses and ensure production is not limited.

Application method

Application method will affect the accessibility of applied nutrients. Different placement methods can ensure that the nutrient is immediately available to rapidly growing plants (e.g. banded below the seed at planting) or is applied very gradually over a lengthy growing period (e.g. fertigation in horticulture). Placement will also affect the degree of interaction between the fertiliser and the soil, which is particularly important where nutrients can become unavailable due to reactions with soil minerals (e.g. phosphorus fixation) or organic matter (e.g. nitrogen immobilisation).

Placement of fertiliser should conform to the Spreadmark Code of Practice for both Aerial and Ground Fertiliser Spreading.

Common options for fertiliser placement include:

- surface broadcast application (by ground or aerial spreading)
- surface broadcast and incorporated
- banded into the soil at various band widths and depths
- surface banded
- fertigation
- foliar application
- fine particle suspension or slurry application (ground or aerial).

The best placement method will depend on the nutrient(s) concerned, topography and individual production situations. For example, applications to crops, especially in horticulture, generally require more accuracy and precision than applications to intensive pastures where nutrients are continually redistributed by the grazing animals.

In deciding on the right application method, key questions to consider include:

- does the method apply the nutrient sufficiently accurately for its purpose?
- is the equipment suitable for the terrain and soil conditions?
- is the equipment appropriate for the size of the application area?
- is the use of the equipment likely to result in noise or dust nuisance to third parties?
- is the equipment certified to meet accuracy requirements?

There is more detail about application methods and best management practices for fertiliser spreading in Chapter 5.3

Frequency of application

The best way to ensure that added nutrients are used efficiently by plants and to reduce the risk of nutrient loss to the environment is to match nutrient availability to plant demand over time. Annual crops, perennial crops and pastures all have different patterns of nutrient demand over time, and respond differently according to soil moisture status and temperature. These factors should be considered in planning fertiliser applications.

Mobile nutrients such as nitrogen or potassium are most effectively used when split applications of fertiliser are applied frequently during the periods of crop or pasture growth. This is usually preferable to one large application. However, crops and pastures may have short periods of very high nutrient demand and so a larger application will be required at that time.

Fertigation systems (adding nutrients in irrigation water) provide flexibility in applying nutrients to meet plant demand but regular top-dressing or side dressing of fertiliser can have similar effects, provided that there is sufficient moisture to move nutrients into the soil.

Timing of application

Fertiliser application should be timed to achieve maximum plant uptake, thereby reducing losses of nutrient to the environment. Ideal timing will be affected by the solubility (mobility) of the nutrient or fertiliser used, crop stage and rate of growth (and therefore its nutrient demand) and the nutrient fixing capability of the soil. Consider also the amount of rainfall and/or irrigation experienced or expected.

Applying fertiliser long before the plant will take up the nutrient exposes the nutrient to potential loss. This is particularly so with nitrogen fertilisers. Maximum responses and minimal nutrient losses will usually occur if fertiliser is applied when plants are growing rapidly. It is especially important to apply highly mobile nutrients at times when plants are actively growing to avoid losses to the environment between application and plant uptake, and thus to maximise the return on the investment. This is particularly important when highly soluble nutrients are applied in high rainfall or irrigation situations.

Application of fertiliser in relation to soil and air temperatures is also important because these conditions affect plant growth and hence nutrient use. For example, applying nitrogen fertiliser to ryegrass when soil temperatures are less than 6°C and falling is likely to be ineffective in stimulating pasture growth because ryegrass stops growing at soil temperatures below 4°C. If it will be some time before temperatures rise and the ryegrass starts to grow again (and take up the nitrogen), the nitrate may be lost through leaching. Nitrogen fertiliser application should be delayed until the pasture is actively growing, especially if considerable rainfall is expected in the meantime.

Fertiliser often requires water to move it to a site where it can be taken up by plants and, in the case of nitrogen, where it is protected from gaseous losses. Timing of fertiliser application in relation to irrigation or rainfall can be critical to determining the risk of gaseous loss.

Best management practices for fertiliser use

The best management practices provided below cover the four main fertiliser user groups –pastoral, arable, horticultural and forestry. While most practices are generic across all user groups, some will be specific to a particular user group.

For information related to dairy farm nutrient management see the DEC Manual at www.dexcel.co.nz
Dexcel Farm Management Issues
Managing Farm Dairy Effluent

Best management practices for nitrogen (N) fertiliser use

Activity	Best management practices	Fact Sheet
Choice of fertiliser	• Use Fertmark registered products	4
Rate of fertiliser application	• Nutrient application rates are determined using some or all of the following factors: - *soil and plant tissue analysis* - *nutrient budgets (including any effluent and/or feed imported to the block)* - *crop type, yield/quality/stocking rate targets* - *the need for capital or maintenance applications* - *previous crop and fertiliser history on the site* - *soil moisture conditions and expected future weather patterns* - *local knowledge* - *feed budgeting/monitoring* - *soil temperature*	2, 5, 7,8
	• The amount of nitrogen applied per application is limited: - *on soils where groundwater lies under permeable sediments (e.g. gravels)* - *in areas where there is a high water table* - *on areas where there is subsurface mole and tile drainage*	8,9
	• Apply nitrogen fertiliser in split dressings of 50kg N/ha when 200kg N/ha or more is required	6,8,9
	• Nitrogen is applied in proportion to other nutrients, according to plant requirements. (Adding excessive N when other elements limit crop or pasture growth leads to greater N losses.)	5
Application technique	• Application equipment is suitable for the conditions and fertiliser type.	3,4
	• Only *Spreadmark* accredited spreading companies (experienced operators and calibrated equipment) should be used	4
	• GPS and GIS technology is used for precise application and for a digital record of fertiliser application locations.	3
	• Non-target application of fertiliser is avoided by: - *using fertiliser with larger particle sizes (mean size greater than 1mm) and few or no fine particles* - *application techniques that direct or specifically place the fertiliser appropriately* - *application in bands when sowing crops or pasture seed* - *choice of fertiliser types that can be applied more precisely (e.g. slurry/liquid)* - *applying fertiliser only when any significant wind is blowing away from sensitive areas* - *fertiliser is not applied by air when wind speed exceeds 15 km/hr*	3,4

Frequency of application	• Nutrient availability is matched to plant demand. • Lower rates of N fertiliser are applied more often, at times to match the growth cycle of the crop or pasture and soil moisture conditions, rather than in single large applications.	6,8 6,7, 8
Timing of application	• Nitrogen application is matched to times of high plant growth. • Pasture is at least 25mm high (approx. 1000 kg DM/ha) before nitrogen is applied. • In the case of border-dyke irrigation fertiliser is applied afterwards, provided the soil is not saturated. If the soil is saturated fertiliser application is delayed until ground conditions are suitable. • Nitrogen is not applied when the 10cm soil temperature at 9am is less than 6ºC and falling (at these low soil temperatures plant nitrogen uptake is slow and there is greater risk of leaching loss). • Nitrogen is not applied after a dry (drought) period until sufficient regrowth has occurred after rain. • Where possible, fertiliser N application is adjusted to complement the release of soil mineralisable N. • For information about the effects on stock of high nitrate in grass contact Fert Research for a Wise N Use fact sheet • N fertiliser is not applied in mid to late autumn to fallow land unless there is a cover crop. • N fertiliser is not applied when the ground is saturated and/or when tile drains are running. • N fertiliser is applied 4-6 weeks before the feed is required.	7,8 9 9 6,9 9 6,9 9 9
Fertiliser use and management measures	• N fertiliser is not applied to severely compacted soils. Soil aeration techniques are used on such soils before fertiliser application. • Pasture is at least 25mm high (approx. 1000kg DM/ha) before N fertiliser is applied. • Vegetated riparian buffer strips of sufficient width (10m – adjust for slope) to filter any run-off are maintained adjacent to all waterways. • Urease inhibitors – can be used to reduce urea losses to the atmosphere when conditions are conducive to volatilisation. • Nitrification inhibitors can be used: - either with the fertiliser N or - applied across the whole area to help reduce nitrogen leaching from urine patches.	- 9 - 11

Best management practices for phosphorus (P) fertiliser use

Activity	Best management practices	Fact Sheet
Choice of fertiliser	• Soluble phosphate fertiliser is used where: - *rapid plant response is required* - *soil P levels are required to be increased rapidly* - *plants are actively growing* - *there is a low risk of runoff*	6,9, 13
	• Slow release phosphate fertiliser is used when: - *there is a high risk of runoff and/or* - *a rapid plant response is not required and/or* - *soil P levels are adequate and/or* - *soil pH is less than 6.0 and annual rainfall is greater than 800mm*	6,9, 13
Rate of fertiliser application	• Nutrient application rates are determined using some or all of the following factors: - *soil and plant tissue analysis* - *nutrient budgets (including any effluent and/or feed imported to the block)* - *crop type, yield/quality/stocking rate targets* - *the need for capital or maintenance applications* - *previous crop and fertiliser history* - *soil moisture conditions and expected future weather patterns* - *local knowledge*	5, 6, 7
	• The amount of phosphate applied per application is limited: - *when high rainfall is anticipated or irrigation is planned* - *on very sandy soils, particularly for soluble phosphate fertilisers* - *when slope is greater than 25º, and/or pasture is less than 25mm high (approx. 1000 kg DM/ha)* - *during winter*	6,8, 13
	• Soluble phosphate fertiliser must be applied in split dressings if the single application rate would exceed 100 kg P/ha.	6, 13
	• Phosphate is applied in proportion to other nutrients, according to plant requirements. (Adding excessive P when other elements limit crop or pasture growth is inefficient and could lead to P losses.)	5,6
Application technique	• Application equipment used is suitable for the conditions and fertiliser type.	3,4
	• Only *Spreadmark* accredited spreading companies (experienced operators and calibrated equipment) should be used	4
	• GPS and GIS technology is used for precise application and for a digital record of fertiliser application locations.	3
	• Non-target application of fertiliser is avoided by: - *using fertiliser with larger particle sizes and few or no fine particles (aerial application)* - *application techniques that direct or specifically place the fertiliser appropriately* - *application in bands when sowing crops or pasture seed*	4

	- *applying fertiliser only when any wind is blowing away from sensitive areas* - *apply fertiliser only under agreed conditions (e.g. wind speed of less than 15 km/h)*	
Frequency of application	• Nutrient availability is matched to plant demand, particularly for soluble P products and liquids. • Split applications are used where the single application rate would exceed 100 kg P/ha for soluble P or liquid fertiliser.	5, 6 6
Timing of application	• Pasture is at least 25mm high (approx. 1000 kg DM/ha) before P is applied. • Phosphate fertiliser is not applied after a dry (drought) period until sufficient regrowth has occurred after rain. • P fertiliser is not applied when the soil is saturated	- 5 5, 6
Fertiliser use and management measures	• P fertiliser is not applied to severely compacted soils. Soil aeration techniques are used on such soils before fertiliser application. • To avoid fluoride toxicity to stock, pastures top-dressed with P fertiliser are not grazed for 21 days or until 25mm of rain has fallen. • Only phosphate fertilisers which comply with the industry limit of 280mg of cadmium per kg of P are used. • Vegetated riparian buffer strips of sufficient width (10m – adjust for slope) to filter any run-off are maintained adjacent to all waterways.	- 12 12

5.3 FERTILISER APPLICATION

The fertiliser spreading industries (ground and aerial spreaders) have their own Codes of Practice. Fact sheets 3 & 4 include information of importance to the land manager employing these operators and those who apply some or all of their own fertiliser.

The process of spreading fertiliser on a property is a critical part of managing fertiliser use. The objective should be to achieve evenness of spread at the required rate in order to maximise economic return from the investment while ensuring minimal environmental impact. Spreading should be even within an LMU, but differential rates are expected between LMU's.

The key factors that will influence this objective are:

- the environmental understanding of the person doing the spreading
- the skill and competency of the spreader
- the suitability of the machinery being used (i.e. to spread fertiliser accurately)

Spreading fertiliser to maximise returns and avoid adverse impacts is a technically demanding task. While some land managers spread some or all of their fertiliser themselves, spreading by *Spreadmark* accredited spreading companies is recommended.

The person spreading fertiliser has four main objectives:

- to spread the fertiliser at the desired rate and as evenly as possible over the target area
- to avoid any fertiliser directly entering surface water
- to control wind drift to avoid any fertiliser indirectly entering or landing on surface water, or going outside the boundaries of the target zone
- to ensure that the work is undertaken safely

Application accuracy

Fertiliser application must be confined to the desired application site. Fertiliser spread more widely is inefficient and potentially environmentally harmful. The person applying fertiliser shall ensure that it is applied as accurately as is reasonably possible. A clearly marked map showing buffer zones should help contractors ensure that non-target areas are not treated.

As well as keeping fertiliser to the target area, application needs to be even across this area at the desired fertiliser application rate. The potential evenness of application for any given fertiliser is affected by:

- the physical form of the fertiliser
- size guide number (SGN), uniformity index (UI) and bulk density (BD) of fertiliser mixes
- the type of application equipment
- application techniques
- operational factors at the application site, including the weather (wind speed and direction)

The evenness of distribution is described using the coefficient of variation (CV%). This can be measured by catching fertiliser in collectors across the distribution area and weighing the fertiliser in each container.

CV is defined as:
standard deviation (of weight of fertiliser retained in each collector) ÷ mean weight across all containers and is expressed as a percentage.

