# Nutrient Management

## Code of Practice

Version 2.0 | JUNE 2026

# Nutrient Management Code of Practice

**Version 2.0 | June 2026**

Document control

| Role | Name | Organisation | Date |
|---|---|---|---|
| Prepared by | Andrew Barber and Sarah Dobson | Agrilink New Zealand | April 2025 |
| Reviewed by | Ailsa Robertson | Horticulture New Zealand | July 2025 |
| Approved by | Kate Scott | Horticulture New Zealand | March 2026 |

Summary of review changes since previous version (2014 - v1.1)

| Change | Reference |
|---|---|
| Structure change | Whole document |
| Addition of risk assessments | Section 4 |
| Addition of nutrient risk groups, and minimum and additional management practices | Section 5 |
| Addition of Nutrient and Erosion Management workbook | Appendix A |

This Code of Practice will be reviewed, as necessary, by Horticulture New Zealand Incorporated. Suggestions for alterations, deletions or additions to this Code of Practice, should be sent, together with reasons for the change, any relevant data and contact details of the person making the suggestion to info@hortnz.co.nz.



**Acknowledgements:** Horticulture New Zealand and Agrilink New Zealand would like to acknowledge the valuable time, expertise, and input provided by the technical working group who supported the development of this Code of Practice, including Claire Graeme (HortNZ), Damien Farrelly (NZGAP), Greg Sneath (Fertiliser Association), Col Gray (Ravensdown), Will Talbot (Ravensdown), Mike Nelson (Fruition Horticulture), Roger Blyth (Seed & Field), Luke Posthuma (Grow Maps / kūmara grower), Carl O'Brien (AgFirst), Raymond Williams and Warwick Catto (Ballance Agri-Nutrients). Many thanks also to the growers who tested early versions of this Code and workbook and provided feedback.

**Citation:** Barber, A., Dobson, S., & Robertson, A. (2026). *Nutrient Management Code of Practice*. Version 2. Horticulture New Zealand. https://www.hortnz.co.nz/compliance/grower-resources/codes-of-practice

AGRILINK

# CONTENTS

# 1 Code of Practice overview

## 1.1 Introduction, purpose and scope

This Code of Practice is intended to be used by outdoor vegetable and fruit growers. It is a guide to support the development and review phases of a Nutrient Management Plan as part of an operation's farm or orchard plan. It collates evidence-based research and thinking on nutrient management for horticultural production, and steps through nutrient risk assessments and management practices using a workbook template, to support grower decision-making and implementation of management practices.

It is important that principles of nutrient management are considered and addressed responsibly in each stage of production. There is no 'one size fits all'. Decisions and actions taken will vary between operations and growing locations. Variables, including climate, soil properties, the previous crop, crop residues, soil nutrient status and irrigation management can impact production. Getting the right mix of macro and micro-nutrients for a crop is critical, as is understanding how excess nutrients can impact the environment.

Excess nutrients can reach waterways and affect water quality and aquatic life. Nitrogen lost from the crop rooting zone via soil drainage can enter groundwater and surface water. The use of nitrogen inputs can also lead to nitrous oxide ($N_2O$) emissions to the atmosphere. Phosphorus attached to sediment can be lost during erosion and sediment loss events, particularly on cropping operations, which can reach surface water. This Code of Practice signposts to the Erosion and Sediment Control Code of Practice, which contains risk-based practices for managing erosion and therefore phosphorus loss.

Managing nutrients is crucial to the sustainable production of high-quality fruit and vegetables. Today, consumers and regulators want to know that growers are implementing practices to manage environmental risks from their operation. So, it is in the grower's interest to understand the risks of nutrient losses and how they can best manage them.

## 1.2 How to use this Code of Practice

The Code starts with catchment context. It places the need for these efforts in the context of the local environment. It provides background information about nutrient use and how losses occur. It then steps through how to determine an operation's block-level risk for nitrogen and phosphorus loss. Based on the level of risk, growers then identify nutrient risk groups and associated practices to manage their risk over time.

In some cases, management practices to address nutrient loss risk may require the installation of permanent features (e.g. riparian borders) or physical works. In the case of leased and swapped blocks, implementing these practices may require a conversation with the landowner. It is recommended that lessees engage with their landowner(s) early in the process to discuss the benefits and explore practical solutions that meet both parties' needs. In some cases, these expectations may form part of lease agreements.

Nutrient management planning is the vehicle for sustainable nutrient use in operations. Growers can use this Code of Practice to complete and update their nutrient management plan. The plan (and workbook template in Appendix A) includes the following key elements:

- Risk assessments for nitrogen and phosphorus loss
- Identification of practices to manage the use of nutrients and risk of environmental losses
- Evidence and records to show progress
- An action plan to illustrate commitment to continuous improvement.

To note, the risk assessments used in this Code are not an assessment of nitrogen leaching loss or an assessment of environmental effects.

**Figure 1.1** sets out how farm planning, nutrient risk assessments, and on-farm/orchard actions, fit together.

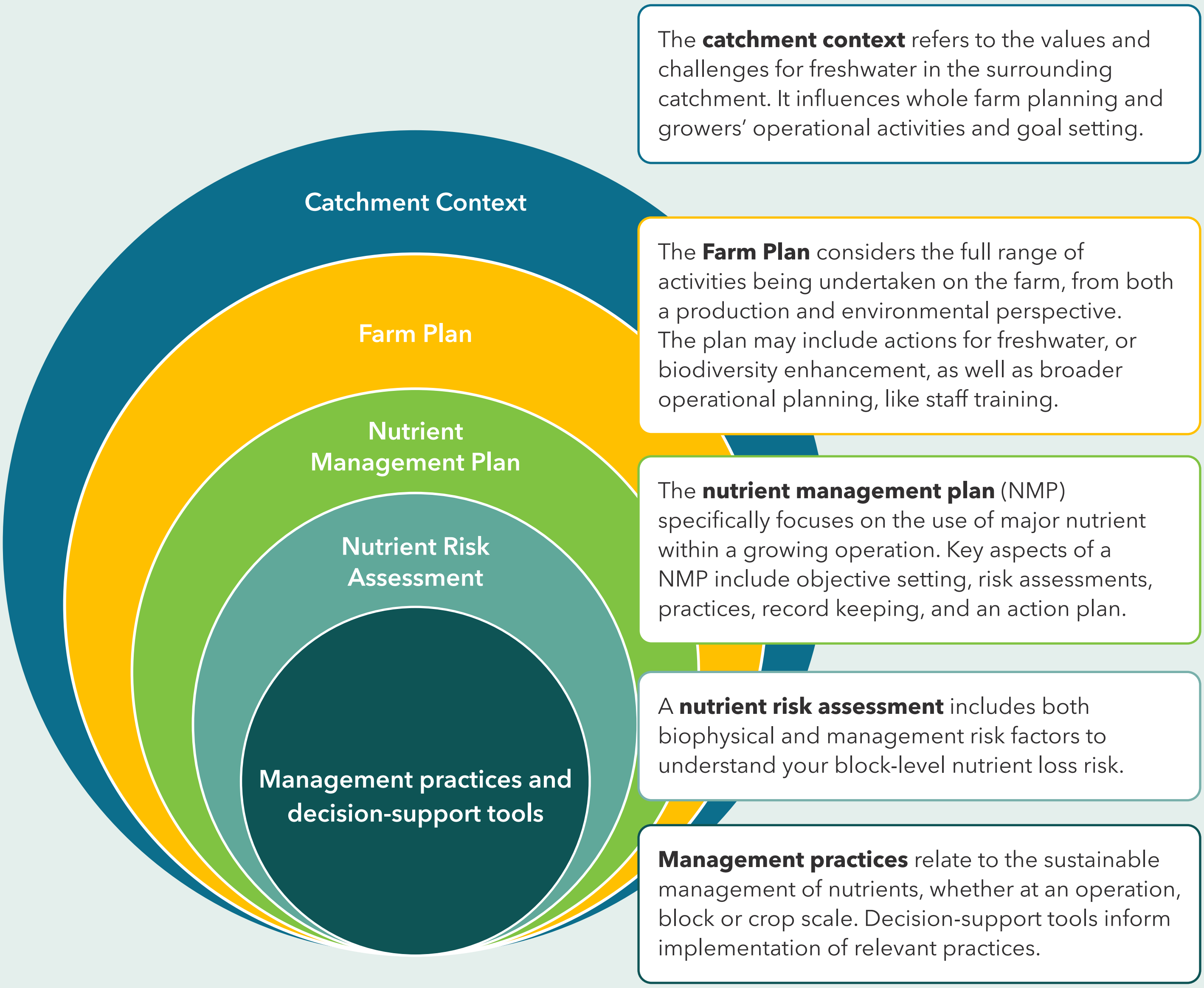
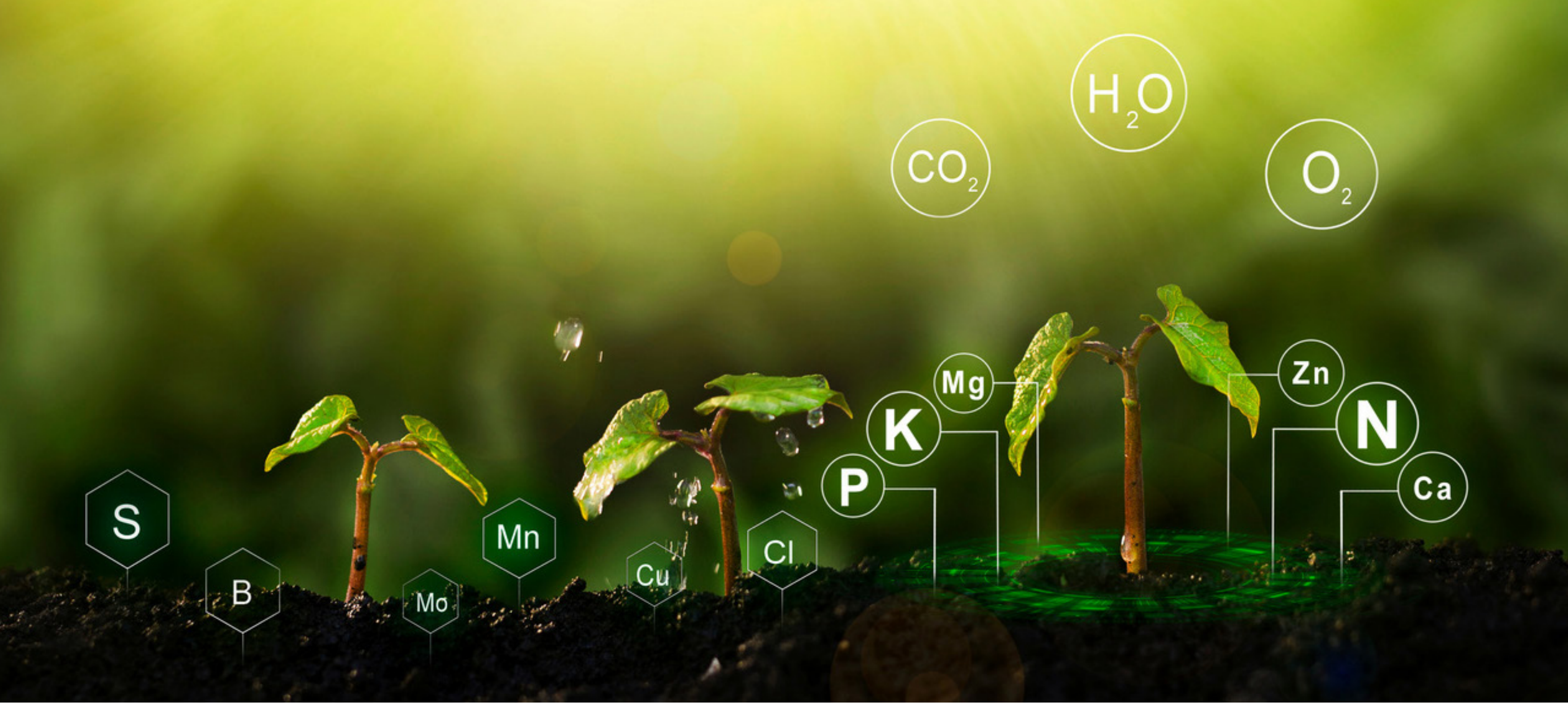



**Figure 1.1:** Nutrient management planning within a wider farm/orchard context. Adapted from Edmeades et al. (2011)[1] and Foundation for Arable Research[2].