A high CV indicates poor (uneven) spreading while a CV of zero indicates perfectly even spreading.

The target application rate should be chosen to meet the true plant nutrient requirements. Inappropriate application may increase the risk of adverse environmental effects and reduce production potential.

In New Zealand, the standards set under the *Spreadmark* Code of Practice for the Placement of Fertiliser allows for a single pass transverse spreading CV of no greater than 15% for nitrogen fertilisers and 25% for all other fertilisers. When making recommendations for the amount of fertiliser to be applied, fertiliser providers and consultants assume a CV of zero percent.

Modern technology, such as GPS and GIS systems, has enabled commercial fertiliser spreaders (ground and aerial) to achieve a high degree of fertiliser spreading accuracy. This technology enables spreaders to cover precise areas with minimal overlap or gaps between spreading runs and to achieve accurate buffers between target and non-target areas. See Fact Sheet 3 & 4 for more information about precision application technology.

Application methods

Interactions between the form of fertiliser and the type of application equipment can have serious effects on the evenness and accuracy of application. Terrain and the task to be done often dictate the type of application system used – e.g. aerial spreading on steep hill country.

Weather conditions can significantly affect both the containment of fertiliser on the application site and the evenness of application within this site. The importance of weather conditions depends on the form of fertiliser, the application method and equipment used.

Recommendations and nutrient management plans from fertiliser and agricultural consultants assume the fertiliser material will be spread evenly and accurately over the target area at the target application rate. Poor spreading can negate the best management plans and result in significant production losses and pollution of waterways.

Ground based application

Ground based application includes a wide range of application methods to apply a vast array of fertiliser products, requiring careful matching of equipment and technique to the fertiliser and production system.

Spreading operators must understand the spreading characteristics of all products they spread, and how their equipment and equipment settings affect spreading performance. For example, products may be solid (free flowing particles or mass material) or fluid (solutions, suspensions, slurries). Particle sizes in free flowing solid fertilisers typically range from less than 1mm to over 5mm in diameter. When ejected laterally from spreading equipment, particles of different sizes have different ballistic trajectories and therefore variable spreading patterns. Particle shape also varies but is usually near spherical in manufactured products. Particle shape, density and surface roughness all affect the flowability of the product.

There are two broad types of ground based spreading equipment:

- ground based equipment that spreads fertiliser beyond the width of the machine – e.g. bulk spinners
- ground based equipment where the swath width is equal to or less than the width of the machine – e.g. boom sprayers, combine drills, pneumatic top dressers

Factors that may affect ground based fertiliser spreading performance:

- Calibration – application equipment must be calibrated for the fertiliser product to be applied. Different products have different bulk densities and even different lines or batches of the same product can vary in bulk density.
- Slope – the performance of all ground based application equipment is likely to be affected by sloping ground. It is generally preferable to operate up and down rather than across slopes. Unless the spreader is computer controlled, variations in surface roughness may lead to uneven spread as vehicle speed varies.
- Weather, atmospheric conditions – some fertiliser materials are hygroscopic, i.e. they absorb water from the atmosphere. Changing temperatures and humidity during the day can affect their flow rate through machinery.

- Soil conditions – slippery ground conditions can interfere with accurate fertiliser placement. Avoid operating machinery on soft soils where there is a risk of compaction. On slopes, slippery conditions can create a safety issue for the operator.
- Speed of spreader.
- Broadcast (spinners, reciprocating spouts, muck spreaders) – because the material is thrown beyond the width of the machine there is a risk that driver error and wind will make it difficult to keep the fertiliser within the target area and achieve a low CV%.
- Other equipment (e.g. drills, pneumatic booms, boom sprayers) – these are capable of achieving lower CV% results, especially where tramlining and bout markers are used, but only if they are accurately calibrated.
- Irrigators and sprinklers – the volumes applied must be controlled so that nutrients are not washed off the surface or subject to deep percolation through the soil. Application evenness and distribution pattern should be calibrated as for other application equipment.

The application of fertiliser from ground based machinery should comply with the Code of Practice for the Placement of Fertiliser in New Zealand (*Spreadmark*). See Fact Sheet 4.

Aerial application
In many situations, aerial application is the only practical means of applying fertiliser. Where fertiliser is applied by air, the minimum acceptable standards for evenness of spreading should be the same as for other application methods used on similar classes of land. Where the risk of environmental contamination is low, higher CV values for evenness of distribution may be acceptable.

Keys to quality aerial topdressing include:
- good communication and direction from land manager
- the calibration efficiency of the equipment being used
- the accuracy of spread
- the skill level of the pilot
- high environmental standards
- use of GPS to achieve higher accuracy of fertiliser placement

The aerial application of fertiliser should comply with the Code of Practice for the Placement of Fertiliser in New Zealand (*Spreadmark*), Part B: The Aerial *Spreadmark* Code. See Fact Sheet 4.

Best management practices for fertiliser application

Most agricultural fertiliser is spread by contract ground spreaders and aerial applicators following the applicable parts of the Code of Practice for the Placement of Fertiliser. Good communication between the contractor and farmer or land manager is essential for best value from fertiliser and to minimise environmental risks. The ideas listed below are also useful considerations for land managers who apply their own fertiliser.

Clearly state the name of product and application rate. Use correct product names as stated on sales documents - common names and abbreviations can cause confusion.

- Express all application rates in kilograms per hectare (kg/ha); lime application may be stated in tonnes/ha. Be sure your spreading operator is absolutely clear about the desired fertiliser application rate.

- Give details of the application area. A map showing the location, boundaries and size of the area(s) to be treated is best. Pointing out easily identifiable ground features can help the contractor find the right paddock.

- Describe any hazards present, such as power lines, trees, silage pits or hidden steep slopes that may be dangerous to the operator. It is also important to highlight any 'unusual' activities that may be taking place on the farm – e.g. tree felling.

- Note any areas and features to be avoided, such as streams, lakes, ponds, wetlands and riparian strips. It is helpful to mark these on the map, rather than rely on verbal explanation. Areas of high nutrient status may not respond to the fertiliser being applied and should usually be avoided – e.g. stock camps.

- Note any conditions to be avoided. Avoid applying fertilisers, particularly those containing nitrogen, when soil moisture levels are high (at or near field capacity) to avoid the risk of nutrient moving laterally rather than being absorbed into the soil. There is a risk that fertiliser applied on slopes will be washed downhill if the soil surface is hard and dry and/or the vegetative cover is very short. Delay spreading fertiliser materials if the wind is strong enough to cause drift away from the target area or if the wind direction is towards nearby sensitive crops or dwellings.

- Consult the fertiliser supplier for information about hazards to livestock from direct intake of fertiliser. Avoid application on blocks where livestock are grazing.

- Specify the accuracy and evenness required. The usual measure for evenness of spread is the coefficient of variation (CV%), in which the lowest figure represents the most even spread. Spreader operators should be given a clear indication of the evenness (CV%) required for the job in hand.

Appendix 1: Legislation and fertiliser use

Fertiliser products covered by the Code

The Code is intended to cover the full range of products that are used, known as or seen as fertilisers, and are recognised as such under the Agricultural Compounds and Veterinary Medicines Act 1997, and the Agricultural Compounds and Veterinary Medicines Regulations 2001. If there is any uncertainty about whether a given product is considered a 'fertiliser', this Code specifically covers:

"Any substance (whether solid or fluid in form) which is described as or held out to be for, or suitable for, sustaining or increasing the growth, productivity, or quality of plants or animals through the application of the following essential nutrients to plants or soils:

> *nitrogen, phosphorus, potassium, sulphur, magnesium, calcium, chlorine, sodium, as major nutrients or manganese, iron, zinc, copper, boron, cobalt, molybdenum, iodine, selenium, as minor nutrients or additives"*

and,

> *"Any other product which is considered to meet identified soil or plant nutrient deficiencies and is applied with this as the principle objective. Products discharged or applied as part of a waste treatment process require resource consents. Products that have received resource consent and will be used as a nutrient source should comply with the principles of the Code."*

Notes:
To be considered a fertiliser under this Code, any product shall be free from pathogens or any other agents which could effect disease and pest transmission.

Substances not specifically manufactured as a fertiliser (e.g dairy shed effluent, chicken litter and manures) may be subject to specific legislative requirements not covered in this Code.

Legislation

Various regulatory and other industry or quality assurance requirements affect the use and application of fertiliser. The main legislative requirements are the Resource Management Act (1991), the Agricultural Compounds and Veterinary Medicines Act (1997) (ACVM), Agricultural Compounds and Veterinary Medicines Regulations (2001), the Hazardous Substances and New Organisms Act 1996 (HSNO), the Transport Act 1985 and the Transport Law Reform Act 1990. The Health and Safety in Employment Act 1992 (HSE) is also relevant in relation to safe workplace requirements.

The RMA

The principal item of legislation that affects the application of fertiliser is the Resource Management Act 1991 (RMA).

Part 1 of the Act - Interpretation and Application
Section 2. Interpretation
The RMA does not define what a fertiliser is but does define contaminant.
"Contaminant" includes any substance (including gases, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat -
(a) When discharged into water, changes or likely to change the physical, chemical, or biological condition of the water; or
(b) When discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged.

Fertiliser, along with numerous other substances, is regarded as a "contaminant".

Part 2 of the Act states that:
Section 5. Purpose

(1) The purpose of this Act is to promote the sustainable management of natural and physical resources

(2) In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while
- (a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Part 3 Duties and Restrictions under this Act
Section 15. Discharges of contaminants into the environment

(1) No person may discharge any
- (a) Contaminant or water into water; or
- (b) Contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or
- (c) Contaminant from any industrial or trade premises into air; or
- (d) Contaminant from any industrial or trade premises onto or into land unless the discharge is expressly allowed by a rule [in a regional plan and in any relevant proposed regional plan], a resource consent or regulations.

(2) No person may discharge any contaminant into the air, or into or onto land, from
- (a) Any place; or
- (b) Any other source, whether moveable or not, in a manner that contravenes a rule in a regional plan or proposed regional plan unless the discharge is expressly allowed by a resource consent or regulations, or allowed by section 20A (certain existing lawful activities allowed).

Regional and District Councils prepare resource management policies and plans under the RMA. The plans of Regional Councils usually include rules that govern various activities, including the discharge of contaminants. The definition of a 'contaminant' given in the RMA includes fertilisers. The discharge of contaminants into the environment, which includes the application of fertiliser, is covered in Section 15 of the Act. Section 17 of the RMA states that every person has "a duty to avoid, remedy or mitigate adverse effects on the environment." As a result, rules governing the discharge of contaminants may appear in Regional Plans including Regional Air, Water, and Land plans. For nutrients derived from waste products the rules may be contained in Regional Waste Plans.

The Agricultural Compounds and Veterinary Medicines Act 1997 (ACVM)

This legislation covers the requirements for the fertiliser group of agricultural compounds. Fertilisers are broadly defined as substances or products that are used to encourage plant growth but are further classed as either:

- Fertilisers – used to provide nutrients to encourage plant health and growth
- Fertiliser additives – used to adjust the chemical or biological characteristics of soil to facilitate uptake and use of nutrients
- Soil conditioners – used to adjust the physical characteristics of soil.

All products that are either fertilisers or fertiliser additives are exempt from registration under the ACVM Regulation 9 as long as the requirements of the ACVM Regulations that cover the import, manufacture and trade in fertilisers and fertiliser additives are met. This means that the fertiliser must be fit for the purpose specified in the directions for use and include a label at the point of sale detailing information such as trade name, nutrient content, modifying pH, details of any precautions to be taken to prevent or manage risk and directions for use. The *Fertmark* Code is a compliant Code under ACVM.

The Hazardous Substances and New Organisms Act 1996 (HSNO)

The Minimum Degrees of Hazard Regulations 2001 and Hazardous Substances Regulations 2001 determine and describe the hazardous properties of substances. Some fertilisers may be hazardous substances under these regulations, in which case any controls applied under the HSNO regulations must be complied with. The controls may relate to any stage of the life cycle of the substance including manufacturing, transport, storage, use or disposal.

Most fertilisers fit into an Environmental Risk Management Authority (ERMA) group standard called 'subsidiary'. ERMA administers HSNO. Provisions around this group standard relate to labeling, signage, safety data sheets, advertising, storage and health and safety and transport. In general these provisions only affect the fertiliser companies. However, if the fertiliser is classified under the oxidiser group standard (e.g. nitrate products such as ammonium nitrate and potassium nitrate) then there are additional restrictions applied to the land manager (who must be an approved handler) and quantities stored on the property.

Transport Act 1987 and Transport Law Reform Act 1991

Users will comply with the requirements of the Transport Act and Transport Regulations when transporting fertiliser by road. Under these Acts it is the driver's responsibility to ensure:

- All freight is correctly restrained
- All hazardous substances are segregated correctly,
- The drivers license has the appropriate endorsements
- The safety equipment required, which is provided by the carrier is used.

The carrier is responsible for ensuring that this is achieved.

All carriers shall be aware of the Operators Handbook for the Transport of Hazardous Substances by Road (Land Transport Safety Authority).

The Health and Safety in Employment Act 1992 (HSE)

All employers and self-employed people must also comply with the Health and Safety in Employment Act. The key focus of this Act requires that people must:

a) As employers, identify hazards to employees at work and manage these so that people are not harmed. Note that a driver's place of work includes the vehicle being driven.

b) As employees, ensure personal safety and the safety of others, including using safety equipment as instructed.