---

[1] Edmeades, D. C., Robson, M., & Dewes, A. (2011). Setting the standard for nutrient management plans. https://flrc.massey.ac.nz/workshops/11/Manuscripts/Edmeades_2011.pdf

[2] https://www.far.org.nz/resources/far-focus-6-nutrient-management-plans.




## 1.3 Catchment context

Growers need to consider the catchment's context in their freshwater farm plan. Regional Councils are responsible for collating and writing catchment context information for growers and other land users to refer to.

The catchment context can impact on a grower's nutrient management plan. Catchment context refers to information about what's important in your local freshwater area – like its natural features, how people use the water, and water quality challenges from activities like farming[3].

Catchments can be sensitive or vulnerable to degradation. Regional councils may require growers in these catchments to have specific or extra nutrient management practices in their farm plan.

There is a need for Council driven catchment-scale solutions to manage water quality alongside farm-scale actions. In some catchments, for example, with significantly modified drainage and landforms, councils should be responsible for a catchment plan.

Requirements from councils for growers may include the following:

1. Awareness of catchment context, regional vision, regulatory requirements and any non-regulatory catchment plans. Regional Councils are responsible for making this information available.
2. Setting of short, medium, and long-term objectives in their farm plan (i.e. objectives related to the environmental impact of land-use activities on surrounding waterbodies).
3. Progress towards practices, with timeframes set for actions to be undertaken.

Farm plans may also include non-regulatory, collective actions that contribute to improved water quality outcomes at a catchment scale. See Section 5.2.1 for catchment scale actions.

While these actions may extend beyond the farm gate, they reflect a proactive and collaborative approach to freshwater management that complements individual on-farm practices. Recognising and documenting such efforts in farm plans demonstrates a commitment to broader environmental outcomes and alignment with community-led freshwater improvement goals.

[3] https://www.horizons.govt.nz/managing-natural-resources/our-freshwater-future/freshwater-farm-plans/catchment-context,-challenges-and-values.

## 1.4 Farm Plan

A farm plan contains important information about your operation, and how you identify, assess, and manage risks. Most growers have integrated Good Agricultural Practice (GAP) farm plans. GAP farm plan standards integrate risk management across food safety, environment, and employment law.

Farm planning drives outcomes for both growing operations and the environment. The New Zealand Good Agricultural Practice (NZGAP) Environment Management System (EMS) add-on is designed as a farm planning pathway for growers to demonstrate environmental performance and meet regulatory requirements to manage impacts to freshwater. It covers property mapping, soil and nutrients, water, and biodiversity, and mahinga kai.

The Freshwater Farm Plan Regulations, under Part 9A of the Resource Management Act 1991, apply nationally and focus on addressing adverse effects from agriculture on freshwater. Freshwater farm plans contain farm maps, risk assessments, action planning, and records. Collectively, freshwater farm plans support regional councils' plans to achieve catchment water quality outcomes.

This Code of Practice supports growers to develop a Nutrient Management Plan. Section 1.5 below introduces nutrient management planning, and how this Code of Practice supports growers to build and maintain a plan for their operation, as part of their overall farm plan.

## 1.5 Nutrient Management Plan

A Nutrient Management Plan (NMP) outlines how nutrients, in particular nitrogen and phosphorus, are managed on a horticultural operation to minimise environmental losses. An NMP forms part of the overall farm/orchard plan and ties specific practices to an assessed level of risk. NMPs are living documents that evolve with new knowledge, practices, tools, and regulatory requirements.

Once risk levels for nitrogen and phosphorus are assessed, practices proportionate to the level of risk can be applied. Each NMP is tailored to the farm or orchard, and reviewed annually to reflect changing conditions, so that the plan stays relevant and practical. NMPs include flexibility to manage uncertainty, such as extreme weather resulting in unexpected nutrient losses. Using this approach, nutrients are used efficiently, and environmental risks are minimised as much as practicable.

A well-communicated NMP supports production performance, market assurance programmes, and regulatory compliance. This Code of Practice helps growers develop comprehensive NMPs that meet minimum expected industry practice, and supports growers to address regulatory requirements. Knowing what rules apply to your farm or orchard helps build a plan that can both demonstrate compliance and become an asset to your business, to help achieve other goals, relating to finance, overall productivity, or soil health.

The 4Rs—Right Product, Right Rate, Right Time, Right Place—form the foundation of effective nutrient management planning. It is an evidence-based approach to keeping nutrients in the field for optimal plant growth and minimising losses to the environment. Applying the 4Rs makes nutrient decisions more strategic.

Criteria for a strong NMP includes:

- **Clear goals and objectives** including production and environmental goals
- **List of blocks and crops** of commercial horticultural production
- **Risk assessment results** for nitrogen and phosphorus (Section 4)
- **Practices and tools** to improve nutrient use and minimise nutrient losses (Sections 5 and 6 and Appendix A)
- **Alignment with other management areas,** for example irrigation management, and erosion and sediment control in your wider farm or orchard plan
- **Comprehensive records** of practices, for example, maps, soil test results, fertiliser recommendations
- **Action plan** of all actions, responsibilities and timeframes (Appendix A)
- **Review process** to track and adapt over time.

Figure 1.2 illustrates the steps to build and update a NMP using this Code of Practice and the workbook template in Appendix A.

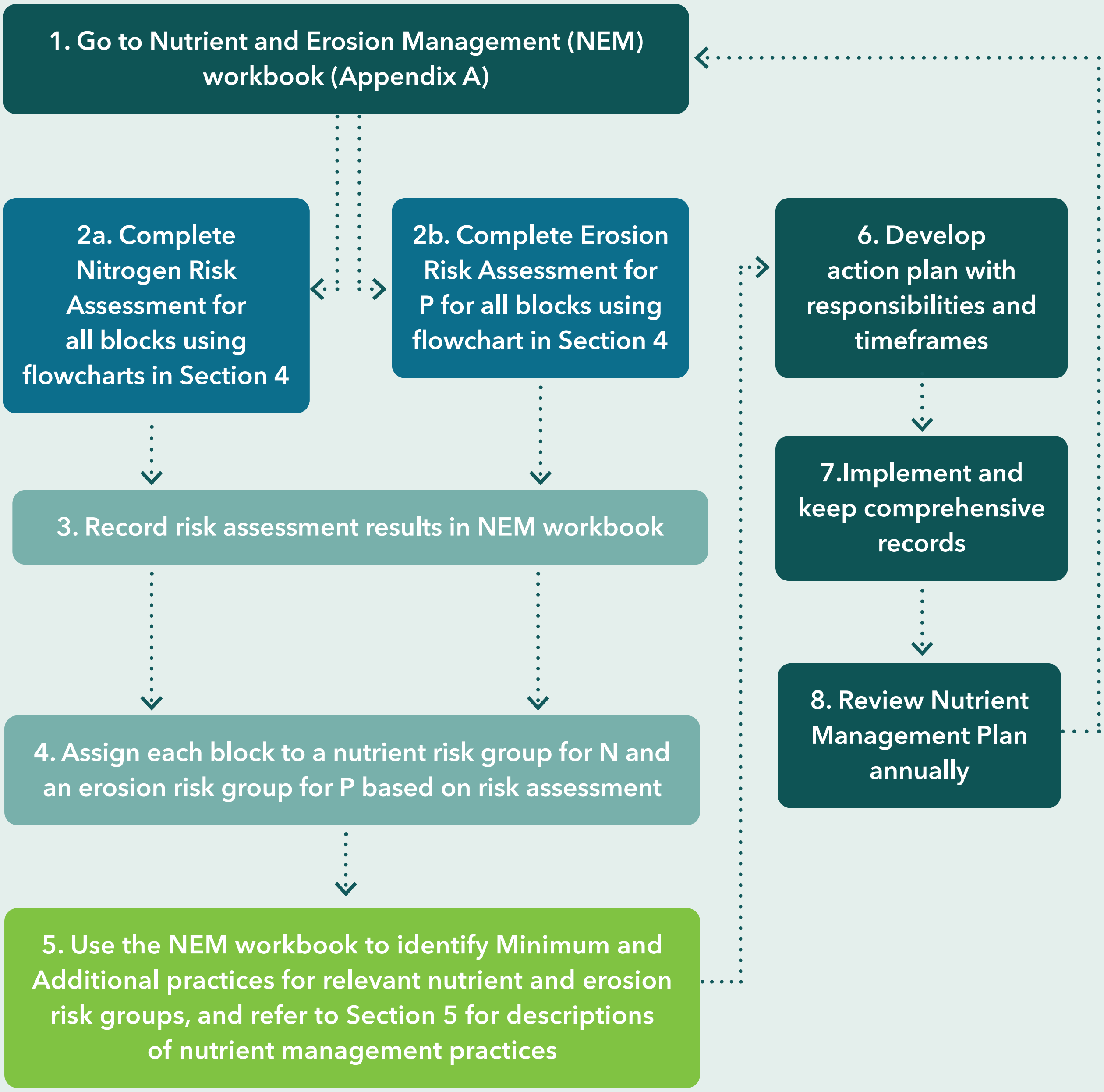



**Figure 1.2**: Steps to building and updating a Nutrient Management Plan using this Code of Practice.

For more information on erosion risk groups and erosion and sediment control practices, refer to the Erosion and Sediment Control Code of Practice. The NEM workbook can be used to document relevant information on erosion risk management, including erosion risk assessment results, and actions to implement risk-based practices over time.

# 2 Understanding nutrients in horticulture

This section describes the nitrogen and phosphorus cycles in horticulture production. It includes the different phases and pools of each nutrient as they cycle through the soil, water, and air. It also explains why these nutrients need to be managed to minimise environmental losses.

## 2.1 Nitrogen cycle

Nitrogen is an essential element for all plants. It is a major component of chlorophyll, and critical to protein and nucleic acid production in plant cells.

Figure 2.1 shows the main pathways of nitrogen cycling in soil, air, and water. Nitrogen is present in the environment in many different forms. These include $N_2$ (atmospheric di-nitrogen), nitrous oxide ($N_2O$), ammonia ($NH_3$), nitric oxide (NO), $NH_4^+$(ammonium), $NO_2^-$ (nitrite), $NO_3^-$ (nitrate), and as organic nitrogen in soil organic matter.

Plant available inputs to the nitrogen cycle include:

- **Mineral nitrogen:** The nitrogen currently in the soil in plant available forms (nitrate and ammonium).
- **Mineralisation of nitrogen from soil organic matter:** As the amount of organic matter increases, the amount of mineral nitrogen increases over time and becomes available to plants.
- **Mineralisation of nitrogen from incorporated crop residues:** Some crops such as brassicas contain large amounts of nitrogen. Residues left to break down after harvest mineralise over time and become available to plants.
- **Nitrogen fixation:** When some plants (such as legumes) have microbes in their roots that convert atmospheric nitrogen to nitrogen available to the plant. This nitrogen becomes available when roots of the nitrogen fixing plants turnover, or the fixed nitrogen in the legume is ingested by grazing animals, excreted, and then mineralised.
- **Fertiliser applications**, including both synthetic and organic inputs such as compost.
- Application of **animal manures** / grazing animals.

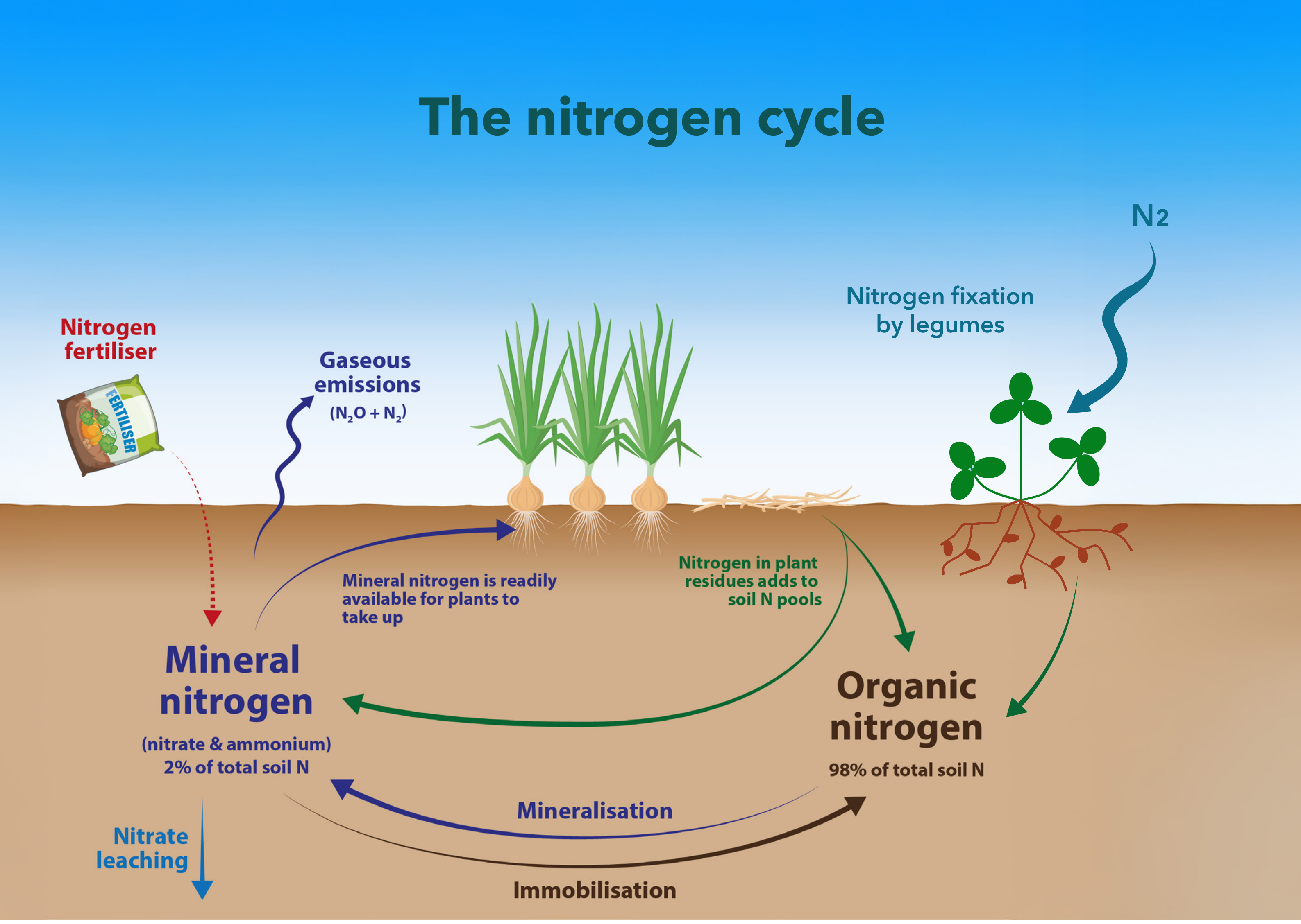



**Figure 2.1:** Nitrogen cycle in horticulture systems. Adapted from original produced by Plant & Food Research (addition of nitrogen fixation by legumes).

Nitrogen loss pathways include:

- **Leaching:** This is the major process by which nitrogen as nitrate is lost to groundwater and can make its way to surface water. Nitrate pools in soils are flushed below the root zone in drainage events. Drainage is caused by excess rainfall and irrigation on saturated soils. The risk of leaching is higher in winter, particularly for vegetable crops, as rainfall is higher, and plant uptake is slower. Excessive irrigation also increases the risk of leaching.
- **Surface runoff:** Excess nitrogen on the soil can be lost via surface runoff during rainfall events.
- **Denitrification:** Where microorganisms convert plant available nitrate back to nitrous oxide, and this greenhouse gas is released into the atmosphere.

Nitrogen lost to water and the atmosphere from production negatively impacts the environment. Growers need a plan to demonstrate how they are minimising nitrogen losses from their operation. Many of the practices used to manage losses to water are also effective for managing losses to the atmosphere.

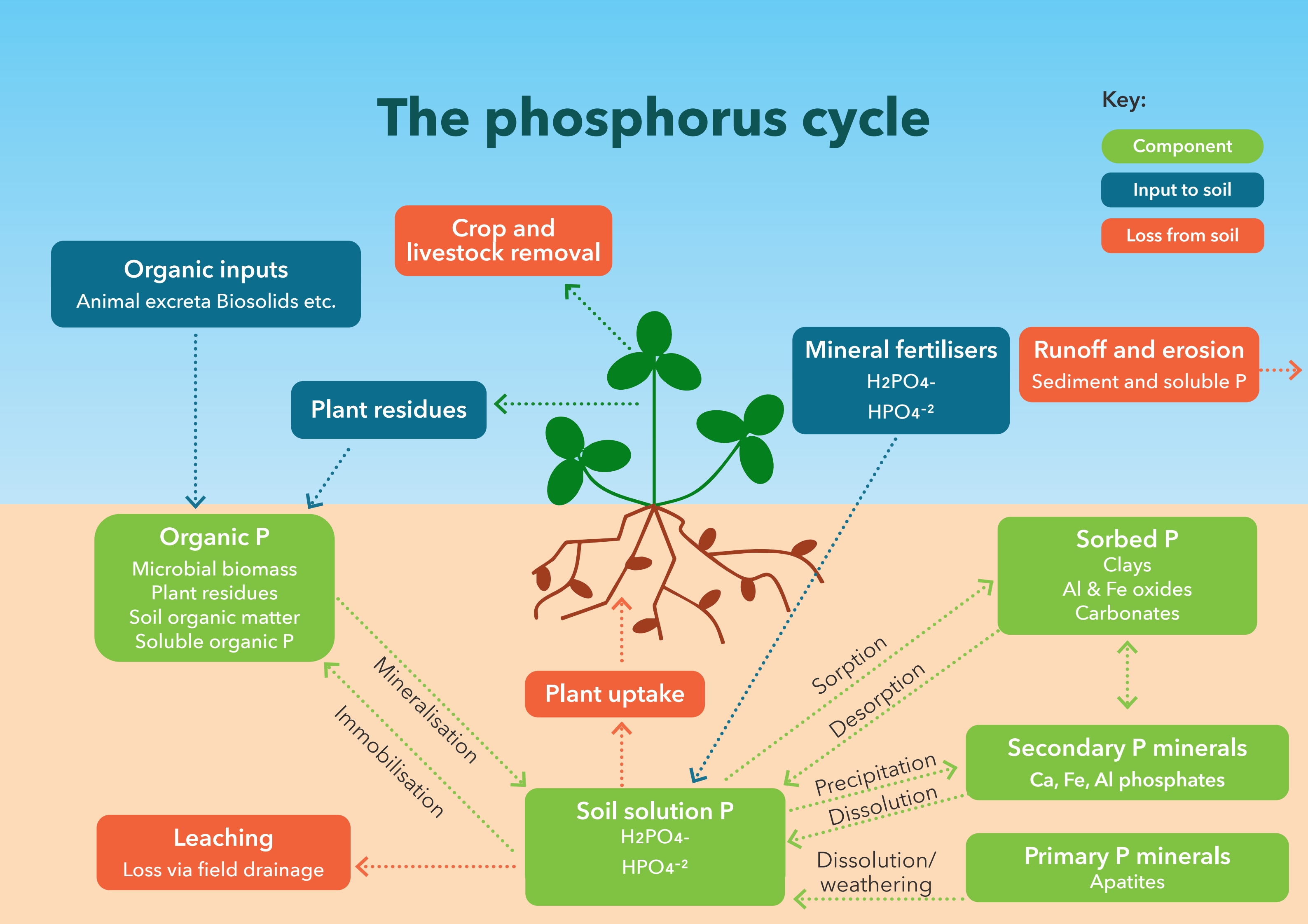



**Figure 2.2:** Phosphorus cycle in horticulture production systems.[4]

## 2.2 Phosphorus cycle

Phosphorus is an essential element for cell division and plant development. Phosphorus is a major component of adenosine triphosphate (ATP) which is important for producing and storing energy in plants. Figure 2.2 shows the major phosphorus pathways in horticultural production systems.

The different forms of phosphorus include mineral phosphates (not available to plants), inorganic phosphorus or phosphate ions (available to plants), and adsorbed phosphates (can become available to plants).

Plant available inputs to the phosphorus cycle include:

- **Desorption of phosphorus:** release of adsorbed phosphorus from its bound state into the soil.
- **Mineralisation of soil organic phosphorus:** Microorganisms in the soil break down organic matter, converting organic phosphorus to inorganic phosphorus (available to plants) into the soil.
- **Fertiliser** applications containing phosphorus.
- Application of **animal manures.**
- **Weathering of mineral phosphorus** in the soil and release of inorganic phosphorus (available to plants) into the soil. This is a natural process and happens very slowly.

[4] Used with permission from Charles Merfield. https://ourlandandwater.nz/wp-content/uploads/2024/05/Strategies-to-improve-the-efficiency-and-decrease-the-negative-environmental-impacts-from-phosphorous-fertiliser-use-FINAL-2024-.pdf

Phosphorus loss pathways include:

- **Surface runoff (sediment):** phosphorus bound to sediment is lost through erosion in overland flow and can enter waterways.
- **Surface runoff (fertiliser):** phosphorus can be lost in overland flow as it can take time to be adsorbed by the soil. The risk of loss is higher when fertiliser containing soluble phosphorus is applied to wet soils at risk of overland flow events[5].
- **Leaching:** The loss of soluble phosphorus through drainage.
- **Preferential flow through artificial drains:** The loss of soluble phosphorus through field or tile drains which allows soluble phosphorus to bypass the soil matrix.

The most significant phosphorus loss pathway in horticulture production is in sediment via erosion and surface runoff. A comparatively small amount of phosphorus in solution (dissolved reactive phosphorus [DRP]) can be lost via leaching[5].

## 2.3 Why do nitrogen and phosphorus need to be managed?

Nitrogen, phosphorus, potassium, sulphur, and micro-nutrients are essential for fruit and vegetable production. Nitrogen and phosphorus are also key freshwater contaminants that can be lost (via leaching and runoff) from horticultural production systems. The application of nitrogen also contributes to agricultural emissions.

Nitrogen and phosphorus lost to the environment can impact environmental and human health. Too much of these nutrients in freshwater can lead to excessive algal growth[6] and nitrogen toxicity. As the algae dies and decomposes, they use up available oxygen needed to support aquatic life such as fish. Leached nitrate can also contaminate drinking water supplies. Water with nitrate levels over the drinking water standard (11.3 mg/L nitrate-nitrogen)[7] have the potential to cause blue-baby syndrome[8]. Sustainably managing nitrogen and phosphorus in agriculture contributes to improved environmental and human health outcomes for New Zealand.

Managing the levels of nitrogen and phosphorus in freshwater is the responsibility of regional councils. Councils set in-stream limits on attributes like nitrogen, phosphorus, algal growth and dissolved oxygen, and set conditions on land use activities. Growers can use farm plans to demonstrate how they are managing nitrogen and phosphorus to minimise losses.

Achieving desired yields and managing nutrient losses requires careful planning. Key principles of nutrient management are the 4 Rs - Right Product, Right Rate, Right Time, Right Place. Using practices like nutrient budgets and soil/leaf tests are key to demonstrating the 4 Rs in your plan.

[5] McDowell, R. W., Monaghan, R. M., & Carey, P. L. (2003). Potential phosphorus losses in overland flow from pastoral soils receiving long-term applications of either superphosphate or reactive phosphate rock. New Zealand Journal of Agricultural Research, 46, 329-337.
[6] https://www.lawa.org.nz/learn/factsheets/phosphorus.
[7] New Zealand Water Services (Drinking Water Standards for New Zealand) Regulations 2022. Water Services (Drinking Water Standards for New Zealand) Regulations 2022 (SL 2022/168) – New Zealand Legislation
[8] https://www.pmcsa.ac.nz/topics/nitrates/.

# 3 Nutrient loss risk factors

## 3.1 What risk factors influence nutrient loss?

Many, often interacting factors influence the risk of nitrogen and phosphorus losses. Awareness of these factors assists in understanding how and when nutrient losses might occur in your operation, and how to manage that risk over time.

Risk factors are divided into two categories below – biophysical and management. Dominant risk factors form the basis of nitrogen and phosphorus risk assessments in Section 4. Risk factors have been tagged to practices in Section 5.

### 3.1.1 Biophysical risk factors

Biophysical risks relate to the natural environment on the land where horticultural activities are taking place. Examples of biophysical risks are climate, soils and topography. Table 3.1 describes each risk factor and how it relates to nitrogen and phosphorus losses.