Staff on the area being treated must know about the fertiliser application. Employees have a duty to comply with safety directives (including using safety equipment as instructed) to ensure their personal safety and the safety of others. Fertiliser users should seek information about their products from the supplier or a qualified consultant.

A safety data sheet should be available for all products used on the property.

Legislation and other nutrient management activities

Most nutrient management activities are covered by the Resource Management Act 1991. Check with the local Regional Council for specific requirements relating to these activities. There may also be other legislation and regulations that cover other operational activities undertaken on the property. Again check with the Regional Council for these.

Appendix 2: Industry programmes

Industry programmes have been developed to promote improved nutrient management, some of which are listed below.

Fertmark

Fertmark is an independently assessed fertiliser and lime quality assurance programme run by the Fertiliser Quality Council. It provides quality assurance on the claimed nutrient content of each *Fertmark* registered fertiliser product. Independent audits are made on product quality and the quality systems of the participating fertiliser or lime companies.

Fertmark registered manufacturers, importers and suppliers also have an advertising code of conduct, so they should be able to verify the claims they make about the products they sell. The bright green *Fertmark* tick stands for fertiliser quality assurance.

Spreadmark: Code of Practice for the Placement of Fertiliser in New Zealand

The *Spreadmark* Code of Practice for the Placement of Fertiliser in New Zealand enables farmers and land managers to get the best value for their fertiliser dollar through a fertiliser placement quality assurance programme. Like *Fertmark*, it is also administered by the Fertiliser Quality Council. There are two sections to the *Spreadmark* programme. One applies to ground spreading and another to aerial topdressing.

Spreadmark: Groundspreading

The *Spreadmark* programme was established by the NZ Ground Spread Fertilisers Association in 1994. It was subsequently expanded by a group with representatives from Federated Farmers, the NZGFA, fertiliser companies and Fert Research, and came under the Fertiliser Quality Council by 2002.

It has as its objective the placement of fertilisers in locations where they can be of the most agricultural benefit and the least environmental harm. The scheme registers spreading companies provided they have certified spreading machinery that can operate with accuracy within defined bout widths, trained operators and an appropriate quality management system which ensures that farmer/land manager outcomes are met and environmental sustainability is protected. Overall systems are subject to an independent audit.

Spreadmark: Aerial Application

In June 2006 the Fertiliser Quality Council introduced a programme for aerial applicators (fixed wing and rotary) of fertiliser. This was developed with the NZ Agricultural Aviation Association. The *Spreadmark* module can be completed as part of the NZAAA Accreditation Programme. Like the ground spreaders, aerial companies must have an active quality management programme, have spreading test patterns for their equipment, and competent operators. The programme assists in the management of risks, and has traceability of the application.

Code of Practice for the Management of Nutrient Solutions Released from Greenhouses

This Code is designed for the management of nutrient solutions associated with soil-less production of vegetables and flowers in modern greenhouses – in particular, it addresses responsible discharge of nutrient-rich solution which may reach ground or surface water.

Nitrates are the principal nutrients addressed by the Code which aims to:

- assist in management decisions
- retain access to international markets as part of a quality assurance scheme
- help growers to meet their responsibilities under the RMA.

Three main sections include -

- design and operation of a soil-less system
- solution collection and storage
- fact sheets with information, figures, calculations and tables for assessing viable options for nutrients stored and discharged

Clean Streams Accord

The Accord promotes sustainable dairy farming in New Zealand. It focuses on reducing the impacts of dairying on the quality of New Zealand streams, rivers, lakes, ground water and wetlands.

Market Focused

An environmental management system for New Zealand dairy farmers. Market Focused assists dairy farmers meet their industry requirements.

Appendix 3: Fertiliser activities and environmental concerns

Nitrate leaching to groundwater
Indicator: Increasing nitrate nitrogen in groundwater
Note: *Nitrate leaching is not easily measured by users so the emphasis should be on avoiding leaching by following best management practices such as nitrogen fertiliser application, animal grazing and dairy effluent irrigation rather than remedial action after it has occurred.*

Possible cause	Best practice for remedial action	Fact sheet
Nitrogen input exceeding nitrogen uptake	• Reduce nitrogen input. • Increase nitrogen uptake in plants by matching nitrogen applications to plant growth. • Ensure low or excessive pH is not directly or indirectly restricting N uptake. • Ensure pastoral growth is sufficiently abundant to cope with the uptake. Pasture should be at least 25 mm high (approx. 1000 kg DM per ha) before nitrogen is applied. • Balance nutrients (fertiliser inputs). • Avoid winter application of N when the temperature is low and /or it is wet.	6,9 9 9 9 9 6,9
High nitrogen application rates (e.g. greater than 200 kg N/ha/yr)	• Reduce nitrogen input. • Ensure high nitrogen uptake by: - *Timing for growth periods* - *Splitting dressings* - *Ensure appropriate placement*	8,9 8,9
Applying nitrogen in a single application	• Split the nitrogen applications so that smaller amounts are applied more frequently.	9
Heavy rainfall (i.e. >20mm within a day of applying N) or irrigation within a day of applying fertiliser	• Check weather forecast and avoid application if heavy rain seems likely. • Avoid applying fertiliser when soil is above field capacity (i.e. puddles on the ground). • Select a less mobile nitrogen fertiliser (containing ammonium N rather than nitrate N). • Apply fertiliser after irrigation (e.g. border-dyke irrigation) especially when ground cover is low (<80%).	9 9 5,9 9
Permeable soils which can cause nitrogen leaching. (i.e. if puddles disappear quickly after heavy rainfall)	• Apply smaller amounts of fertiliser more often. • Reduce the amount of nitrogen applied. • Select a less mobile nitrogen fertiliser e.g. Ammonium N rather than nitrate.	9 9 5,9
Nitrogen fertiliser not securely stored	• Ensure nitrogen is contained within the storage area on an impervious floor. • Protect stored N from rain.	6 6
High water table present	• Reduce amount of N applied per application. • Match application to plant uptake.	9 6,9
Contamination from loading sites	• Ensure no spillage when loading in or out of storage, or into application equipment.	6

Contamination of surface water from fertiliser run-off
Indicator: Algal blooms/excessive weed growth - elevated nutrient levels (e.g. nitrogen and phosphate)

Possible cause	Best practice for remedial action	Fact sheet
Slope too steep for vehicle access or natural drainage lines running down to open water	• Use slower release fertilisers, or split fertiliser applications. Apply smaller amounts more frequently. • Develop and maintain riparian strips. • Avoid applying fertiliser when the ground is saturated. • Increase buffer distance between application site and the open water.	6,9,13 9 9 9
High rainfall or irrigation within a day of fertiliser application	• Check weather forecast and avoid application if heavy rain seems likely. Avoid irrigation in excess of field capacity. • Use slower release fertilisers, or reduce the fertiliser application rates in wetter conditions. • Split the application rates. Apply smaller amounts more frequently. • Apply fertiliser after irrigation (in the case of, border-dyke irrigation) especially when the ground cover is low (<80%). • Check irrigation technique is appropriate for the crop.	9 9,13 9 9 9
Less than 80% ground cover (e.g. pasture less than 25 mm high or approx. 1000 kg DM/ha)	• Increase ground cover before applying fertiliser. • Maintain resilient and productive ground cover that is capable of efficiently using the fertiliser. • Plant row crops on contour. • Ensure pasture is not over-grazed (reduce stocking rate or grazing time). • Avoid pugging damage. • Install and maintain riparian strips. • Surface incorporate, drill or directly apply fertiliser to the root zone.	9 9 - 9 9 9 9
Saturated soils (puddles forming)	• Delay fertiliser application until soil conditions improve. • Use a less soluble or slow release fertiliser.	9 9, 13
Excessive rates of application	• Set realistic crop yield goals and apply fertiliser at times of maximum plant uptake. • Account for all sources of nutrients and apply nutrients in correct proportions.	8,9 8,9
Uneven application	• Use equipment suitable for the conditions. • Use calibrated equipment and experienced operators.	3,4 3,4
Soil permeability low, soil cracking (macropores)	• Improve soil draining characteristics (subsoiling). • Reduce soil compaction. • Reduce stocking rate. • Split fertiliser application rates. Apply less fertiliser more often.	- 2 - 9
Storage site too close (less than 50 metres) to open water	• Improve the storage facility so that all fertiliser is effectively contained (under a roof).	6
Loading site too close	• Minimise spillage of fertiliser when loading into or out	9

(less than 50 metres) to open water	of storage. • Move loading site away from open waterway.	9
Outflow from tile drainage system	• Apply fertiliser when tile drains are not running. • Avoid application when soil is saturated.	9 9
Drought (excessively dry soils allowing high surface run-off because of slow infiltration rate)	• Delay applying fertiliser until sufficient regrowth has occurred after rain.	8

Contamination of open water from direct application of fertiliser
Indicator: Algal blooms/excessive weed growth - evidence of elevated nutrient levels (e.g. nitrogen and phosphate)

Possible cause	Best practice for remedial action	Fact sheet
Aerial application	• Use fertiliser with larger particle sizes (less wind effect). • Choose alternative aerial techniques to allow more precise placement e.g. use of GPS and GIS. • Use methods other than aerial application. • Use selective application techniques (cover part of the area).	3,4 3,4 3,4 3,4
Ground application close to open water (e.g. less than 10m away)	• Allow a larger margin between fertilised area and open water. • Use application techniques that direct or specifically place the fertiliser. • Use fertiliser with larger particle size. • Erect a physical barrier/riparian strip around the water.	4,9 4,9 4,9 -
Wind speed greater than 5km/hr towards open water	• Apply fertiliser when wind direction is away from open water. • Use fertiliser products and application techniques that confine fertiliser to the target zone. • Change application techniques e.g. drill fertiliser at planting rather than broadcast.	4 3 4
Fertiliser particle sizes with poor ballistic properties (e.g. less than 1 mm in diameter for dry material)	• Use fertiliser with larger particle sizes. • Use application techniques that direct or specifically place the fertiliser.	4 3,4
Storage site within 50 metres of open water	• Move storage site away from open water. • Ensure the storage facility effectively contains the stored fertiliser (under a roof).	9 6
Fertiliser loading/handling operations less than 50 metres from open water	• Relocate the loading site away from open water. • Use wind shelters around the loading site to contain fertiliser.	9 9

Social/ third party effects
Indicator: Complaints from affected parties

Possible cause	Best practice for remedial action	Fact sheet
Use of dusty fertiliser	• Use fertiliser with a larger particle size (dry material). • Use other forms of fertiliser (e.g. slurry/liquid/suspensions). • Ensure the wind is blowing away from sensitive areas. • Apply fertiliser only at agreed times.	4, 6 4 4 -
Noise during fertiliser application	• Change to quieter application equipment. • Change time of day when fertiliser is applied. • Change operational technique to reduce effects of noise on affected parties. • Apply fertiliser only at agreed times.	4 4 - 4
Off-target contamination (solids and liquids)	• Use fertiliser with larger particle size. • Use precise application techniques. • Apply fertiliser only when the wind direction is away from affected parties. • Apply fertiliser only at agreed times.	4,6 3,4 4 4

Nutrient Management Plan User Guide

Part A: Property details

This section identifies the property and the people responsible for the nutrient management plan.

- Complete the contact details.
- State the farm areas – total, effective (i.e. in production or fallow in preparation for production; exclude non-effective areas such as lanes, buildings, farm shelter belts) and irrigated (if any).
- State the irrigation type(s).
- Tick all of the enterprise types that apply.
- The template provides a sample statement of purpose. You can add to this if you wish.

Part B: Plan objectives, land management units and environmental risk

- Code specific objectives are supplied in the template and must be adopted if they apply. If you choose to reject any of these, attach justification (e.g. a farm map showing that there are no areas of significant vegetation or wildlife habitat).
- There is space for additional 'property management objectives'. Write in any extra objectives the owner or manager chooses to set – e.g. objectives about achieving particular nutrient level targets or objectives about farm practices such as soil testing.
- There is space to identify 'land management units' (LMUs) for the farm – i.e. areas of the farm that are under similar management and that will respond to management in similar ways. Consider such things as soil types, slope, management activities (e.g. dryland or irrigated, significantly different crop types, areas receiving dairy effluent) and differences in historical management.
- If all of the farm is managed similarly and responds to that management in similar ways, only one LMU is needed.
- Make a brief note distinguishing each LMU in the table and note the area it covers.
- Mark these on a farm map and attach it to the NMP.
- On a separate piece of paper, make a list of farm nutrient management activities and their possible environmental consequences – e.g. nitrogen fertiliser use might lead to contamination of surface or ground water. For each of these, estimate the likelihood of adverse environmental effects and the consequences of such events. (See Chapter 4, step 3 of the Code for more information about assessing likelihood and consequences.)
- Consider only the inherent risk caused by the activity and do not discount the risks because good management will overcome it. Good management will be highlighted in Part C of the template.
- Note any activities that have medium or higher likelihood of adverse environmental effects and/or medium or higher consequences in the table of environmental risks. Tick the LMUs on which these will occur.
- Add any comments you want to make about the risks identified. For example, you might note industry rules or regional concerns about farm activities.
- Tick the box at the bottom of the page to indicate nutrient management activities that you will address in your planning. Three common activities are already listed – add your own labels for the other boxes if necessary.

You can add any objectives you like, but be aware that management practices should then reflect these and set out steps to achieve them.