**Table 3.1:** Biophysical risk factors and their influence on nitrogen and phosphorus losses.

| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Rainfall** | High annual rainfall, or significant rainfall events, increase drainage and the risk of nitrate leaching through the soil. This risk increases on light soils or fallow ground. | Heavy rainfall events increase the risk of soil erosion and sediment loss, particularly in highly erodible areas and bare/fallow soils. However, erosivity is not always aligned with the periods of highest rainfall – summer storms cause the highest rates of erosion in New Zealand[9,10]. |
| **Soil texture** | Soils with a lighter or more coarse texture like sand have a lower water holding capacity and drain easier, therefore are more likely to leach. | Susceptibility to erosion varies by soil type. In general, soils with lower permeability (the rate at which water moves through the profile) like clay/silt are more likely to erode[10]. |
| **Topography** | Sloped ground can increase loss of N via surface runoff during rainfall events, if fertilisers or other N inputs are at or near the soil surface. | Sloped ground will increase risk of surface runoff (containing sediment) in vegetable and cropping operations. Slope also increases the risk of overland flow and loss of soluble P fertiliser, particularly on wet soils in winter. |

[9] Klik, A., Haas, K., Dvorackova, A., & Fuller, I. C. (2015). Spatial and temporal distribution of rainfall erosivity in New Zealand. Soil Research, 53, 815-825.

[10] Donovan, M. (2022). Modelling soil loss from surface erosion at high-resolution to better understand sources and drivers across land uses and catchments; a national-scale assessment of Aotearoa, New Zealand. *Environmental Modelling and Software, 147*, 105228.

| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Soil anion storage capacity (ASC)** | - | Phosphate retention in soil, referred to as ASC, is an intrinsic property of soils. Soils with low ASC (10-30%) e.g. peat soils, podzols, have a higher risk of P loss through leaching and in surface runoff. Soil P should be monitored and managed, to minimise the risk of loss. |

### 3.1.2 Management risk factors

Management risk factors relate to an operation's growing system(s) and crop management. Examples include nutrient use practices, irrigation, cultivation and rotation practices, and presence of critical source areas. Table 3.2 describes each risk factor and how it relates to nitrogen and phosphorus losses. Practices specific to vegetable/cropping operations are coloured **brown**.

**Table 3.2:** Management risk factors and their influence on nitrogen and phosphorus losses.

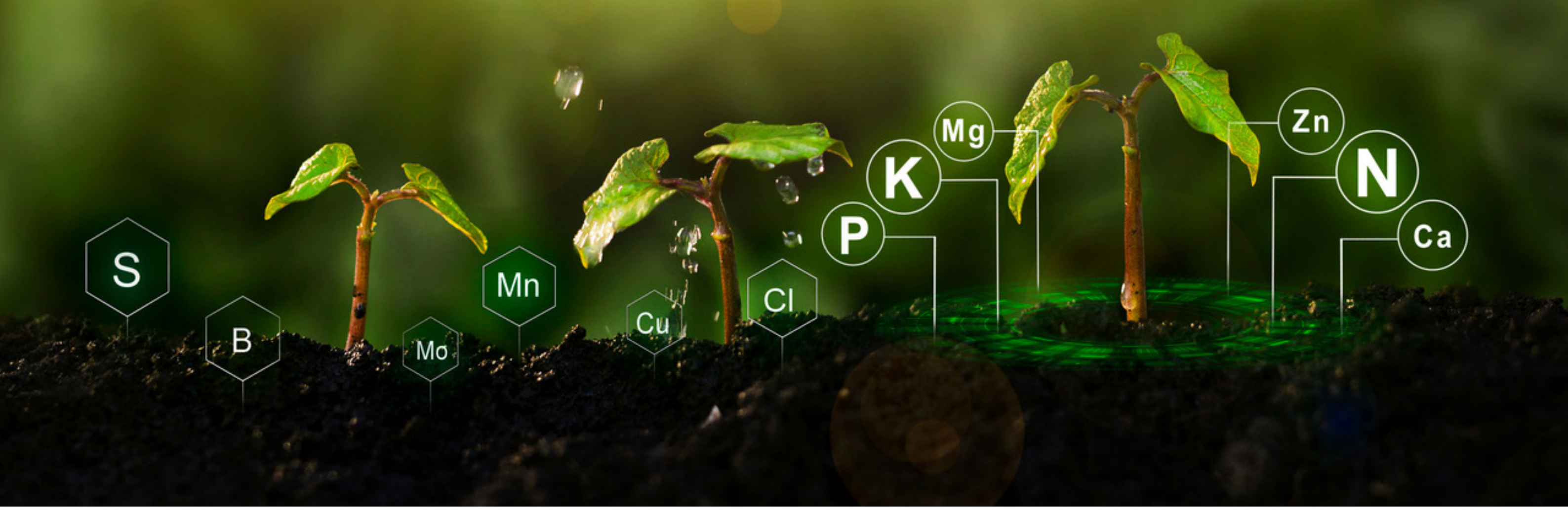
| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Rate of nutrient application** | Exceeding the optimum rate of nutrients required by the crop can increase the risk of both N and P losses to the environment. As the risk of losses increases, so too does the level of management required to minimise this risk. | |
| **Timing of nutrient applications** | N inputs applied in times of slow growth (winter) or high rainfall will increase the risk of N loss. Plants take up less N if not actively growing, and high rainfall increases the risk of N leaching through the soil profile. | There is greater risk of P loss through surface runoff if applied at times of higher risk of overland flow ponding, or when soils are saturated and still draining, as well as on sloped ground. |
| **Placement** | The method of fertiliser application will impact how accessible the applied nutrients are to the plant. Placement methods with greater precision can ensure that the nutrient is immediately available to rapidly growing plants (e.g. below the seed at planting) or is applied gradually over the crop's growing period (e.g. multiple split applications or fertigation).<br><br>The best placement method will depend on the nutrient(s) concerned, topography, spreading equipment, and individual production situations.<br><br>Fertiliser spread across non-target areas is inefficient and can be environmentally harmful, for example, near waterways where fertiliser can directly enter water.<br><br>For further guidance, refer to the 2025 Spreadmark Code of Practice for the Application of Nutrients in New Zealand. https://fertqual.co.nz/spreadmark/ | |

| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Type of nutrient applied** | The type of N fertiliser applied will affect uptake by the crop and risk of N losses to the environment.<br><br>Urea is highly soluble and quickly available to plants. It is also easily lost as ammonia gas via volatilisation (to the atmosphere). This is more common in alkaline soils, dry conditions, and/or when broadcast. Urease inhibited urea (e.g. N-Protect® or SustaiN®) will reduce N volatilisation losses by, on average, 50% compared to standard urea. This improves N-use efficiency.<br><br>Ammonium fertilisers (e.g. CAN) can also reduce N losses compared to nitrate-based fertilisers. Ammonium bonds to clay particles, reducing the risk of loss in drainage. | The type of P fertiliser applied will impact the risk of losses. Especially if applied at high risk times when there is overland flow ponding, or soils are saturated and still draining, as well as on soils with low ASC.<br><br>Using slow-release P fertilisers (e.g. RPR, serpentine super) can reduce the risk of soluble P sitting in the soil waiting for plant uptake (thus at risk of loss in drainage events). |
| **Nutrient application method** | Application methods can significantly influence the risk of nutrient losses. Techniques that place nutrients closer to the plant's root zone, such as fertigation, banding, or incorporation, are generally lower risk as they improve nutrient use efficiency and reduce risk of leaching and runoff. In contrast, methods like broadcast spreading where nutrients are applied more broadly across the soil surface, increases the chance of losses, particularly if not followed by incorporation or if heavy rain occurs soon after application. | |
| **Critical source areas** | These are areas on a property that contribute disproportionately large quantities of contaminants to water, relative to their extent. They are both a source of contaminants, and a contaminant transport pathway. Critical source areas transport nutrients in surface run-off or intermittent drainage[11]. Examples of these areas that may appear in horticulture include low-lying areas where water ponds (e.g. gullies, swales, depressions), fertiliser storage and loading areas, washdown areas, and erodible banks. | |
| **Irrigation** | Both over and under irrigating can increase the risk of N loss.<br><br>Over-irrigation can increase drainage, which increases the risk of N leaching, especially if the timing of irrigation is not managed alongside nutrient applications. Surface run-off of fertiliser on sloped ground can also occur if over-irrigating after fertiliser is applied.<br><br>Insufficient irrigation during dry periods can increase the risk of nitrate loss in heavy rainfall events, because nitrate remains in the soil, rather than being taken up by the crop, and is vulnerable to loss during drainage events. | Surface run-off of P fertiliser due to overland flow on sloped ground can occur if over-irrigating after fertiliser is applied. Ensure irrigation rates are less than the rate of soil water infiltration to reduce this risk. |

[11] Ministry for the Environment. 2023. Critical-source-areas-Guidance-for-intensive-winter-grazing.pdf\

| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Spills or leaks of fertiliser product** | Spills or leaks of fertiliser can cause concentrated nutrient losses, especially near drains, hard surfaces, or waterways. Even small, repeated spills can build up over time and lead to environmental harm. | |
| **Block history** | Crops such as brassicas tend to leave smaller amounts of mineral N in the soil but can leave large amounts of N in their residues. N from these residues can be lost if unaccounted for in a nutrient budget. Understanding the release rate is part of on-going research work.<br><br>Land which has been in long term pasture or has received repeated applications of organic manure can increase the amount of soil organic matter, which can be mineralised and supply N. This supply of N should be considered when making fertiliser application decisions.<br><br>Animals bring in and take away nutrients. The nutrients that they bring in also tend to be in concentrated patches, for example, in livestock camp areas. Maintain an awareness of these additional inputs in your system. | If excess P in the soil from the previous crop(s) is not measured and accounted for (i.e. soil testing and nutrient budgets), additional P fertiliser applied could increase P levels above optimum and increase the risk of losses.<br><br>Animals, if used within the operation, can disturb the soil structure (via pugging and compaction), and when combined with sloped land, can lead to increased risk of erosion and sediment loss, and consequently P loss. |
| **Crop root depth** | Shallow-rooted crops only take up nutrients from the topsoil. Leftover nutrients, particularly nitrate, deeper down can easily leach away after rain or irrigation. When shallow-rooted crops are grown in sequence, the risk increases that nutrients left deeper in the soil will be lost beyond the root zone, particularly under wet conditions. In contrast, deeper rooted crops access nutrients from deeper soil layers, reducing the build-up of unused nutrients lower in the soil profile. | |

| Risk factor | Nitrogen (N) | Phosphorus (P) |
|---|---|---|
| **Fallow periods** | A period when a block is left unplanted, allowing beds to be formed, the soil to rest and recover before the next crop is planted.<br><br>The impact of crop residues on potential nitrate leaching depends on the length and timing of fallow periods. Other factors influencing leaching include climate, season, soil nutrient status, and crops in rotation. | Fallow periods contribute to P loss indirectly by making the soil more vulnerable to erosion and sediment loss. Soil is more exposed due to less plant cover. On their own fallow periods do not cause erosion and P loss unless combined with other factors like slope and/or soil type (more erodible soils). |
| **Cropping intensity / cultivation** | An intense rotation can mean that the soil is regularly cultivated and left exposed. The risk of N loss will increase with intensity of vegetable cropping (e.g. sequential cropping). There is an increased N demand and N cycling. | Regularly cultivated and exposed soils negatively impact on soil structure through the loss of soil organic matter, and by increasing the risk of compaction. This increases the risk of soil erosion and sediment loss, subsequent P losses as P attaches to soil particles. Poor soil structure and compaction impact crop growth and nutrient uptake. |
| **Ground preparation and planting method** | Poorly timed cultivation, too early before planting, exposes soil organic matter to oxygen, accelerating nitrogen mineralisation. As nitrogen is highly mobile, if not taken up by plants, it can quickly become prone to leaching. | The over-cultivation of soils, through mechanical action and loss of organic matter, leads to fine tines becoming tighter on the surface, leading to compaction. This can increase runoff from the block. P loss can also increase through an increased risk of wind erosion. |




# 4 Nutrient risk assessment

The structure of this section is as follows:

- **Risk assessment approach** **(Section 4.1)**
- **Nitrogen risk assessment** **(Section 4.2)**
- **Phosphorus risk assessment (from erosion)** **(Section 4.3)**
- **Managing phosphorus use** **(Section 4.4)**

## 4.1 Risk assessment approach

Risk assessment is a core part of an operation's Nutrient Management Plan. Managing the risk of nutrient losses through a Nutrient Management Plan supports production and environmental outcomes, as well as achieving compliance requirements.