Part C: Management guides

- Pages for management planning are provided for nitrogen fertiliser use, phosphate fertiliser use and dairy effluent application. Complete these if they apply for the property.
- Note the types of applicable fertiliser, application rates and locations where they will be spread (LMUs).
- List any specific requirements your industry has about this nutrient use or activity.
- List any specific requirements your Regional Council has about this nutrient use or activity. These will include conditions that must be met for the activity to be a 'permitted activity' or conditions imposed as part of any resource consent held by the farm for this nutrient management activity.
- List the best management practices (BMPs) that the farm will use to reduce environmental risks from this activity.
- There are tables of BMPs in Chapter 5 of the Code. Choose suitable practices from these tables and note them in the NMP.
- It is not necessary to adopt all the possible BMPs for a particular risk or activity but the practices chosen need to be suitable for managing the inherent risks identified for the property.
- For each BMP included, note how the manager will check that these are implemented – e.g. diary entry or noted on a farm map.
- Use the management guide pages as a model for further activities if necessary. In each case, check that the activity itself is reasonably explained (e.g. fertiliser types and application rates, LMUs treated), industry or Regional Council rules are stated and best management practices have been listed.

Doing self-assessment

- The property manager needs to complete a self-assessment at the end of the season, checking that the management practices did achieve the objectives set at the beginning.
- For each nutrient management activity included in the management guides, check through the industry and Regional Council requirements and tick 'yes' or 'no' to show whether these were met.
- For each management practice listed at the planning stage, tick 'yes' or 'no' to show whether these were actually practiced.
- Now consider the effects of this nutrient management activity overall. Were the Code specific and property objectives achieved? Tick 'yes', 'no' or 'partially' (if only some objectives were met and/or objectives were barely achieved or the manager was not satisfied with performance).
- If you have ticked 'no' or 'partially' then changes in management practice are required. Note the new management practices that will be used, the person responsible for ensuring these are implemented and a deadline for completion or introduction.
- Write in the actual completion date when each new management practice is adopted.
- The person responsible for the NMP (owner or manager) needs to sign off and date the self-assessment.

Farm map

- Check that there is at least one farm map attached, showing the land management units or other distinctions between management areas.
- Extra farm maps can be added – e.g. to show areas receiving particular fertiliser types, to show riparian strips or protected vegetation that are not treated, etc.

Nutrient budgets and soil test results

- Check that there is at least one nutrient budget attached for each land management unit, this is particularly relevant where you identified significant environmental risks from nutrient management activities.
- This nutrient budget should use the planned nutrient inputs and the expected production outputs from the area. If several fertiliser options were considered then the nutrient budget should support the final choice.
- Soil test results are important for establishing initial soil nutrient levels for nutrient budgeting.
- Further soil tests are useful checks on trends in soil fertility over time to compare actual changes with those expected and planned.

The following document is an interactive PDF version of the Nutrient Management Plan Template and User Guide.

This document maybe filled out using your computer and printed, or alternatively printed and filled out by hand.

Contact details:

Fert Research (NZFMRA)

P: 09 415 1357
F: 09 415 1359

E: info@fertresearch.org.nz
W: www.fertresearch.org.nz

PO Box 9577
Newmarket
Auckland

Nutrient Management Plan

Prepared by

for

Date

Part A: Property details

Property name:			
Owner:			
Postal address:			
Phone No.		Mobile No.	
E-mail address:			

Manager:			
Postal address:			
Phone No.		Mobile No.	
E-mail address:			

Property area (ha):				
Effective area (ha):				
Area under irrigation (ha):	water		effluent	
Irrigation Type :	water		effluent	

Enterprise type: (please click to tick box)

Dairy	Dairy grazing	Sheep & Beef	Deer	Cropping
☐	☐	☐	☐	☐
Horticulture	Viticulture	Arable	Forestry	Other
☐	☐	☐	☐	

Purpose of plan

Part B: Plan objectives, land management units & environmental risk

Objectives:

Comply with all legal requirements related to nutrient management activities.

Take all practicable steps to maintain or enhance the quality of the property's water resources.

Take all practicable steps to ensure that there is an adequate supply of soil nutrients to meet plant needs.

To take all practicable steps to contain nutrients within the property boundaries.

Take all practicable steps to minimise the risk of nutrient contamination of any areas of significant vegetation and/or wildlife habitat.

Undertake a nutrient budget.

Property management objectives

Production	
Financial	
Environmental	
Personal	

Land management units

We have identified the following land management units on this property.
(See map described in Code Appendix 4 and Fact Sheet 1: Land Management Units and Land Capability Mapping)

Extra information may be recorded on a seperate page and included with this document

Unit	Description	Approximate area (ha)
A		
B		
C		
D		

Environmental risks

We have identified the following environmental risks for these land management units.

Extra information may be recorded on a seperate page and included with this document

		Inherent risk assessment (see Fig. 3)			
Activity	Potential risk/s*	LMU A	LMU B	LMU C	LMU D

* Potential risks	Yes	No
• Contamination of ground water		
• Contamination of surface water		
• Undesired changes in soil nutrient status		
• Nutrient application to non-target land		
• Accumulation of non-nutrient impurities in the soil profile.		
• Excess stocking rate		
• Pugging and compaction		
• Poor cultivation methods		
• Other		

Comments about specific risks identified.

From the table above, we have chosen the following nutrient activities as significant.
These are addressed in management plans.

N fertiliser use	P fertiliser use	Effluent disposal	Supplement use	Other
☐	☐	☐	☐	

Part C: Management guides

Nitrogen fertiliser use

Fertiliser applications

Fertiliser type	Rate of application (kg/ha)	LMU where it is applied

Industry and legal requirements

Specific industry requirements (Contact industry representative for details)	Met requirements Yes	No

Specific Regional Council requirements (Contact local Regional Council for their requirements)	Met requirements Yes	No

Management practices

We have identified the following management practices to meet the objectives as set out in Part B of this plan.

Management practices implemented to achieve our objectives (See Chapter 5 of the Code for examples	Verification method	Checklist Yes	No

Self assessment for nitrogen fertiliser use

Did the management practices achieve the Code objectives and any farm objectives?

Yes	☐	Objectives achieved
No	☐	Fill out table below
Partially	☐	Fill out table below

Changes in management practices required	Person responsible	Timeframe for completion	Completion date

Verification
I verify that the information supplied above is correct.

Property owner / manager

Signature ....

Date ....

Phosphate fertiliser use

Fertiliser applications

Fertiliser type	Rate of application (kg/ha)	LMU where it is applied

Industry and legal requirements

Specific industry requirements (Contact industry representative for details)	Met requirements Yes	No

Specific Regional Council requirements (Contact local Regional Council for their requirements)	Met requirements Yes	No

Management practices

We have identified the following management practices to meet the objectives as set out in Part B of this plan.

Management practices implemented to achieve our objectives (See Chapter 5 of the Code for examples	Verification method	Checklist Yes	No

Self assessment for phosphate fertiliser use

Did the management practices achieve the Code objectives and any farm objectives?

Yes	☐	Objectives achieved
No	☐	Fill out table below
Partially	☐	Fill out table below

Changes in management practices required	Person responsible	Timeframe for completion	Completion date

Verification
I verify that the information supplied above is correct.

Property owner / manager

Signature ....

Date ....

Dairy effluent application

Do you apply dairy effluent?

Yes ☐ No ☐ - if yes, fill in the following, if no, go to next section.

Effluent application

Rate	LMU (site/location)

Industry and legal requirements

Specific industry requirements (Contact industry representative for details)	Met requirements Yes	No

Specific Regional Council requirements (Contact local Regional Council for their requirements)	Met requirements Yes	No

Management practices

We have identified the following management practices to meet the objectives as set out in Part B of this nutrient management plan.

Management practices implemented to achieve our objectives (Contact your local Regional Council for their requirements & refer to the DEC Manual)	Verification method	Checklist Yes	No

Self assessment for dairy effluent irrigation

Did the management practices achieve the Code objectives and any farm objectives?

Yes	☐	Objectives achieved
No	☐	Fill out table below
Partially	☐	Fill out table below

Changes in management practices required	Person responsible	Timeframe for completion	Completion date

Verification
I verify that the information supplied above is correct.

Property owner / manager

Signature ....

Date ....

Potassium fertiliser use

Fertiliser applications

Fertiliser type	Rate of application (kg/ha)	LMU where it is applied

Industry and legal requirements

Specific industry requirements (Contact industry representative for details)	Met requirements Yes	No

Specific Regional Council requirements (Contact local Regional Council for their requirements)	Met requirements Yes	No

Management practices

We have identified the following management practices to meet the objectives as set out in Part B of this plan.

Management practices implemented to achieve our objectives (See Chapter 5 of the Code for examples	Verification method	Checklist Yes	No

Self assessment for potassium fertiliser use

Did the management practices achieve the Code objectives and any farm objectives?

Yes	☐	Objectives achieved
No	☐	Fill out table below
Partially	☐	Fill out table below

Changes in management practices required	Person responsible	Timeframe for completion	Completion date

Verification
I verify that the information supplied above is correct.

Property owner / manager

Signature ....

Date ....

Lime use

Lime applications

Lime source	Calcium Carbonate content	Rate of application (kg/ha)	LMU where it is applied

Industry and legal requirements

Specific industry requirements (Contact industry representative for details)	Met requirements Yes	No

Specific Regional Council requirements (Contact local Regional Council for their requirements)	Met requirements Yes	No

Management practices

We have identified the following management practices to meet the objectives as set out in Part B of this plan.

Management practices implemented to achieve our objectives (See Chapter 5 of the Code for examples	Verification method	Checklist Yes	No

Self assessment for lime use

Did the management practices achieve the Code objectives and any farm objectives?

Yes		Objectives achieved
No		Fill out table below
Partially		Fill out table below

Changes in management practices required	Person responsible	Timeframe for completion	Completion date

Verification
I verify that the information supplied above is correct.

Property owner / manager

Signature ....

Date ....

Farm map

If you are filling this in on your computer, or online slot your farm map in here after printing the completed plan.

If you don't have a farm map discuss this section with your fertiliser advisor or consultant.

A farm map might be an aerial photograph of your land, a topographical farm layout, or another document you have created to show your farm's layout and specific details.

Attach detailed nutrient budgets and soil test results.

Include the most recent nutrient budgets (using the fertiliser applications detailed in the Nutrient Management Plan) and soil tests to support the Nutrient Management Plan. Historic soil test results are also useful to show soil fertility trends over time. Also include effluent area and its location.

Appendix 5: Sample monitoring and recording templates

The following tables show one method of recording fertiliser application details on a paddock recording sheet. Template A shows a completed example with a blank template B provided.

Individual paddock sheets make it easy to add up total nutrient applications in each season. Land managers with small properties may choose to combine all paddocks or blocks on a single recording sheet, listing the paddock name alongside the date and fertiliser type.

Most land managers will develop their own abbreviations – e.g. 'A' for aerial application by aeroplane, 'H' for helicopter, etc. In the example, 'spinner' refers to the land manager's own tractor-mounted spreading equipment. There is no need to repeat the operator name or other details if these are always the same – e.g. one company is used for all groundspreading.

Template A: Sample paddock recording sheet for fertiliser applications

Paddock Name: No. 12

LMU: A

Present Use: Pasture

			Major Nutrients (kg nutrient/ha)								
Date	**Fertiliser type**	**Application rate (kg/ha)**	**N**	**P**	**K**	**S**	**Mg**	**Ca**	**Operator**	**Method**	**Other nutrients; comments**
23/5/06	*30% potash super*	*250*		*16*	*38*	*20*		*35*	*Bob's GS*	*Truck*	
28/7/06	*Urea*	*87*	*40*						*Self*	*Spinner*	*Had to leave wet area beside boundary – see map*
18/10/06	*Cropmaster 20*	*300*	*58*	*30*		*38*			*Bob's GS*	*Truck*	
20/11/06	*Urea*	*65*	*30*						*Self*	*Spinner*	
20/12/06	*Urea*	*65*	*30*						*Self*	*Spinner*	
	Total for the year		*158*	*46*	*38*	*58*		*35*			

Template B: Paddock recording sheet template for fertiliser applications

Paddock Name:

LMU:______________

Present Use:

			Major Nutrients (kg nutrient/ha)								
Date	Fertiliser type	Application rate (kg/ha)	N	P	K	S	Mg	Ca	Operator	Method	Other nutrients; comments

Fact Sheets

Land Management Units & Land Capability Mapping

Introduction

Successful farming requires good land management. As we seek higher production levels and greater intensification, it's sensible to establish the capabilities of individual land units, over the long term. Farm scale mapping is a precise measurement and monitoring system which enables good land management decisions to be made in line with the long term goals of an overall farm management plan.

Land capability mapping

Variable soils; changes in topography; differences in vegetation, drainage and erosion; or diverse soil chemical and physical characteristics all impact on land use and productivity on the farm.

Mapping your farm at an appropriate scale (such as 1:10,000) allows you to record zones with similar characteristics, and more precisely identify areas with potential to lift productivity, or mitigate environmental impacts. It also helps identify zones which are contributing little to your income. Keeping good records teaches you more about how your land performs over time.

There are eight land use capability classes, ranging from Class I (flat land with good soil and few limitations) through to Class VIII (steep land with severe physical limitations). See the Ministry for the Environment website publications section for information on these classes at www.mfe.govt.nz/publications.

Land management units

Once zones are identified with similar soil and land management characteristics, they can be divided into separate Land Management Units (even within existing blocks) so that each can be individually monitored, evaluated and managed for improved performance.

> Precision technologies such as GPS and GIS present new opportunities to improve the recording of variations in the nature and management of individual zones within larger farm blocks. Decision support tools such as OVERSEER® make it easy to evaluate different management scenarios for each Land Management Unit on the farm – before you implement changes.

Land Capability Mapping and Land Management Units are important for good land management. They are valuable tools for recording, monitoring and improving resources and productivity within farm blocks and should form part of any farm management plan.

For more information see: Your Fertiliser Sales Representative
Your Regional Council Land Management Officer
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Soil and Plant Testing

Introduction

Establishing and maintaining the right balance of mineral nutrients is key to achieving the optimum biological and physical condition for your soil and plants and ultimately enhancing your farm's profitability.

Without the use of scientifically proven protocols to reliably monitor and assess soil health it's easy to use either too little or too much fertiliser. Too much fertiliser is a waste of money and can be damaging to the environment, too little may restrict your farm's productivity.

Soil testing

Like all biological measurements, soil test results can vary and a single result can be misleading. The best information is obtained by regular ongoing testing to monitor patterns, trends and the long term impact of farm management decisions.

The following is an example of the range of characteristics that can change across the different management areas on your farm:

Chemical Tests	Physical Tests	Biological Tests
pH Nutrient Status	Aggregate size & stability (especially for cultivated soil)	Soil Organic Matter (total Carbon & Nitrogen)
Total Organic Carbon & Nitrogen	Infiltration rate	(Mineralisable C & N) (Microbial Biomass – especially for cultivated soil)
Cation Exchange (Storage) Capacity	Compaction	Earthworm numbers
Anion Exchange (Storage) Capacity	Water holding capacity Soil depth Texture Drainage	

Sampling protocol

Correct sampling methods are essential – so seek reliable qualified professional advice before collecting soil samples. Incorrect sampling methods may provide misleading information, wasting time and money and possibly leading you to make the wrong farm management decisions.

Best practice:

- Soil sampling is conducted at least every 1 to 3 years (depending on the known soil history)
- Sampling occurs at the same time of year
- Sampling occurs along fixed transect lines which follow zones of uniform soil types, topography, and management history
- In subsequent years, sampling should be conducted along these same fixed transect lines
- Sub-samples on the transect lines are collected at regular, measured (unbiased) intervals
- Avoid 'atypical' samples (eg, wheel tracks, dung/urine patches, chemical spills)
- Understand the important soil characteristics for your farm system/environment.

In many situations herbage testing may be required in conjunction with or instead of soil testing.

Plant testing

Plant tissue analysis is a direct measure of the nutrients being taken up by the plant. It can be a valuable tool for determining nutrient requirements as it measures nutrients available from the whole root system and tests for all nutrients that are essential for plant growth. Trace element levels in the plant are often more meaningful than soil measures, and in the case of pasture analysis, may be useful for assessing livestock trace element intakes. Remember, however, that the results indicate the nutrient status at the time of testing and nutrient levels change as plants mature. This can be one reason why the tissue analysis may not align with soil testing from the same area.

Actively growing plant tissue provides the best sample. For pastures, it is particularly important to sample fresh re-growth as older pasture with a higher percentage of dead material will produce poorer less meaningful results for nutrient recommendations – but will more accurately reflect the diet stock are ingesting. For crops, it is critically important to note the growth stage, or the part of the plant sampled.

Analysis provided in standard plant tissue tests include the major elements nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca), magnesium (Mg), and sodium (Na). These are usually expressed as a percentage of the dry matter. Trace elements generally include copper (Cu), manganese (Mn), zinc (Zn), iron (Fe), boron (B) and molybdenum (Mo). These are usually expressed in parts per million (ppm) or milligrams per kilogram (mg/kg). Cobalt (Co), iodine (I) and selenium (Se) may also be included. Iron content on pasture is principally an indication of soil contamination on the pasture (unless the sample is washed).

Some of these elements are primarily required for plant growth and others may be more important to grazing animals. It is important to know the characteristics of each element before assuming a low value requires treatment. There are also interactions between various nutrients, for instance the interactions between sulphur, molybdenum and copper are well known.

Use plant tissue analysis to:

- Monitor the nutrient status of a crop or pasture by sampling plant tissues at the same stage of development on a regular basis (yearly or within a season). Identify trends and adjust the plant nutrient status before yield losses, deficiencies or toxicities occur.
- Identify possible reasons for poor plant performance. Samples from poor performing plants should be compared with plants of a similar growth stage that are doing well.
- Identify nutrient disorders from visual leaf symptoms. The presence of visual symptoms usually indicates a serious problem exists and some yield or quality losses will have already occurred. Take care not to jump to conclusions that nutrients or trace elements are the cause of visual symptoms. Consider spray or wind damage, water stress or disease.

Sampling protocol

Samples for plant analysis should be collected and packaged in paper bags and sent immediately to the laboratory for analysis. Plant tissue, leaf or sap analysis is becoming a much more widely used technology. As care is required in interpretation, it is critical that the analysis of the results is undertaken by a competent person. If in doubt, technical advice or assistance should be sought. Some testing laboratories provide "optimum" ranges for ease of interpretation, while other laboratories only provide an "average" or normal concentration based on previous samples that have been analysed.

Always seek professional advice before collecting samples and for interpretation of soil or herbage test results.

For more information see: Your Fertiliser Sales Representative
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd.(www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Precision Application Technology

Introduction

Accurate application of fertiliser helps ensure maximum benefit and minimises adverse environmental impacts from applied nutrients. In addition to farming efficiencies, proof of placement and good agricultural practice are fast becoming an integral part of marketing and quality assurance.

Fine tuning allows you to maximise production and minimise waste of fertiliser; one of the greatest on-farm operating expenses.

Precision agriculture

Global Positioning System (GPS) tracking and Geographic Information System (GIS) mapping provides for:

- Uniform application
- Checks on area and therefore rate of application
- Tracking to match swath width
- Accurate record of spread zone
- Check on distance to open water and non target areas
- Proof of placement

Measuring spreading evenness

The international measure for spreading evenness is known as the CV (Co-efficient of Variation).

For perfectly even spreading the CV = 0%. However, in practice this cannot be achieved.
A CV of less than 10% is considered to be excellent.

Certification under the Spreadmark Code of Practice requires a CV of no more than 15% for nitrogen fertilisers and no more than 25% for all other fertilisers.

Fertmark and Spreadmark accreditation ensures you are receiving the fertiliser product described, and that it is applied to the correct area, at the correct rate.

For more information see:

Fertiliser Quality Council (www.fertqual.co.nz)
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative Ltd (www.ravensdown.co.nz)
Your Groundspread operator
Your Aerial Spread operator
Your Fertiliser Sales Representative

Fertiliser Spreading

Fertmark Registration and Spreadmark (Ground and Aerial) Accreditation

Introduction

Greater precision in fertiliser application is increasingly important if profits are to be lifted by more intensive farming. However, intensification also brings a greater risk of negative impacts on farm profits and on the environment through errors and inefficiencies in fertiliser application.

Fertiliser and its application is often the single biggest discretionary expense.

Fertiliser spreading

More accurate fertiliser spreading is possible through:

- Awareness and skill of the operator
- Accurate tracking and spreading technology
- Diligent maintenance and calibration of machinery (specific to the type of fertiliser being applied)
- Uniform application
- Correct rates of application
- Correctly chosen blends (chemically and physically compatible for safe, efficient spreading without clumping or segregating)

Environmental responsibility is achieved through:

- Meticulously avoiding open water
- Sound environmental awareness
- Being a good neighbour (being considerate to neighbours needs, and keeping neighbours informed, to avoid misunderstandings about farm practice)
- Thorough knowledge of legislative requirements under the RMA and Regional Council Rules.

Spreadmark and Fertmark

Companies registered under the Spreadmark and Fertmark schemes are independently audited and monitored.

Fertmark provides assurance that you are receiving the fertiliser product as described.

Spreadmark provides assurance that there are systems and procedures in place for spreading fertiliser at the desired rate and evenness on the designated area with qualified operators and tested spreading equipment.

Ask for Fertmark registered fertilisers spread by Spreadmark accredited operators.

For more information see:

Fertiliser Quality Council (www.fertqual.co.nz)
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative Ltd (www.ravensdown.co.nz)
Your Groundspread operator
Your Aerial Spread operator
Your Fertiliser Sales Representative

Nutrient Behaviour in Soils

(Nutrient Cycling)

Introduction

Complex nutrient cycles have been an integral part of farming practices throughout history. However, with intensification of farming systems, there is now greater awareness about the need to minimise nutrient losses through achieving the correct balance between inputs and outputs of nutrients.

Understanding nutrient behaviour in New Zealand soils, presents a valuable opportunity for farmers to more efficiently utilise essential nutrients to increase profitability while reducing environmental impacts.

Essential nutrients

Nutrients essential for plant growth are divided into two groups. Macro-nutrients are those required in larger quantities and micro-nutrients (also called trace elements) are required in relatively small quantities. However, all the essential elements must be present, in their correct proportions for optimum plant growth to occur.

Fertilisers help replace essential nutrients which are lacking or being removed.

Nutrient cycles

Nitrogen

Nitrogen is utilised by growing plants and animals and also soil micro-flora. Much of the soil's nitrogen is bound in organic matter but only 2–3% is released by decay at any one time, to give soluble, plant available forms (ammonium and nitrate).

The atmosphere is an important source of nitrogen for legumes such as clover, which can convert or 'fix' between 50–300 kg N/ha/year. Other sources of nitrogen include organic matter brought on to the farm, as occurs with animal feed supplements, animal excreta and nitrogen containing fertiliser.

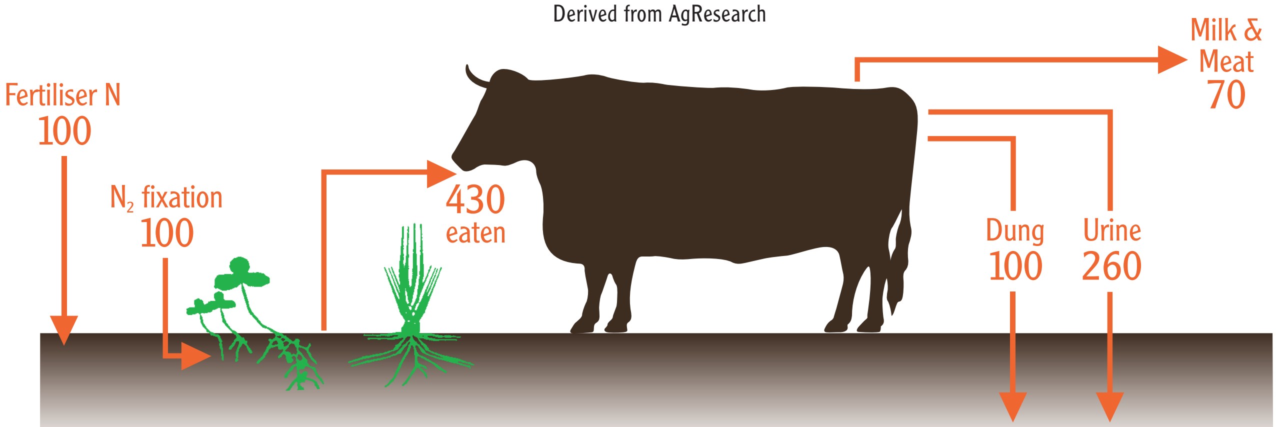
This 'available' nitrogen (from all sources) is easily lost once it has converted to the nitrate form. It is relatively mobile and requires careful management to ensure the right quantities are maintained in soil solution, without excessive amounts being lost from the productive farming system.

Within the cycle, nitrogen is converted to many different forms. Large amounts can be lost to the atmosphere as ammonia, nitrous oxide, or nitrogen gas. Plants utilise the water soluble forms, ammonium and nitrate.

SIMPLIFIED NITROGEN CYCLE

kg N/ha/year

Derived from AgResearch



Ammonium has a positive charge and can be held more readily by the predominantly negatively charged soil particles. Nitrate is negatively charged and therefore very mobile in soil solution, and easily leached.

Both the consumption and evolution of ammonium and nitrate forms of nitrogen in the cycle can occur relatively quickly, which means growth responses to nitrogen can be rapid, but also short lived.

In horticultural and cropping systems there is potential for high nitrogen losses unless it is carefully managed to ensure nitrogen inputs match the plant requirements of economically productive systems.

In grazed pasture systems loss of nitrogen from urine patches is the significant source of nitrogen loss.

Phosphorus

Like nitrogen, phosphorus is an important essential nutrient. Almost all New Zealand soils are naturally deficient, however, unlike nitrogen, phosphorus is relatively immobile, there are no atmospheric contributions and it is not readily lost by leaching.

Phosphorus is bound tightly to both the soil minerals and the organic matter. At any one time, only small fractions become soluble in soil solution. However, these pools operate in equilibrium. So, as P is removed from the soil solution, more is released from the organic matter or mineral content. The pool of available phosphorus is increased by the addition of fertiliser, increased organic matter, or by natural weathering of the soil's parent material.