This section contains risk assessment processes for both nitrogen and phosphorus losses. Risk assessments are completed for every block in an operation where commercial horticultural production is occurring, and nutrient inputs are being applied. The risk assessments are designed to assess the risk of uncontrolled nutrient losses at the block scale. The results inform the level of management practice that a grower implements to effectively manage that risk over time. The outcome achieved, once relevant practices are implemented, is that the risk of nutrient loss is considered well controlled for that operation.

Based on the risk assessment results, each block is assigned to a **nutrient risk group**. These are groups of blocks with the same nutrient loss risk profile (green, amber or red), and the same level of management required. Each nutrient risk group has a set of minimum and additional practices - see Tables 5.1 and 5.2.

Management practices are implemented at a range of scales, from operational, to block and crop. All operational practices in Section 5.4 are minimum regardless of your risk level. All other practices in Sections 5.5 and 5.6 are either minimum or additional, depending on each block's risk level.

As part of the annual review of the Nutrient Management Plan, risk assessments may need to be updated. For example, if you are adding or swapping production blocks, new blocks will need to be assessed and relevant practices incorporated into your plan.

Note: the risk assessments in this code of practice are not an assessment of nitrogen leaching loss or an assessment of environmental effects.

## 4.2 Nitrogen risk assessment

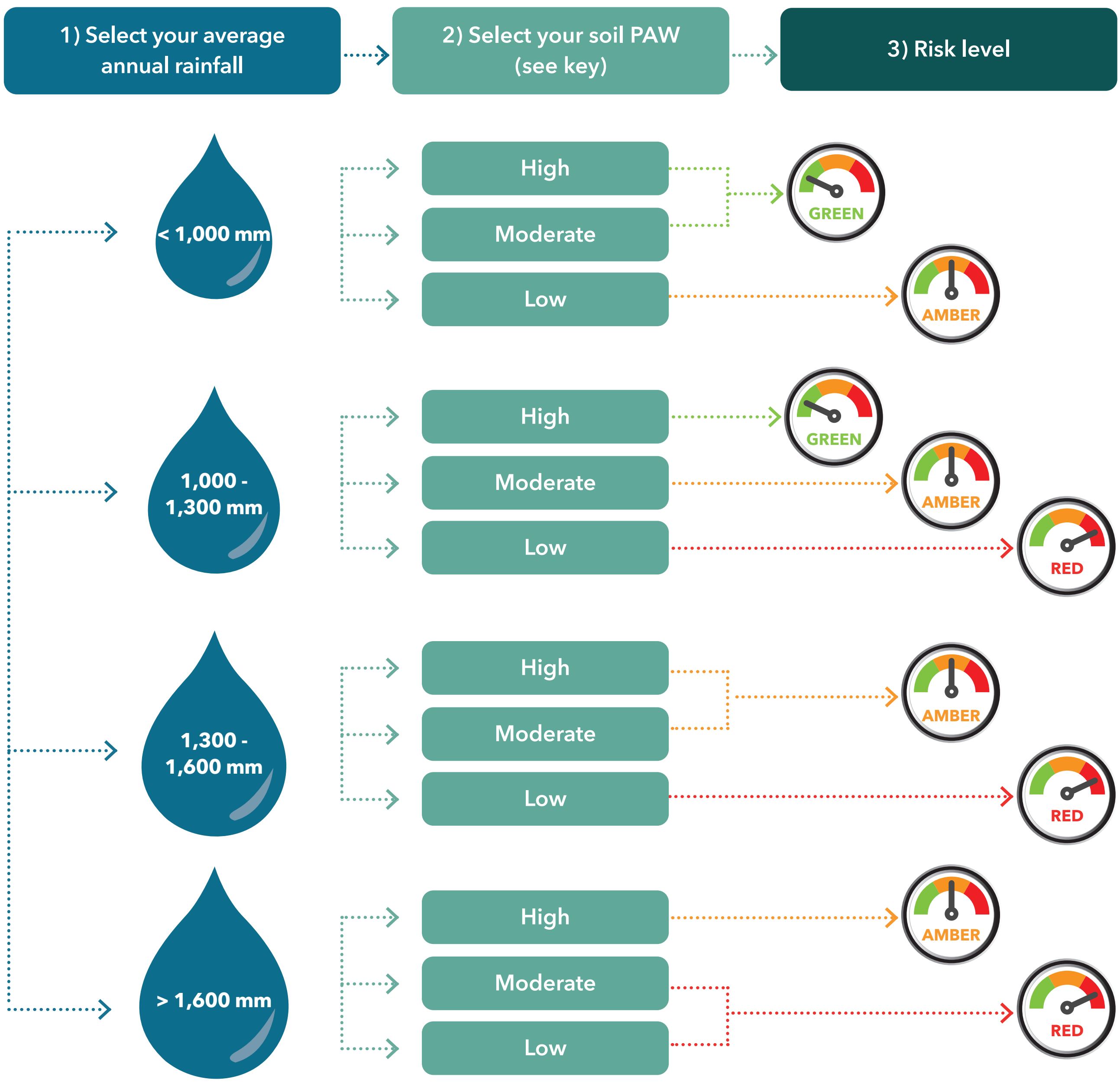
The nitrogen loss risk level for each block signals the level of practice that applies. Once all relevant practices are implemented across blocks, the risk of nitrogen loss is considered well controlled.

The risk assessment for each block is divided into three steps. First, biophysical risk is assessed, followed by nitrogen fertiliser risk, and in the last step, results are combined to assign blocks to a nutrient risk group. Each nutrient risk group will have relevant practices that apply.

### Step 1: Biophysical risk

The dominant leaching pathway for nitrogen is through the soil, below the plant's active root zone. From here it can enter groundwater and surface water and impact water quality. Key drivers of nitrogen leaching risk are rainfall and profile available water (PAW). More information on PAW is provided on the next page.

Rainfall and PAW form the basis of the nitrogen biophysical risk assessment. Use this risk assessment in Figure 4.1 to assess the biophysical risk for your blocks. Resulting risk levels are GREEN, AMBER or RED.




**KEY:**

**Profile available water (PAW) in top 1m of soil**

**High PAW (> 150 mm)** **Moderate PAW (61-150 mm)** **Low PAW (< 60 mm)**

**Figure 4.1:** Nitrogen biophysical risk assessment decision tree. See the following page for description of profile available water.

Note, a high RED biophysical risk does not necessarily mean more nitrogen is being lost to the environment, only that there is potential for greater losses based on the biophysical risk factors.

Profile available water (PAW) is the total amount of water that soil can hold and supply to plants within their root zone. Vegetable crops typically have rooting depths of between 30 – 60 cm, while permanent horticulture typically have roots to one metre or more. PAW is a soil property influenced by soil texture, as texture affects the soil's ability to retain and release water to plants. Medium-textured soils like loams generally hold more plant available water than sandy or heavy clay soils.

Figure 4.2 shows PAW mapped for New Zealand soils. PAW data has been sourced from the Fundamental Soil Layer[12] managed by Bioeconomy Science Institute - Manaaki Whenua Landcare Research (BSI-MWLR). This is a publicly available mapping tool that provides a range of information on soil properties across New Zealand.

MWLR also manages the online soil information resource, S-map. S-map contains PAW estimates in the top 1m of soil. BSI-MWLR are actively updating S-map. PAW by rooting depth is available for some but not all of New Zealand soils, at the time of publication of this code of practice.

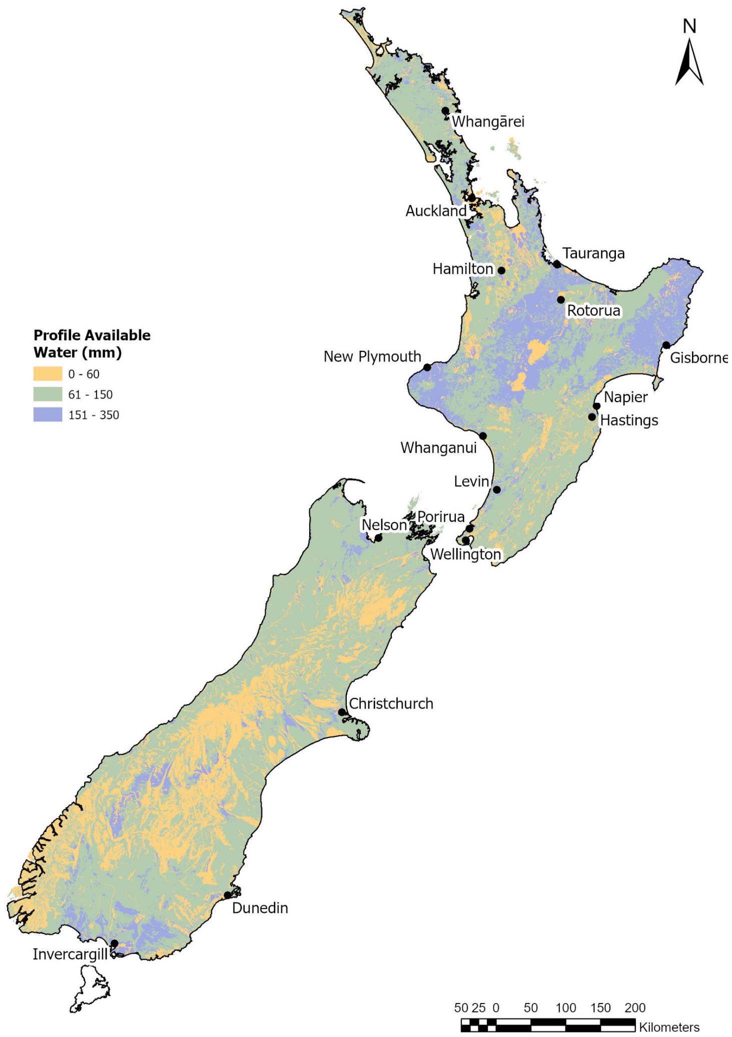



**Figure 4.2:** A map of PAW classes in the nitrogen biophysical risk assessment to a depth of 0.9 m[13].

[12] https://soils.landcareresearch.co.nz/tools/fsl

[13] **Soil Profile Available Water** – from the NZ Land Resource inventory (NZLRI) (accessed via the LRIS Portal) https://lris.scinfo.org.nz/layer/48100-fsl-profile-available-water/

## Step 2: Potential nitrogen fertiliser use risk

The decision tree in Figure 4.3 helps growers understand the potential risk from their nitrogen fertiliser application use on each block. Potential risk refers to the level of risk that exists based solely on nitrogen application rates.

It is important to keep in mind that the purpose of the risk assessment is not to achieve a specific risk level. The purpose is to identify practices that are proportionate to the level of risk for your blocks to prioritise effective management over time.

To work out the total annual nitrogen used on each block, add up all the nitrogen components in fertiliser and organic inputs applied to that block in a 12-month period. Then, divide by the block's productive area. Total nitrogen used includes synthetic fertiliser, as well as organic products, such as compost.

The productive area includes the area the crop is grown, wheel tracks and uncropped beds, as well as headlands and races. Buildings and areas in long-term pasture should be excluded from the productive area calculated. Both owned and leased blocks in production need to be included in this assessment.

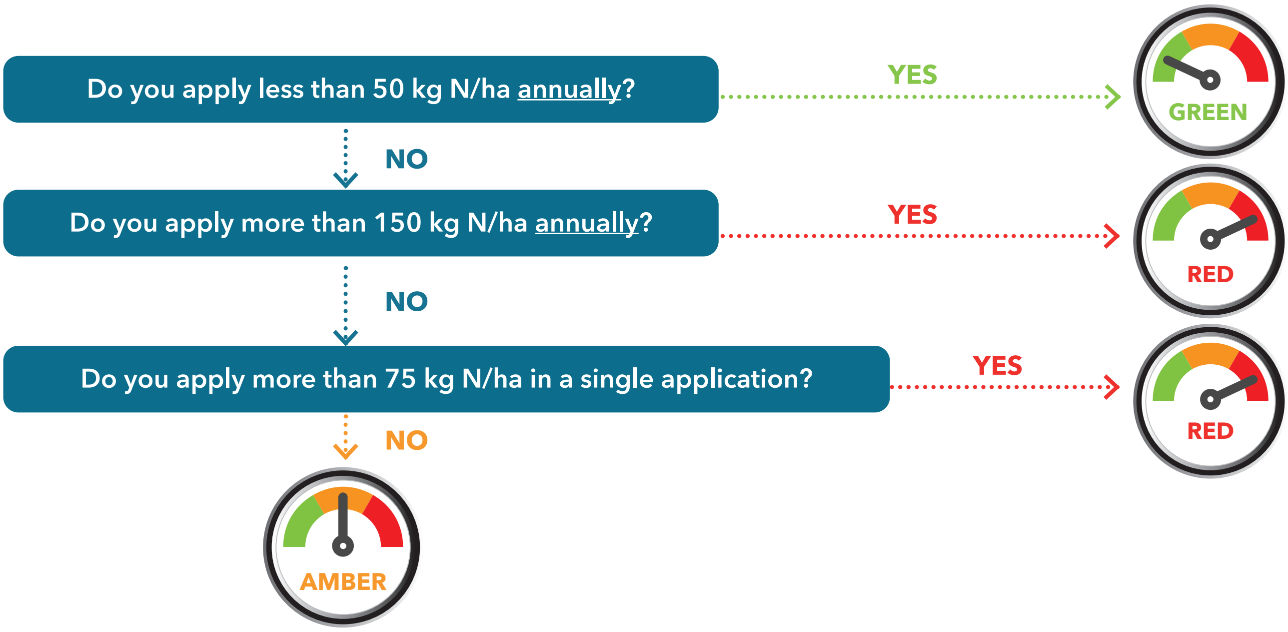



**Figure 4.3:** Potential nitrogen fertiliser use risk assessment.

## Step 3: Nutrient risk groups

Based on the assessment of each block in Steps 1 and 2, determine your block's nutrient risk group using the matrix in Table 4.1.

**Table 4.1:** Nutrient risk groups (NRG) based on level of nitrogen loss risk.

| | Potential nitrogen fertiliser use risk | | |
|---|---|---|---|
| Biophysical risk | GREEN | AMBER | RED |
| GREEN | NRG Green | NRG Green | NRG Amber |
| AMBER | NRG Green | NRG Amber | NRG Red |
| RED | NRG Amber | NRG Red | NRG Red |

Repeat these steps for all your blocks. Record the risk assessment results in your Nutrient and Erosion Management workbook (Appendix A).

See Section 5.3 for further description of nutrient risk groups, and lists of minimum and additional practices for each group.

In the next section, follow the steps to assess each block for erosion and phosphorus loss risk.

## 4.3 Phosphorus risk assessment (from erosion)

Phosphorus typically binds to particles of sediment and is transported during erosion events. Phosphorus attached to sediment (particulate phosphorus - PP), or in solution as dissolved reactive phosphorus (DRP), moves either in overland flow or leached below the active rootzone in water. The project Don't Muddy the Water[14] found that in the overland flow pathway, PP comprises about 95% of the total phosphorus leaving a block (entering the sediment retention pond [SRP]), and the remaining 5% as DRP. Using correctly sized SRPs reduced the total quantity of phosphorus by more than 98%.

Trials conducted by Plant and Food Research at a Pukekohe site found phosphorus was being leached in solution below the active rootzone at an average of 0.1 kg P/ha[15]. This is just 0.06% of the overland component, hence why phosphorus practices are primarily focused on erosion and sediment control. Managing phosphorus use in crop production is also an important part of managing the risk of phosphorus loss (see Section 4.4).

The risk of phosphorus loss is assessed using the erosion risk assessment from the Erosion and Sediment Control Code of Practice 2026.

This risk assessment is designed to assess the level of risk of erosion risk, and therefore risk of phosphorus loss, at the block scale. Block slope and soil erosivity are key factors in determining phosphorus loss risk. Complete the risk assessment in Figure 4.4 for each production block.

Assign blocks to an erosion risk group and record results in the Nutrient and Erosion Management (NEM) workbook (Appendix A). Each erosion risk group has a set of minimum and additional practices: see Table 5.2, and the NEM workbook. Refer to the Erosion and Sediment Control Code of Practice for more detail on each management practice. Once relevant practices are implemented, the erosion (and phosphorus loss) risk is considered well controlled.

For growers undertaking major orchard developments or contouring (i.e. large-scale soil movement), this risk assessment applies to 'business as usual' soil and sediment erosion risk. Growers should contact their local authority to understand earthworks consent conditions or legal requirements for more significant erosion and sediment control projects.

14 Barber, A., Stenning, H., & Hicks, M. (2019). Don't muddy the water: Quantifying the effectiveness of sediment control on cultivated land. Final report – July 2015 to June 2019. MPI SFF Project 407925. https://potatoesnz.co.nz/wp-content/uploads/2019/07/PukekoheFinalReportFinal2.pdf

15 Norris M, Johnstone P, Sorensen I, Arnold N, van den Dijssel C, Dellow S, Wright P, Clark G, Green S. May 2019. Protecting our groundwater (FAR/MFE Fluxmeters): May 2019 update. A Plant and Food Research report prepared for: Foundation for Arable Research.

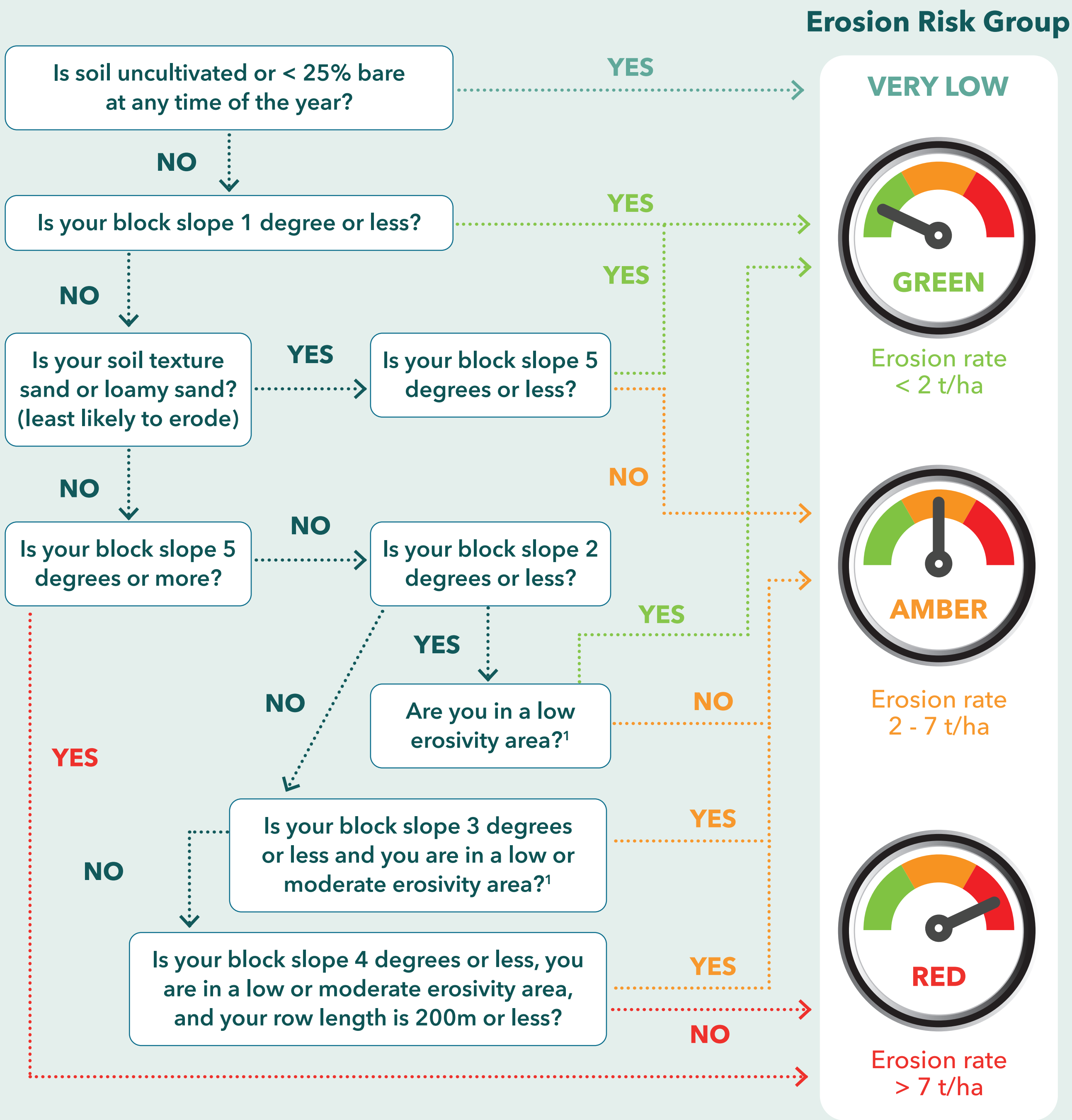



**Figure 4.4:** Erosion risk decision tree to determine risk of phosphorus loss in a horticulture operation.

Note: When cultivated rows are present, block slope should be assessed based on the direction of the rows, which should already be situated to reduce the risk of erosion. A slope of 1 degree is equivalent to a slope of 1.7%.

[1] These regions generally have low rainfall erosivity (Klik et al., 2015). Use the DMTW web app to determine the best estimate of your erosion rate. Low erosivity R factor is <1,000; moderate is 1,000 to 1,500; high >1,500.

## 4.4 Managing phosphorus use

The risk of phosphorus loss is not limited to erosion. It is also influenced by how phosphorus inputs are planned and managed for crop production. Getting phosphorus inputs right is important for both nutrient use efficiency and freshwater outcomes. Appropriate planning and management can reduce the amount of phosphorus available to be lost in the first place.

Applying the 4 Rs - the foundational principles of nutrient stewardship - is key to sustainable nutrient management across an operation (see Section 5.1). As part of this approach, soil testing is used to understand that status of soil phosphorus. Knowing how much is in the system and available to plants supports sound decision making about nutrient inputs for upcoming crops. It is important that decisions to maintain or change phosphorus inputs are informed by long-term soil phosphorus trends, rather than one-off results, to create optimum conditions for planned crops.

The Reid & Morton guidelines on Nutrient Management for Vegetable Crops, linked in Appendix B, provide direction on phosphorus application rates, based on soil Olsen P levels. Olsen P is the main soil test used to determine phosphorus availability, alongside ASC (i.e. P retention). Vegetable growers in particular should make use of resources like the Reid & Morton guidelines to avoid over-application and excessive soil Olsen P levels, which has been observed in regions with long term, intensive vegetable production.

In this code of practice, several key practices apply to both nitrogen and phosphorus, including (but not limited to):

- All operation-wide practices (Section 5.4)
- Preparing crop nutrient budgets (5.5.1)
- Planning nutrient rates and timing based on crop needs (5.5.2)
- Regular soil testing (5.5.3.1)
- Representative soil sampling (5.5.3.7)

Refer to Table 5.1 for a full list of practices that apply to each nutrient risk group.

It is expected that nutrient management practices implemented for nitrogen are also implemented to manage phosphorus, where appropriate. These can be recorded in the Nutrient and Erosion Management workbook (Appendix A).

# 5 Practices to manage nutrient loss risk

## 5.1 Introduction

This section contains nutrient management practices for outdoor fruit and vegetable growers. The combination of practices is based on the block-level risk assessment results, and nutrient risk groups that apply. For a complete list of minimum and additional practices for each nutrient risk group and erosion risk group, refer to Tables 5.1 and 5.2, respectively. Relevant practices for each risk group are included in the Nutrient and Erosion Management Workbook (Appendix A).

**Practices are grouped into key areas:**

**Practice sections**

- Practices operate at different scales (5.2)
- Nutrient risk groups (5.3) and description of minimum and additional practices (5.3.1, 5.3.2)
- Record keeping
- Operation wide practices to minimise nutrient losses (5.4)
- Nutrients are applied accurately and responsibly (5.5)
- Soil management to maximise nutrient uptake and minimise losses (5.6)

Practices align with the Code of Practice for Nutrient Management (NZ Fertiliser Manufacturers' Research Association 2023) for sustainable nutrient use in New Zealand. These practices can help growers meet regulatory or market requirements.

To note, practices included in this section are based on best available information at the time of publication. However, as innovation and research evolve, understanding of existing practices may change, or new practices may be developed. Practices such as these will be incorporated in subsequent reviews of the Code.