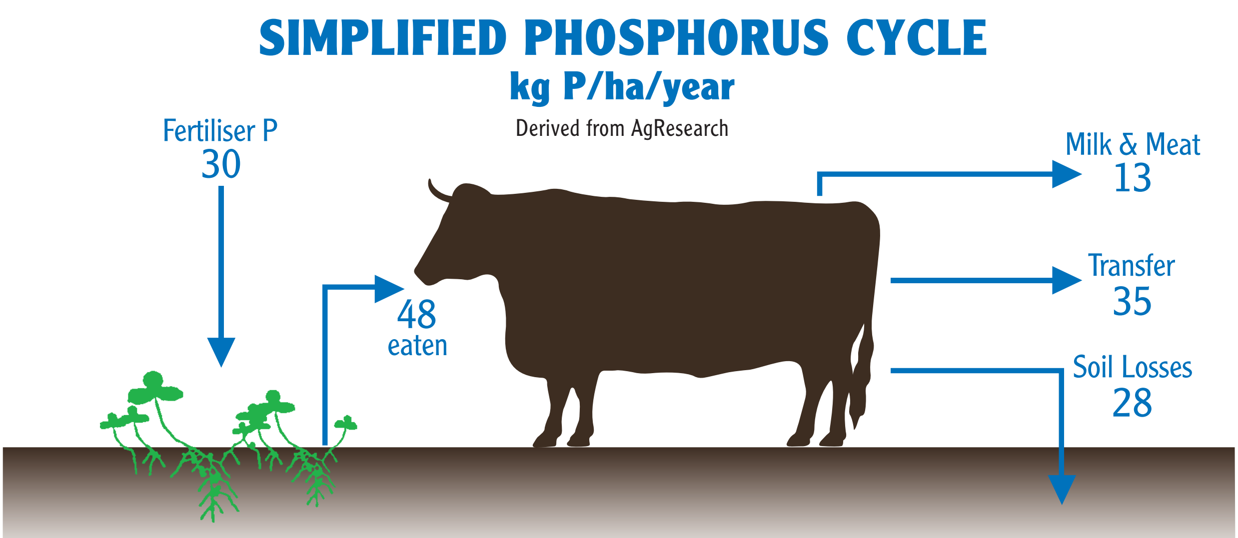
Olsen P soil tests provide an indication as to the amount of plant available phosphorus in the soil.

The timing for phosphorus fertiliser application is not usually critical because phosphorus is retained in the soil. However, it can take years for fertiliser applications to build up the plant-available component in the soil reserves.

Phosphorus will not generally move far from the soil surface, and is not easily leached except in peat and coarse textured soil with low P retention properties (eg, leaching losses may occur under high rainfall with recently applied superphosphate or dairy effluent, applied to soils with low P retention characteristics).

Serious losses of phosphorus occur through soil erosion.

Much of the phosphorus is bound tightly to soil particles and organic matter in the surface layers of soil and this has serious implications with soil erosion. Most of the phosphorus lost from farming systems is through attachment to soil particles. In the waterways phosphorus enrichment



occurs mainly due to the release of phosphorus from eroded soil particles. Algal growth only requires a small amount of phosphorus and nitrogen to 'bloom' when the right conditions occur.

Potassium

Like nitrogen and phosphorus, potassium (K) is required in relatively large quantities.

Unlike nitrogen and phosphorus, it is not retained in significant quantities in soil organic matter.

Potassium is an important element in many soil minerals, but the quantity available to soil solution in 'exchangeable' form is small – perhaps 1 or 2% of the total soil potassium. As it is used or lost, more 'exchangeable' K is released.

Some of the 'non-exchangeable' K is still available to plants when it is released from internal layers of hydrous mica, and illite clays. These minerals, particularly in Brown or Pallic soils, provide a slower, but valuable, supply of potassium.

The QTK soil test measures the pool of available potassium in soils.

In soil solution, potassium has a single positive charge and as it becomes available for plant uptake it is vulnerable to leaching in association with negatively charged nitrate, sulphate or chloride ions.

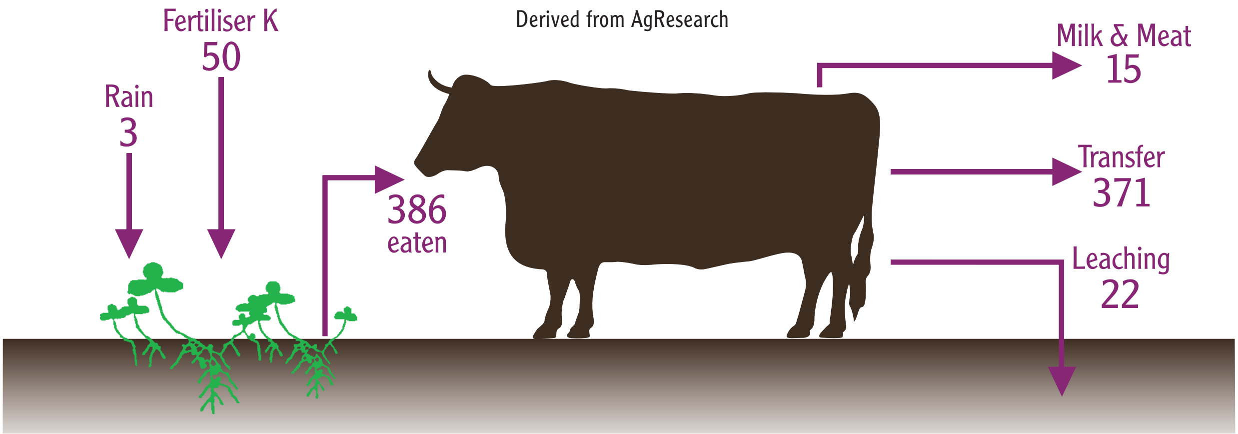
Losses of potassium are primarily through removal in farm produce, leaching, and transfer to non-productive areas by livestock (excreta and effluent are high in potassium – therefore this is also a source of potassium). Some leaching of K can occur.

Potassium is positively charged, as are sodium, calcium and magnesium. To some degree they interact competitively, therefore it is important to retain the correct range of proportions for these nutrients – not only for plant growth, but also for animal health considerations.

SIMPLIFIED POTASSIUM CYCLE

kg K/ha/year

Derived from AgResearch



For more information see: Your Fertiliser Sales Representative
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Fertiliser Use

Introduction

Achieving the best result from fertiliser starts with good storage, transport and handling. Absorption of atmospheric moisture will shorten the acceptable storage period and also impact on handling, flow and spreading characteristics.

Fertiliser storage

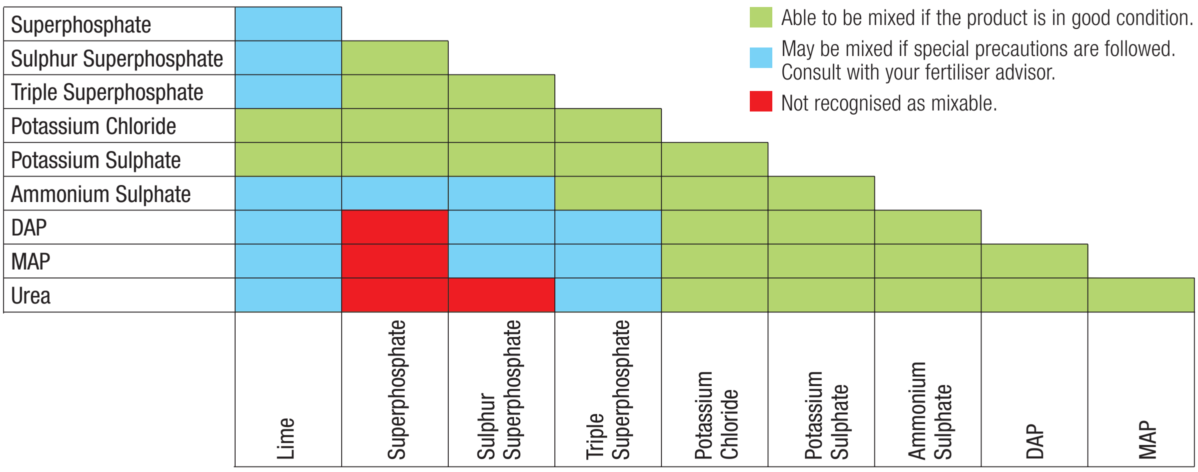
- Keep it dry and free from contamination
- Use an impermeable (moisture proof) concrete floor
- Wrap stored fertiliser eg, bags (include a layer under the bags)

Compatibility for mixing

- Check chemical and physical compatibility using the guide below
- Mixing fertilisers will generally make them more prone to moisture absorption
- Wherever possible, mix immediately prior to use
- Ensure particle size of blended fertilisers are similar
- More than 10% difference in particle size can lead to separation during transport and handling
- Seek qualified and appropriate advice before blending fertilisers

NB: Do not blend herbicides or other agrichemicals with fertiliser, as it may result in unpredictable responses, reduced effectiveness, or even hazardous chemical reactions.

Compatibility Guide for Blending Fertilisers



Timing of application

Correct timing can be critical for an economic response and value for money.

Nitrogen (N) – if the plant can't take up and respond to applied nitrogen, then the nitrogen is at risk of being lost through leaching or atmospheric losses. Timing for nitrogen application must match appropriate growing conditions and plant health.

The following factors influence recommendations for the amount and timing of nitrogen applications, because they affect the potential for optimum plant growth.

- Soil temperature (>6°C at 10cm & 9am)
- Soil moisture (avoid the extremes of either being too wet or too dry)
- Soil compaction
- Plant species/cultivar
- Field history
- Plant disease levels

If more than 50 kg N/ha/yr is required, then split applications are recommended.

Potassium (K) – with a high rainfall (>1500mm year) spring applications are preferred to autumn.

For ash or pumice soils with lower rainfall, then spring and autumn applications are equally effective.

If more than 50 kg K/ha/yr is required, then split applications are recommended.

Avoid application of K immediately before calving/lambing.

Superphosphate and Lime – Timing is considered less critical for these products. However, timing for the sulphur content of superphosphate can be important on sedimentary, peat or pumice soils – particularly under higher rainfall. Using a mixture of sulphate sulphur and elemental sulphur can reduce the requirement of split applications for sulphur. Care should be taken to ensure superphosphate particles are not washed into waterways.

Applications of greater than 100 kg P/ha (1 tonne of superphosphate/ha) should be split.

Reactive Rock Phosphate (RPR) – Phosphorus is only slowly released from RPR and the rate of dissolution is influenced by RPR properties (ie, particle size, chemical make-up of the RPR used) and farm properties (ie, soil pH, rainfall, drainage and exchangeable magnesium).
It is recommended soil pH is below 6.0 and that there is at least 800mm annual rainfall for RPR to be most effective. RPR will reduce the potential for runoff losses of phosphorus from applied fertiliser during the first 0–50 days after application however, over the longer term losses from RPR and more soluble fertilisers are similar. Care should be taken to ensure RPR particles are not washed into waterways.

To avoid 'acute fluorosis' it is recommended that stock are not grazed on pastures which have received phosphate fertilisers for 21 days or until 25mm rain has fallen.

Product selection

Choice of fertiliser may be influenced by many factors including:

- cost per tonne/cost per nutrient
- nutrient analysis (% N, P, K, S, Ca, Mg +trace elements)
- Fertmark assurance
- anticipated plant response and economic return on investment
- particle size
- dissolution rate
- effects on pH
- blending & handling characteristics
- soil nutrient test results
- physical structure of soil
- animal health requirements
- potential for off farm impacts
- presence of contaminants
- spreading characteristics
- flowability from aircraft

Environmental considerations:

- risk of surface runoff to waterways
- risk of leaching to sub-surface drains or groundwater
- risk of high rainfall/no rainfall
- neighbouring properties (schools, homes etc)

Your fertiliser sales representative or qualified advisor can help match the correct requirements for farming goals and farming system.

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Fert Research (www.fertresearch.org.nz)
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Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Nutrient Management

Introduction

To achieve the best results for farm production, individual land units need to be managed appropriately to ensure that the correct quantities and ratios of nutrients are available for optimum growth and minimum waste.

Fertiliser applications are the largest discretionary expense for many farming businesses – but are not the only source of nutrients on the farm.

Resources

As with any other management programme, it is important to hold an inventory of resources and to understand how they work.

Variation in the physical and chemical characteristics of soils means that soil nutrients will be held in many different forms, with different chemical and physical interactions influencing nutrient availability.

Understanding soils and fertilisers are obvious factors in nutrient management, but plant varieties, weather patterns, stock management, effluent disposal, crop management, and crop rotations are all examples of factors which influence nutrient resources.

Document the nutrient sources, nutrient sinks, nutrient transfers, and environmental risks as interacting factors which impact on nutrient resources.

Planning

Planning for nutrient management is best achieved by identifying and recording long term farming goals, personal goals, Regional Council requirements, risk factors and best management practices related to each of the Land Management Units on your farm.

Nutrient status

Soil analysis, plant analysis and animal health monitoring on each Land Management Unit are all tools which help identify nutrient requirements.

However, soil and plant analysis provide a ‘snapshot’ at one point in time, and monitoring long term trends and changes provide better information than a single test will.

To ensure consistent and reliable results, it is important to use recommended standard sampling and testing procedures.

Nutrient recommendations

Nutrient recommendations are based on a full understanding of the nutrient cycles for each of the Land Management Units on the farm, and take into account the farm history, monitoring results, long term goals, anticipated farm production, environmental risks and best management practices.