*4Rs graphic used with permission from the Fertiliser Association of New Zealand.*


All growers that apply nutrients should also follow the 4Rs of nutrient management, which guide many practices in this Code of Practice.

1. **Right product** – Match fertiliser type to crop needs
2. **Right rate** – Apply the right amount
3. **Right time** – Time applications to crop uptake
4. **Right place** – Target application areas and avoid sensitive areas[16].

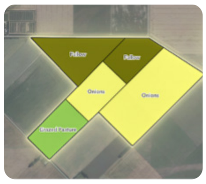
[16] https://www.fertiliser.org.nz/about-fertiliser/caring-for-our-environment.

## 5.2 Practices operate at different levels

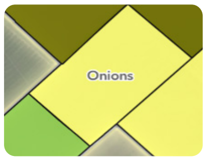
Each practice applies at a defined scale within an operation so that nutrient management plans remain effective and practical, and risks are addressed at the appropriate level.

**CATCHMENT SCALE** (optional) — **Participate in a wetland restoration project with your catchment group**


**OPERATIONAL SCALE** — **Calibrate fertiliser and irrigation equipment**



**BLOCK / CROP SCALE** — **Soil test**




### 5.2.1 Catchment scale

There may be opportunities to participate in a catchment scale initiative that goes beyond individual property boundaries. They often involve coordination between landowners, industry groups, or councils.

These may include:

- participation in catchment groups
- attendance at off-farm extension on research or tools to support environmental awareness and management
- coordinated riparian planting, shared wetland restoration projects, network of erosion and sediment control devices, or knowledge-sharing initiatives.

### 5.2.2 Operational scale

These practices are applied across the entire operation and generally relate to overall management systems that influence nutrient management planning, use and control. Examples include fertiliser storage and handling, staff training, and irrigation scheduling.

### 5.2.3 Block or land management group scale

At this scale, practices are applied to individual blocks, or groups of blocks, that share similar nutrient loss risk profiles. For more information on nutrient risk groups see Section 5.3.

Block scale practices can address variability in block scale conditions like soils, slopes, drainage, or crop nutrient demand. Examples include crop nutrient budgets, soil testing, fertiliser application methods, and block-specific erosion and sediment controls.

Practices in Section 5 are tagged with the scale at which each applies.

### 5.2.4 Crop scale

Some practices, like nutrient budgets (5.5.1), apply at the crop scale. Planning nutrient inputs is about selecting the right type and rate of product, and timing applications to match crop growth requirements. Crop budgets estimate the inputs and outputs of nutrients and rely on representative soil testing to determine nutrient availability and soil fertility status to inform nutrient management decisions for that crop.

## 5.3 Nutrient risk groups

A nutrient risk group (NRG) is a way of grouping blocks that share the same level of nutrient loss risk. These blocks will likely share similar characteristics, such as slope, climate, and crops grown. Each NRG has a set minimum and additional practices that apply (see Tables 5.1 and 5.2). That way growers can apply a consistent and appropriate level of practice across blocks of the same risk level. Documenting practices in the Nutrient and Erosion Management workbook (Appendix A) supports a streamlined audit and compliance process by simplifying planning, implementation, and record keeping.

Risk assessments and NRGs may need to be updated if you are making changes to your growing operation. For example, changing location of your growing operation (e.g. adding/swapping blocks) or growing a different crop with different nitrogen requirements on a block. Updates can be done as part of the internal annual review of your Nutrient Management Plan.

### 5.3.1 Minimum practices

Minimum practices for each NRG are required to be implemented for all blocks in that group. These are designed to give growers a clear and practical starting point, or benchmark, for managing nutrient loss risk over time. When combined, the minimum practices in each NRG are considered most effective at minimising nutrient losses in horticultural production, and achievable for growers no matter the size or location of operations. Minimum practices form a key part of a Nutrient Management Plan, ensuring there is a consistent, evidence-based approach to nutrient management across the industry.

The level of minimum practices increases with increasing level of risk. For example, at AMBER level of nitrogen loss risk, growers need to test soil mineral nitrogen annually on their blocks and use this to inform the crop's nitrogen budget. As the risk increases, so do the testing requirements. Both to inform the crop nitrogen budget and to track in-season performance against that budget. For RED level of nitrogen loss risk, the minimum practice involves a mineral nitrogen test at the start and end of each crop. Testing at the end will establish how the actual nitrogen levels (measured) compared to the budget (planned).

If it isn't possible to do a minimum practice, provide an explanation as to why, and set out an alternative timing or approach in your NMP. Justification will be required at the time of audit.

### 5.3.2 Additional practices

These include all other practices described in this Code of Practice, and any other practices that growers may be doing to manage nutrient losses. Additional practices provide further risk management options for growers. For each NRG the following applies:

NRG GREEN – No additional practices required

NRG AMBER – 25% or more additional practices required

NRG RED – 50% or more additional practices required.

Growers can choose the combination of additional practices to implement based on what is most practical and effective for their production system and growing environment. This approach recognises the diversity of horticultural operations and production locations, and the need to retain flexibility when planning and implementing practices.

Sections 5.5 – 5.7 describe each practice in more detail.

### 5.3.3 Decision support tools

Decision-support tools help growers make sound nutrient management decisions by improving the information used to plan and adjust inputs. These tools range from simple, practical options, like in-field soil testing using the Nitrate Quick test, providing rapid results, through to more comprehensive nutrient budgeting platforms like the SVS Tool, that bring together soil test information, crop growth requirements, application history and more.

Refer to Section 6 for more information about the nutrient decision-support tools available for horticulture. Tools are also referenced in individual practice descriptions.

### 5.3.4 Case study example

This example steps through the risk assessment process for an operation, and the steps in identifying risk-based minimum and additional practices that apply.

**Commercial Vegetable Production, Pukekohe**
This grower runs a 5-year crop rotation that includes cabbage, barley, onions, oats, potatoes, phacelia, carrots, and silverbeet.

For this example, we're focusing on Block 1, which covers a 12-month period with the following crop sequence:

- Cabbage: Planted January–March, harvested April–June
- Barley: Sown June–July, incorporated into the soil in September
- Onions: Sown August–October, harvested February–March of the following year

**Nitrogen loss risk: What's the story?**

**Biophysical risk**
Block 1 sits on Pukekohe clay loam, a soil with profile available water of 100–140 mm (medium PAW). Combine that with 1,200–1,400 mm of annual rainfall, and you've got conditions where nitrogen can leach or run off, especially in the wetter months or when soils are saturated.

**Biophysical risk of this block is AMBER.**

**Fertiliser rates**
To support those fast-growing vegetable crops, nitrogen is applied at more than 150 kg N/ha/year. Without careful timing, especially during wet weather or when crops aren't actively taking up nutrients, there's potential for nitrogen losses.

**Potential nitrogen fertiliser rate risk is RED.**

**Overall nitrogen loss risk**
Combine those two assessments and the overall nitrogen loss risk for **Block 1 is RED**.

That places it in NRG RED. Other blocks (3, 4, 6, 7, and 8) also fall into NRG RED, meaning they all need the same level of nutrient management.

**Phosphorus loss risk: What do we need to watch?**

Block 1 is cultivated, has a 4-degree slope, sits in a low-to-moderate erosivity area, and features long rows (200+ metres). With this combination of factors, there is a reasonable potential of sediment and phosphorus movement, especially during heavy rain or irrigation events.

Overall P loss risk is RED. Block 1 is also in Erosion Risk Group (ERG) RED for phosphorus, alongside blocks 3, 4, 7, and 8.

**So What Does NRG RED mean in Practice?**

For NRG RED blocks, the grower must:

- Implement all minimum practices for nutrient management
- Choose and apply at least 50% of the additional practices (that go further to reduce risk).

Using the Nutrient and Erosion Management Plan workbook (Appendix A) a grower will record their risk assessment results, and actions for their blocks.

The grower needs to consider suitable decision-support tools when implementing practices. See Section 6 for Tools.

This example shows how nutrient risk isn't just about what's growing. It's about how the land, soil, and climate interact with growing practices. Grouping blocks by risk helps tailor management so the right level of effort goes to the right places.

### 5.3.5 Other requirements

Other regulations or compliance may require you to do nutrient management practices, some of which may be different to practice in this code, for example:

- GAP checklist questions
- Freshwater farm plan regulatory and catchment actions
- Relevant national environmental standards
- Regional plan rules

## Summary table of Minimum and Additional practices

Tables 5.1 and 5.2 include minimum and additional practices required for each nutrient risk group (NRG) and erosion risk group (ERG) for phosphorus loss. These practices are also provided in the NEM workbook in Appendix A. Further information about each practice is provided in the following sections.

**Table 5.1:** Minimum and additional nutrient management practices for each nutrient risk group.

| COP reference | Management practices | GREEN | AMBER | RED |
|---|---|---|---|---|
| **1.5** | Nutrient Management Plan prepared | Minimum | Minimum | Minimum |
| **1.5** | Nutrient Management Plan is updated and reviewed annually | Minimum | Minimum | Minimum |
| **5.4.1** | Manage fertiliser handling, transport, and storage | Minimum | Minimum | Minimum |
| **5.4.2** | Calibrate fertiliser spreader equipment annually | Minimum | Minimum | Minimum |
| **5.4.3** | Maintain irrigation systems | Minimum | Minimum | Minimum |
| **5.4.4** | Fertiliser spreading operators are trained and competent | Minimum | Minimum | Minimum |
| **5.4.5** | Implement erosion and sediment controls (for P loss risk) | Minimum | Minimum | Minimum |
| **5.4.6** | Use border controls near waterways | Minimum | Minimum | Minimum |
| **5.5.1** | Prepare crop nutrient budgets | Additional | Minimum | Minimum |
| **5.5.2** | Plan nutrient rates and timing based on crop needs - fertiliser recommendations | Minimum | Minimum | Minimum |
| **5.5.3.1** | Test soil fertility annually for 3 years, then every 3 years (leaf/tissue testing if needed) | Minimum | Minimum | Minimum |
| **5.5.3.8** | Representative soil sampling | Minimum | Minimum | Minimum |
| **5.5.7** | Use well granulated fertilisers for ground application to minimise off-target drift | Minimum | Minimum | Minimum |
| **5.6.1** | Assess soil type, structure, drainage, and profile | Minimum | Minimum | Minimum |
| **5.6.11** | Crop rotation is implemented to optimise nutrient use and soil health | Minimum | Minimum | Minimum |
| **5.6.5** | Minimise fallow periods | Additional | Minimum | Minimum |
| **5.6.6** | Use cover crops to improve soil health | Additional | Minimum | Minimum |
| **5.5.4** | Use split fertiliser applications | Additional | Minimum | Minimum |
| **5.6.7** | Budget and monitor soil moisture | Additional | Minimum | Minimum |
| **5.5.3.2** | Representative soil testing for mineral N to inform nutrient budgets (leaf/tissue testing if needed) | Additional | Minimum | Minimum |
| **5.5.3.2** | Representative soil testing for mineral N at the beginning and end of each crop to inform nutrient budgets (leaf/tissue testing if needed) | Additional | Additional | Minimum |
| **5.5.3.4** | Test soil annually for PMN for 3 years, then every 5 years | Additional | Additional | Minimum |
| **5.5.6** | Use GPS-based or targeted application methods | Additional | Additional | Minimum |
| **5.4.7** | Implement controlled traffic farming (CTF) | Additional | Additional | Additional |
| **5.4.8** | Adopt new cultivation and planting technologies | Additional | Additional | Additional |
| **5.4.9** | Retire or manage marginal land | Additional | Additional | Additional |
| **5.4.10** | Construct treatment wetlands or protect existing wetlands | Additional | Additional | Additional |
| **5.5.3.3** | Nitrate Quick Test | Additional | Additional | Additional |
| **5.5.3.5** | Annual testing if nutrient imbalance is detected | Additional | Additional | Additional |

| COP reference | Management practices | GREEN | AMBER | RED |
|---|---|---|---|---|
| **5.5.3.7** | Leaf/tissue testing | Additional | Additional | Additional |
| **5.5.3.9** | Document soil sampling protocol | Additional | Additional | Additional |
| **5.5.5** | Use enhanced fertiliser products | Additional | Additional | Additional |
| **5.6.2** | Maintain soil pH at crop-optimal levels | Additional | Additional | Additional |
| **5.6.3** | Assess and manage soil compaction | Additional | Additional | Additional |
| **5.6.4** | Minimise tillage | Additional | Additional | Additional |
| **5.6.8** | Monitor soil organic matter | Additional | Additional | Additional |
| **5.6.9** | Monitor soil biology | Additional | Additional | Additional |
| **5.6.10** | Use catch crops | Additional | Additional | Additional |