Proposed recommendations will match the best price and form of nutrient to meet the requirements for each Land Management Unit.

Proposed recommendations can then be revised after conducting a nutrient budget.

Nutrient budget

A Nutrient Budget compares overall nutrient inputs to nutrient outputs for a given level of production. It helps to identify production or environmental issues arising from nutrient excesses or deficiencies, and so is a useful way to evaluate a nutrient recommendation and make adjustments before it is implemented.

OVERSEER® nutrient budget model is based on detailed research under New Zealand conditions and is a valuable tool for conducting nutrient budgets.

The nutrient budget allows different nutrient management scenarios to be compared before finalising a nutrient recommendation.

Best management practices

Following 'Best Management Practices' as set out in the Code will minimise waste, improve responses and address legal, social and environmental requirements.

Consider:

- Council regulations
- Staff training
- Transport
- Storage
- Handling
- Product choice
- Application technique
- Timing
- Environmental losses
- Third party effects
- Record keeping

Monitoring

Effective nutrient management requires adjustments and improvements in response to measured outcomes.

- Were production results achieved?
- Did soil/herbage nutrient levels change as expected?
- Were environmental risks avoided/mitigated as expected?

This information is incorporated into ongoing nutrient management evaluation, planning and recommendations.

For more information see: Your Fertiliser Sales Representative
Your Regional Council Land Management Officer
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Nutrient Management Plans

Introduction

Fertiliser applications are the largest discretionary expense for many farming businesses – but they are not the only source of nutrients on the farm.

Efficient, productive and profitable farming requires skilled management of all the resources available.

The Nutrient Management Plan is a valuable tool to help identify nutrient resources and their interactions. It describes how these resources will be managed to improve farm profitability and provide acceptable environmental accountability.

Nutrient management does not stop at fertiliser

Nutrient cycling is influenced by many things, some of which have a greater impact on the effects of nutrients than the fertiliser application.

Consider:

- Topography
- Soil types
- Product removed from the property
- Leaching losses
- Effects of cover crops, legumes, fallow fields
- Soil erosion losses
- Livestock stocking rates
- Feed brought onto the property
- Feeds, product and nutrient transferred within the property (effluent, cut and carry, feed supplements, stock camps, surface and sub-surface drainage water)

Components of the nutrient management plan include:

- Long term personal and farming goals
- Regional Council requirements
- Identified Land Management Units
- Production and Monitoring Records (for each Land Management Unit)
- Annual/Seasonal Nutrient Budget
- Nutrient Recommendations
- Best Management Practices
- Irrigation Management Factors
- Effluent Management Factors
- Measures of Environmental Risks and Impacts
- Steps which Mitigate Environmental Impact
- Annual Review of Goals, Procedures and Achievements

A good business will plan for the responsible and efficient use of nutrient resources.

For more information see: Your Fertiliser Sales Representative
Your Regional Council Land Management Officer
Dexcel (www.dexcel.co.nz)
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Fertiliser Use – Potential Impact on Surface and Ground Water

Introduction

Nutrients come from a wide range of sources, not just from fertiliser.

Excess nutrient can cause health risks with drinking water, and eutrophication of fresh waterways and lakes. The World Health Organisation recommends drinking water should contain no more than 11.3mg of nitrate nitrogen per litre.

(For livestock; the recommended maximum is 40mg of nitrate nitrogen/litre of water for cattle and 60mg/litre of water for sheep.)

However, to promote algal growth in freshwater streams and lakes, it only takes around 0.015–0.030mg of dissolved reactive phosphate and 0.040–0.1mg ammonium and nitrate nitrogen per litre of water.

Just like crops, algae and other water plants require nutrients. With increased nitrogen and phosphorus in waterways they can respond quickly to favourable growing conditions, and choke streams and reduce water quality – sometimes with the potential for serious consequences to livestock and natural fauna and flora.

Safe drinking water, and reduction in algal blooms and choking weed growth can be avoided or mitigated with sensible practices in the application of nutrients in farming systems.

Preventing nutrients from reaching surface water

Nitrogen and phosphate nutrients:

- Avoid direct applications to waterways (make allowances for wind, or runoff on steep terrain near waterways)
- Avoid surface runoff due to spreading nutrients before heavy irrigation or anticipated high rainfall events
- Carefully match nutrient application to crop requirements
- Prevent soil erosion, or soil pugging by livestock (particulate matter washed into streams can be a source of nutrient contamination, especially for phosphorus)
- Avoid discharge of effluent near waterways or onto mole and tile drain areas at times when soils are near saturation or when drains are flowing
- Where possible, drain to wetlands or riparian/filter strips, not to open water
- Keep livestock out of streams and waterways to reduce nutrient and faecal contamination
- Control runoff from stock races, directing it away from open water
- Place fertiliser storage and loading sites more than 50 metres from open water.

Preventing nutrients from reaching ground water

Nitrogen and Phosphorus

Usually nitrogen is far more soluble than phosphorus, and is the more likely of the two nutrients to contaminate groundwater.

The exception: phosphorus from soluble P fertiliser or dairy effluent is most mobile soon after it is applied, prior to it being taken up by plants or bound to soil particles and organic matter. This is an important consideration – especially in coarse, sandy soils with low organic matter content.

- Carefully match nitrogen applications to plant requirements (account for all sources of nitrogen eg, effluent, mineralised organic matter from a newly ploughed field, or nitrogen fixed by legumes)
- Avoid nutrient applications prior to heavy irrigation or anticipated high rainfall events (the more water flowing through the soil profile the greater the leaching potential)
- Carefully schedule irrigation, to meet plant requirements (excessive irrigation will leach valuable nutrients)
- Avoid effluent or fertiliser applications to saturated soils
- Increasing stocking rates increases excreta and therefore nitrogen deposited as urine and dung. To manage this:
  - take account of effluent as a nutrient source
  - use nutrient budgets to estimate nutrient inputs (from all sources)
  - use nitrification inhibitors to retain localised high nitrogen deposits associated with urine and effluent
- Use cover crops in winter (a newly ploughed field will release nitrogen as organic matter is mineralised – if there is no crop to utilise released nitrogen it is at risk of leaching under winter rainfall)
- For horticultural applications, band fertiliser close to plant roots, carefully matching plant requirements (this reduces nutrient leaching losses between rows, prior to root development into the inter-row space)
- Split applications – little and often will more closely match plant requirements
- For broadcast application, ensure good calibration and even application of nutrients at rates matching plant requirements
- Use Fertmark and Spreadmark accreditation to ensure consistent products and reliable applications
- Use nutrient budgets and nutrient management plans, to fine-tune your farming systems, minimise waste and maximise response to nutrients.

For more information see: Your Fertiliser Sales Representative
Your Regional Council Land Management Officer
Dexcel (www.dexcel.co.nz)
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Impact of Fertiliser on Greenhouse Gas Emissions

Introduction

Greenhouse gases are any atmospheric gases which help to trap heat within the Earth's atmosphere, and therefore contribute to global warming.

Carbon Dioxide, Methane and Nitrous Oxide are naturally occurring greenhouse gases that are increased through industrialisation, agricultural intensification and other human activities.

Global warming	1 unit Methane	=	21 equivalents of Carbon Dioxide
	1 unit Nitrous Oxide	=	310 equivalents of Carbon Dioxide

Methane and nitrous oxide are potent greenhouse gases which together are estimated to make up about 49% of New Zealand's greenhouse gas emissions.*

Methane

Microbial activity in the rumen of sheep and cattle produces methane, which is lost to the atmosphere through belching. It is also estimated that ruminant livestock account for 97% of New Zealand's agricultural methane emissions, and 88% of New Zealand's total methane production.*

Fertiliser use promotes increased pasture production and intensification of pastoral land use and therefore greater numbers of animals producing methane, per unit area.

Nitrous oxide

Nitrous oxide is produced as a natural by-product of the nitrogen cycle, when nitrogen, principally from urine patches but also from nitrogen fertiliser, is converted by a series of reactions into nitrate, and also when nitrate is converted back to safe, inert nitrogen gas.

Nitrous oxide production varies and is influenced by the oxygen levels available during the nitrogen cycling processes.

To reduce losses as nitrous oxide:

- Use nitrification inhibitors – not only do they help retain nitrogen in soil for plant uptake; they greatly reduce the nitrous oxide production from urine patches
- Avoid application of nitrogen to saturated soil conditions
- Avoid heavy pugging, which reduces aeration in soil
- Apply nitrogen fertilisers only when the 9am soil temperature is 6ºC or warmer (at 10cm depth). This is when microbial conversion to nitrate is more rapid, and plant uptake is more effective
- Keep soils at desirable pH – raising pH reduces nitrous oxide emissions.

* *Ministry for the Environment (2006): New Zealand Greenhouse Gas Inventory 1990–2004. The National Inventory Report and Common Reporting Format. Wellington.*

For more information see:

AgResearch (www.agresearch.co.nz)
Fert Research (www.fertresearch.org.nz)
Dexcel (www.dexcel.co.nz)
Pastoral Greenhouse Gas Research Consortium (www.pggrc.co.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Nitrification Inhibitors

Introduction

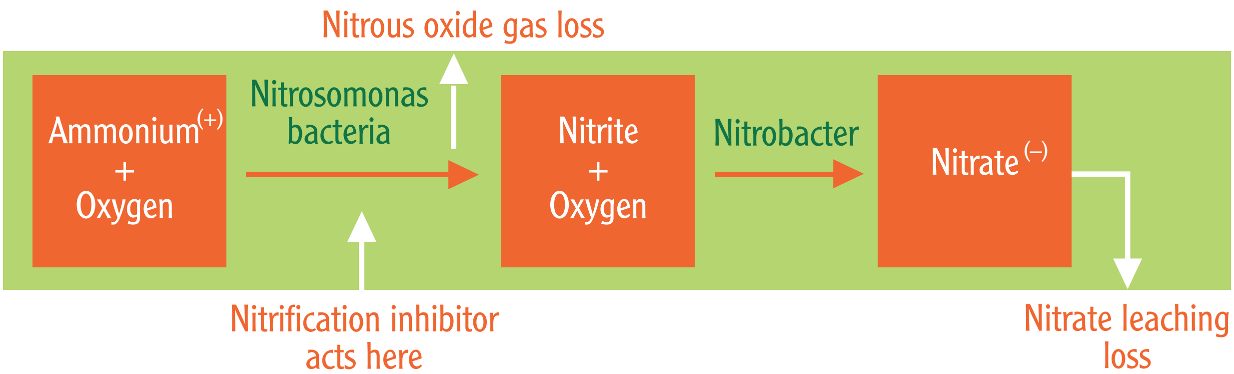
Nitrification inhibitors are a valuable means of reducing nitrogen losses associated with livestock management, and for retaining nitrogen for longer in the soil, thereby contributing to increased plant uptake.

The nitrogen compounds deposited in urine of livestock can provide nitrogen at levels equivalent to as much as 1000 kg N/ha, over the area of the urine patch. This is far more nitrogen than the pasture can utilise, and with intensive farming systems (particularly dairying) livestock can contribute to significant nitrogen losses when this excess nitrogen is leached as nitrate to ground water, or lost to the atmosphere as nitrous oxide, a greenhouse gas, especially during winter.

Nitrification inhibitors used at the appropriate times are known to reduce these environmental losses and retain nitrogen within the soil profile over a longer period.

How it works

Under aerobic conditions, nitrogen compounds in the soil are converted, by bacteria, to nitrates. This includes the conversion of ammonium to nitrate, with the release of nitrous oxide.



Only ammonium and nitrate are readily taken up by plant roots. Ammonium (with its +ve charge) is held on soil particles more efficiently, and nitrate (with its –ve charge) is more easily leached under higher rainfall or irrigation, particularly if it is present in much greater quantities than plants can use.

Using nitrification inhibitors to slow down the conversion of ammonium to nitrate, means more nitrogen is retained as ammonium. It can be used by plants, and being positively charged, is not so readily leached as the nitrate. By slowing down the production and concentration of nitrate, the amount of nitrogen diverted to greenhouse gas (nitrous oxide) production is also reduced.

Nitrification inhibitors work across a wide range of New Zealand soils. Their relative effectiveness will vary depending on the temperature, drainage, aeration, and nutrient holding characteristics of the soils.

Applied at the correct time and location, nitrification inhibitors can greatly reduce nitrogen leaching and greenhouse gas losses from urine deposits. They reduce environmental impacts and make more nitrogen available for plant growth.

Aerobic = *in the presence of oxygen*
Anaerobic = *absence of oxygen*

For more information see: Your Fertiliser Sales Representative
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)
Pastoral Greenhouse Gas Research Consortium (www.pggrc.co.nz)

Fertiliser Cadmium & Fluoride

Introduction

Fertilisers are manufactured from natural raw materials, using industrial chemical processes. One of the raw materials for the manufacture of phosphate fertilisers is phosphate rock. In its natural state it contains low levels of heavy metal minerals and also fluoride. The exact amounts will vary depending on where the rock originates from.

Due to practical constraints and no commercially viable way to remove these elements from the rock during the manufacture of fertilisers, these naturally occurring impurities are also present in the finished product.

Over a prolonged period of time with regular applications of fertiliser to land, some of the impurities within the fertiliser will gradually accumulate in the soil.

Accumulation process

Accumulation will only occur if the amount applied is greater than the amount removed, or transferred. Essential nutrients like nitrogen, phosphorus, and potassium are removed by the growth and removal of the produce from the land. They are also transferred in large amounts by natural processes – so fertiliser must be reapplied as required, to replace the loss.

Some of the impurities are not readily taken up by plants or animals, and are not easily transferred – therefore are prone to gradual accumulation as a result of long-term application of fertiliser. These include fluoride, cadmium, lead, arsenic, uranium, and chromium.

Concentrations of impurities in fertiliser are very low and so the rate of accumulation is slow. Despite many years of fertiliser use, the levels of impurities in New Zealand soils are still low by world standards.

Research in New Zealand and overseas has investigated the nature of accumulation in soil of these naturally occurring impurities of phosphate rocks.

Of these, only cadmium and fluoride have been identified as requiring a management programme for specific circumstances, ie, where localised accumulation may be occurring due to prolonged high rates of fertiliser application or where natural background levels may be elevated due to volcanic depositions.

By implementing appropriate strategies the rates of accumulation can be reduced to a level which ensures a robust safety margin for future human health.

It is recommended that in consultation with fertiliser advisors, consideration is given to implementing the following strategies for the on farm management of fluoride and cadmium.

Cadmium

A voluntary scheme restricts the cadmium content in phosphate fertilisers to less than 280mg cadmium per kg of phosphorus in New Zealand. Away from industrial areas, phosphate fertiliser remains the main source of a very gradual accumulation of cadmium in soils. If there is uptake of these low levels of cadmium by plants, a small portion of ingested cadmium may be absorbed and accumulate in the kidneys and livers of animals and humans.

The 2003/2004 New Zealand Total Diet Survey shows the estimated weekly dietary exposure to cadmium (in representative foods) is well below the Provisional Tolerable Weekly Intake as set by the World Health Organization. Oysters are the largest source of cadmium in the diet, followed by potatoes, bread, mussels, carrots and wheat biscuits.

Over the lifetime of an animal, cadmium will accumulate with concentrations greatest in the kidneys of aged stock.

The following recommendations for the use of phosphate fertilisers will give confidence that cadmium accumulation in soils is kept to a minimum, and to reduce its uptake into edible plant parts.

Recommended practices to reduce cadmium uptake into food crops:

1. Measure cadmium level in soils and in edible plant parts (using an accredited laboratory)
2. Use phosphate fertilisers with lower levels of cadmium
3. Use crop varieties which demonstrate a lower risk of cadmium uptake
4. Avoid fertiliser blends and irrigation water containing high levels of chloride
5. Maintain soil pH at the upper recommended limits for crop type
6. Maintain high organic matter in soil
7. Alleviate any zinc deficiency in the crop
8. Avoid fertilisers which cause localised acidifying effects
9. Phosphate fertiliser applications should be banded, (and not broadcast) where possible.

Considerations relating to these recommendations in New Zealand

1. It is only the cadmium level in edible plant parts that are of concern, and cadmium levels in plants bear no direct relation to soil cadmium levels.
2. Cadmium levels in fertiliser are highly variable. (eg, measured range for DAP is 5–150mg Cd/kg P). Also commodity prices may limit options for the choice of fertiliser.
3. Risk levels for specific crop varieties are unknown, yet they can have an overriding effect relative to all other factors. Australian studies have identified high, medium and low risk potato varieties, but many are different to those grown in New Zealand. Influence of variety on cadmium uptake by other vegetables and arable crops is not known. Only wheat varieties have been examined in New Zealand.
4. Australian and US studies show chloride has a strong influence on uptake of cadmium in potato tubers. Avoiding blends with potassium chloride fertiliser provides an opportunity to reduce the influence of chloride in New Zealand. (Although irrigation and soil-borne chloride is less important in New Zealand than it is in Australia, by changing from potassium chloride to potassium sulphate on low chloride soils in Australia, the cadmium levels in potato tubers decreased by as much as 30%).
5. Several trials show conflicting evidence on the effect of pH,[1] but there is clear evidence that the phyto-availability of cadmium is significantly higher under acidic conditions.
6. Sandy, acid soils are likely to result in a higher cadmium uptake by plants. Cadmium is known to bind to clay and organic matter, thereby reducing its availability for plant uptake. However, it is difficult to raise organic matter levels in soils used for field vegetable production.
7. Ensure soils have adequate zinc content. Banding zinc sulphate at high levels (higher than normally used for correction of deficiency) has significantly reduced the cadmium concentration in potato tubers at some trial sites.[2] However, because cadmium has a similar chemical structure and is found in association with zinc, it may be prudent to ensure zinc fertiliser applications have acceptably low cadmium levels.
8. Acidifying fertilisers such as those containing ammonium are known to have localised acidifying effects which may increase uptake of cadmium. Researchers noted the unexpected observation that CAN, the least acidifying of ammonium fertilisers, resulted in higher cadmium uptake than ammonium sulphate.[3]
9. Banding of fertilisers provides a higher localised concentration of both desirable nutrient and contaminants, increasing the risk of associated plant uptake, but it also allows for lower application per hectare, and an opportunity for dilution of contaminants by mixing soil, to provide a slower accumulation in the soil over the long term.

References

1. *Grant,C.A., Bailey, L.D. et.al. (1999) 'Management Factors which Influence Cadmium Concentrations in Crops – A Review' p175, in "Cadmium in Soils and Plants " Edited by M.J. McLaughlin, and B.R. Singh, Kluwer Academic Publishers.*
2. *"Managing Cadmium in Potatoes for Quality Production" 2nd Edition, (June 1999) Cooperative Research Centre for Soil & Land Management and CSIRO Land and Water. www.cadmium-management.org.au*
3. *Maier et al., (2002), "Effect of nitrogen source and calcitic lime on soil pH and potato yield, leaf chemical composition, and tuber cadmium concentrations.", J. Plant Nutr. 2002, 25 p523–44*

Fluoride

Fluoride is a natural compound present in soils, plants and animals and is assumed to be essential for life.

Fluoride occurs naturally in phosphate rock and so is present in phosphate-containing fertilisers.

Excessive fluoride intake can lead to a condition called Fluorosis (sometimes referred to as "phosphate poisoning") which in severe cases has caused animal deaths.

Livestock which ingest phosphate fertiliser are at risk of fluoride poisoning – to avoid 'acute fluorosis' it is recommended that stock are not grazed on pastures which have received phosphate fertilisers for 21 days or until 25mm rain has fallen.

Volcanic ash deposits onto pasture following a volcanic eruption are also high in fluoride, so once more, grazing by livestock should be avoided until the ash has been washed into the soil.

There is very little uptake of fluoride by plants and it is relatively immobile in soil, therefore with long term, repeated applications of fertilisers which contain fluoride, the fluoride will gradually accumulate in the soil. The rate of accumulation will depend on the type of fertiliser and how heavily it is applied over the long term.

Fluoride is not a threat to human health because it is not taken up by plants, but excessive soil accumulation of fluoride presents a small risk to grazing animals due to soil ingestion.

Fluoride regularly ingested (as with soil ingestion) over a period of time can build up in the bones and cause 'chronic fluorosis' which is characterised by bone abnormalities and loss of production.

Soil ingestion by livestock tends to be higher in winter when pasture cover is lower.

There is no evidence that current levels of fluoride intake through ingestion of soil by livestock in New Zealand are a problem, however steps can still be taken to reduce fluoride uptake.

Reducing the risk of fluoride to grazing animals

- To avoid 'acute fluorosis' it is recommended that stock are not grazed on pastures which have received phosphate fertilisers for 21 days or until 25mm rain has fallen
- Reduce soil ingestion by maintaining good pasture cover during winter and/or bringing in feed supplements as required
- During pasture renovation, deep plough land which is identified as having high fluoride in the top soil layer. This effectively dilutes the fluoride, by mixing it with soil below the surface layer. Otherwise, fluoride accumulates only in the surface and does not migrate through the soil profile.

Acute fluorosis = *Severe fluorosis which appears suddenly due to a very high intake of fluoride over a short period of time.*

Chronic fluorosis = *Fluorosis which develops only after the long-term continuous ingestion of relatively small amounts of fluoride.*

For more information see: Your Fertiliser Sales Representative
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Phosphate Fertiliser Considerations

Introduction

Almost all of New Zealand soils are naturally deficient in phosphorus, and it remains an essential ingredient for successful farming.

To achieve optimum profitability and to avoid or minimise any adverse effects, it is important to give careful consideration to product choice and conditions surrounding the application of phosphorus fertiliser.

Production considerations

Different enterprises require a different balance between an immediate boost in available phosphorus, and steady long term availability through maintaining optimum soil levels.

Soil reserves can be built up – traditionally this is considered as being like 'money in the bank'– except that excessive levels of soil phosphorus are fiscally wasteful, offer no benefits and can contribute to environmental problems.

The current farming enterprise and soil history will determine the balance required between long term slowly available phosphorus and rapidly available soluble phosphorus which is required to meet immediate plant growth demands.

Animal health considerations

Phosphate rock in its natural state contains fluoride. Therefore, fertilisers such as superphosphate and RPR also contain fluoride. If ingested directly by livestock, livestock can suffer from what is known as "phosphate poisoning" which in severe cases can cause death. This is actually fluoride poisoning.

To avoid 'acute fluorosis' it is recommended that stock are not grazed on pastures which have received phosphate fertilisers for 21 days or until 25mm rain has fallen.

Environmental considerations

Phosphorus in waterways – even at very low concentrations – is a major contributing cause of eutrophication of streams and the resulting algal blooms.

Following applications of superphosphate, it can be up to 50–100 days before applied phosphorus appears to reach an equilibrium in adsorption to soil particles. In most soils, phosphorus is strongly bound to soil particles and organic matter, particularly in the surface layers.

Eroded soil particles carrying phosphorus and also runoff carrying soluble forms of phosphorus which are released after recent application of fertiliser (or effluent application) can pose an environmental risk leading to eutrophication of waterways.

Fertilisers derived from phosphate rock will contain naturally occurring heavy metals such as cadmium. Consider if a cadmium minimisation strategy is required for your particular soil cadmium levels and land use.

The choice of fertiliser and circumstances of fertiliser applications can affect production response, animal health and level of environmental risk.

Choosing the correct phosphate product

Advantages of readily soluble forms:

- Immediate availability for plant uptake, and rapid growth response (eg, establishment of vegetable seedlings)
- After 50–100 days even soluble phosphorus becomes 'bound' to soil and organic matter, and then is not readily lost through leaching
- Do not require soil pH <6 and 800mm annual rainfall to ensure solubility

Examples of the more common forms of soluble phosphorus fertilisers include; superphosphate, triple superphosphate, sulphur super, MAP, DAP and compound fertiliser formulations.

Advantages of slower release forms:

- Rate of nutrient release is determined by both RPR properties and soil factors
- Reduced risk of phosphorus losses through runoff and/or leaching during the first 0–50 days after application.

Examples of common phosphate fertilisers with lower solubility include; Reactive Phosphate Rock and partially acidulated Reactive Phosphate Rock.

Environmental considerations during application

- Target appropriate soil P levels for your soil type and land use.
- Avoid build-up of excessive soil phosphorus levels. It has a negative impact on the environment when high P levels in eroded soil sediment reach waterways.
- Avoid soluble P application near streams or onto saturated soil – where soluble P can be carried in runoff or leachate – especially where tile or mole drains operate.
- Do not allow fertiliser particles to be applied directly to water or to subsequently wash into open waterways.
- Provide riparian strips adjacent to waterways – the correct width will depend on soil type, and topography, (wider on steep terrain) to reduce the risk of fertiliser and soil particles being carried into waterways.
- Use wetlands to trap sediment and nutrient.

For more information see: Your Fertiliser Sales Representative
Regional Council Land Management Officer
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Quality Assurance Programmes

Introduction

Quality assurance schemes play a role in ensuring ready market access through strengthening consumer confidence.

Quality assurance schemes demand a well structured framework of records and systems which demonstrate desirable farming practices as measured against established standards.

The Fert Research Code of Practice for Nutrient Management enables fertiliser users to employ practices specific to their situation (farm, orchard, forest) while assisting to fulfil obligations under the Resource Management Act.

In so doing, the Code also provides an audit method which helps the land manager meet quality assurance requirements.

Many rural industry groups and even retail marketing groups operate quality assurance schemes specific to their product or their brand.

Examples of broad-based quality assurance schemes

New Zealand GAP is the name given to the New Zealand Fresh Produce Approved Supplier Programme. It is based on Good Agricultural Practice, and has been successfully benchmarked to the world retail association scheme known as Global Food Safety Initiative (GFSI) and also the European scheme known as EurepGAP. These are broad base quality assurance schemes and demonstrating Good Agricultural Practice promotes access of New Zealand produce into overseas markets.

For example, EurepGAP benchmarking requires a system for recording details of management decisions and actions relating to fertiliser, under general headings:

- Advice on the choice of fertiliser type and quantity
- Records of application
- Application machinery
- Fertiliser storage
- Organic fertiliser
- Irrigation/fertigation
- Soil mapping
- Cultivation
- Soil erosion

The Fert Research Code of Practice for Nutrient Management helps fertiliser advisors (and land managers) operate effectively and efficiently with sound business decisions. It also helps provide a framework for record keeping, which can be used in the participation of quality assurance programmes.

For more information see:
Horticulture New Zealand (www.hortnz.co.nz)
New Zealand GAP (www.newzealandgap.co.nz)
EurepGAP (www.eurepgap.org)
Fert Research (www.fertresearch.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)