**Table 5.2:** Minimum and additional erosion and sediment control practices (for P loss) for each erosion risk group.

| COP reference | Management practices | VERY LOW | GREEN | AMBER | RED |
|---|---|---|---|---|---|
| 2.4 | A block evaluation is conducted on each block to note key features and plan practices to implement. | Minimum | Minimum | Minimum | Minimum |
| | Maintain good ground cover with dense vegetation or coarse mulch. Increase infiltration through higher soil organic matter and mechanical aeration. | Additional | N/A | N/A | N/A |
| 3.1 | Intercept overland flow: Use a combination of interception drains, diversion bunding, culverts, benched headlands, and grassed swales. | Additional | Minimum | Minimum | Minimum |
| 3.3.1 | Raise all accessways. | Additional | Minimum | Minimum | Minimum |
| 3.3.3 | Leave setbacks from rivers and drains. | Additional | Minimum | Minimum | Minimum |
| 3.3.4 | Install and maintain vegetated buffer strips at the edges of your block or orchard. | Additional | Minimum | Minimum | Additional |
| 3.3.8 | Follow Vehicle and Machinery Washdown Code of Practice to prevent soil moving off site. | Additional | Minimum | Minimum | Minimum |
| 3.2.6, 3.2.7, 3.2.8 & 3.2.9 | Follow practices for cultivation, harvest, compaction reduction and postharvest block management described in this Code of Practice. | N/A | Minimum | Minimum | Minimum |
| 3.2.1 | Use cover crops where possible in your operation to avoid bare or fallow soil, especially during winter. | N/A | Additional | Minimum | Minimum |
| 3.2.2 & 3.2.3 | Improve infiltration: Use wheel track ripping or wheel track dyking to increase infiltration on wheel tracks. | N/A | Additional | Minimum | Minimum |
| 3.3.6 & 3.3.7 | Control sediment loss: Install decanting earth bunds or sediment retention ponds to prevent uncontrolled runoff water. | N/A | Additional | Additional | Minimum |
| 3.2.4 & 3.2.5 | Manage the flow of water down rows: Reduce row length to < 200 m or manage using contour drains or in-row cross contour vegetative strips. | N/A | Additional | Additional | Additional |

Refer to the Erosion and Sediment Control Code of Practice for more detail on each practice.

## 5.4 Operation-wide practices to minimise nutrient losses

These practices focus on minimising nutrient loss risks at the operation-wide level. Practices specific to vegetable/cropping operations are coloured **brown**.

| Practices in this section | Section |
|---|---|
| Manage fertiliser handling, transport, and storage | 5.4.1 |
| Calibrate fertiliser spreader equipment annually | 5.4.2 |
| Maintain irrigation systems | 5.4.3 |
| Fertiliser spreading operators are trained and competent | 5.4.4 |
| Implement erosion and sediment control (for P loss risk) | 5.4.5 |
| Use border controls near waterways | 5.4.6 |
| Implement controlled traffic farming (CTF) | 5.4.7 |
| Adopt new cultivation and planting technologies | 5.4.8 |
| Retire or manage marginal land | 5.4.9 |
| Construct treatment wetlands or protect existing wetlands | 5.4.10 |

The table below sets out the content of each practice.

| Field | Description |
|---|---|
| **Purpose and description** | Why this practice matters (the outcome it supports) and overview description |
| **Relevant risk factors** | List all relevant risk factors from Section 3 |
| **Key requirements** | The essential things that must be done |
| **Considerations** | Things that affect how it is applied (e.g. site-specific factors) |
| **Decision support tools** | Relevant tools in Section 6 |
| **Scale of application** | At what scale(s) it applies (operation, block, crop) |
| **Frequency/timing** | How often does the practice need to occur |
| **Records / evidence** | Maintaining accurate and up-to-date records provides evidence of practices trialed and implemented, particularly during audits. Good records support continuous improvement and demonstrates responsible nutrient management.<br>Your records may include both established practices and trials you are currently testing or implementing. Each practice in the following sections includes evidence and records to be kept. |
| **References** | Relevant legislation/regulation/Codes of Practice/Guidelines |

### 5.4.1 Manage fertiliser handling, transport, and storage

| Field | Description |
|---|---|
| **Purpose and description** | Poor fertiliser storage or handling can lead to direct losses to water–especially when located near waterways.<br>This practice ensures fertiliser is managed to minimise losses to water and air, and meets legal requirements related to the management of hazardous substances. It also promotes safe handling and minimises waste. |
| **Relevant risk factors** | Spills or leaks of fertiliser product |
| **Key requirements** | Store fertiliser in:<br>An enclosed, dry, clean, and well-ventilated building<br>Away from water bodies, bores, and stormwater drains<br>Clearly labelled and secure to prevent unauthorised access or spills<br><br>Ensure:<br>Proper staff training<br>Regular inspections and maintenance<br>Spill response kits and emergency procedures in place |
| **Considerations** | Proximity to waterways, wells, or stormwater systems<br>Type and volume of fertiliser stored<br>Compatibility with other stored substances<br>Security and access control<br>Emergency and spill management readiness |
| **Decision support tools** | - |
| **Scale of application** | Operation |
| **Frequency/timing** | At all times |
| **Records / evidence** | Inventory of fertilisers<br>Staff training records<br>Spill response plans<br>Incident and inspection logs<br>Storage location and safety data sheets (SDSs) |
| **References** | Legal requirements:<br>Hazardous Substances and New Organisms (HSNO) Act<br>Health and Safety at Work (Hazardous Substances) Regulations 2017 and guidelines<br>Fertiliser (Subsidiary Hazard) Group Standard 2020 (HSR002571)<br>Resource Management Act (RMA) – regional council rules<br>NZS 8409:2021 Management of Agrichemicals (applicable for mixed storage) |

### 5.4.2 Calibrate fertiliser spreader equipment annually

| Field | Description |
|---|---|
| Purpose and description | Fertiliser is applied accurately and evenly to optimise nutrient use efficiency and reduce risk of losses. Regular calibration means that fertiliser is distributed at the accurate rate and place. |
| Relevant risk factors | Rate of nutrient application, placement, nutrient application method |
| Key requirements | Calibrate spreader equipment at least annually or according to manufacturer's guidelines.<br>Adjust equipment to match product specifications and target rates.<br>Verify application rate annually. Evidence of spread pattern calibration should be available, however, this is not required annually.<br>Engage a SPREADMARK certified contractor if fertiliser spreading is outsourced. |
| Considerations | Type of fertiliser product (granule size, density)<br>Equipment condition and wear<br>Operator skill and experience<br>Weather conditions during calibration (e.g. wind affecting spread pattern) |
| Decision support tools | - |
| Scale of application | Operation |
| Frequency/timing | At least annually |
| Records / evidence | Calibration records (date, who, method)<br>Maintenance logs<br>Evidence of operator competence |
| References | SPREADMARK Accreditation Scheme (Fertiliser Quality Council) |

### 5.4.3 Maintain irrigation systems

| Field | Description |
|---|---|
| Purpose and description | Efficient irrigation (timing, rate, placement/distribution uniformity) through regular maintenance supports nutrient uptake and minimises losses.<br>Well-maintained irrigation systems mean that water is applied at appropriate times and rates to match plant needs. This reduces the risk of nutrient losses, surface runoff, and improves nutrient use efficiency. |
| Relevant risk factors | Irrigation, soil texture, rainfall |
| Key requirements | Maintain and monitor system components (e.g., pumps, pipes, sprinklers)<br>Pressure testing and distribution uniformity checks |
| Considerations | - |
| Decision support tools | - |
| Scale of application | Operation |
| Frequency/timing | According to manufacturer's specifications |
| Records / evidence | Regular maintenance and inspection of irrigation infrastructure (pumps, lines, valves, filters) and repaired as needed<br>Irrigation schedules, areas of irrigation, rates, volumes and timing in relation to rainfall and ET<br>Maintenance, calibration and service logs<br>Performance checks |
| References | Irrigation New Zealand's Code of Practice for Irrigation System Design<br>Irrigation New Zealand's Maintenance Guidelines |

### 5.4.4 Fertiliser spreading operators are trained and competent

| Field | Description |
|---|---|
| **Purpose and description** | Adequately trained operators apply nutrients accurately and responsibly, to maximise the efficiency of the product and minimise the risk of losses to the environment.<br>This includes understanding how to handle and apply fertiliser, operate and maintain equipment, follow safety procedures, and comply with relevant regulatory requirements. Training helps reduce the likelihood of nutrient losses and safety incidents. |
| **Relevant risk factors** | Placement, rate and method of nutrient application |
| **Key requirements** | Operator training of staff can be formal (e.g. certificates) or internal. Operator training includes:<br>Relevant aspects of nutrient management, e.g. fertiliser handling application, equipment calibration, storage, and spill response Understanding of legal obligations (e.g. HSNO, regional rules)<br>If using contractors, they must be appropriately certified (e.g. GROWSAFE trained and/or Spreadmark accredited). |
| **Considerations** | - |
| **Decision support tools** | - |
| **Scale of application** | Operation |
| **Frequency/timing** | At all times |
| **Records / evidence** | Staff training records<br>Contractor Spreadmark accreditation/GROWSAFE training certificate |
| **References** | Spreadmark Code of Practice<br>Fertiliser Quality Council – Requirements for Accreditation<br>Accredited Operator List https://fertqual.co.nz/spreadmark/<br>GROWSAFE Website – NZ Agrichemical Education Trust (NZAET) |

### 5.4.5 Implement erosion and sediment controls

| Field | Description |
|---|---|
| **Purpose and description** | Erosion and sediment runoff is the major contaminant loss pathway for phosphorus, particularly for cropping and vegetable operations. As such, this Nutrient Management Code of Practice has adopted the erosion risk assessment from the Erosion and Sediment Control Code of Practice to assess the risk of phosphorus loss risk – see Section 4.3. |
| **Relevant risk factors** | Rainfall, topography, soil texture, critical source areas |
| **Key requirements** | Block risk assessments are required on each production block. The level of risk directs growers to a toolbox of practices that are proportionate to the level of risk and tailored to particular growing environments. Refer to the Erosion and Sediment Control Code of Practice for full details on each practice.<br><br>The Erosion and Sediment Control Guideline applies to 'business as usual' operations such as rotational cropping. For growers undertaking major orchard development or contouring (i.e. large-scale soil movement), contact your local authority to understand what requirements may need to be met. |
| **Considerations** | Refer to the Erosion and Sediment Control Code of Practice |
| **Decision support tools** | https://www.vri.org.nz/esc/ (also known as Don't Muddy the Water) |
| **Scale of application** | Erosion and sediment control is important across all blocks in an operation. Specific practices are applied at the block scale. |
| **Frequency/timing** | Refer to the Erosion and Sediment Control Code of Practice |
| **Records / evidence** | As above. |
| **References** | Erosion and Sediment Control Code of Practice |

### 5.4.6 Use border controls near waterways

| Field | Description |
|---|---|
| **Purpose and description** | To minimise the risk of fertiliser from directly entering waterways during applications. Border controls act as physical or vegetative barriers between cropped areas and waterways. Border controls and careful spreading techniques serve as the final barrier to protect water quality. |
| **Relevant risk factors** | Placement, rate of nutrient application, topography, critical source areas |
| **Key requirements** | When applying fertiliser within 50% of the spread pattern width near a drain or water body, use spreader technology or setbacks to prevent fertiliser entering waterways.<br>Use a 5 metre uncultivated setback from all rivers as an interim measure. Over time, runoff into all rivers and drains needs to be controlled by contouring to intercept overland flow or an appropriate sediment treatment device, determined through the block risk assessment process in the Erosion and Sediment Control Code of Practice. |
| **Considerations** | Topography – steeper slopes create faster runoff<br>Rainfall and runoff risk – poorly draining soils increase the need for effective border controls<br>Leased land – ensure landowners are aware of border control requirements – discuss responsibilities for establishment and maintenance |
| **Decision support tools** | - |
| **Scale of application** | Block |
| **Frequency/timing** | As needed |
| **Records / evidence** | Location of border controls on farm maps<br>Detail of installation and type of control used<br>Take photographs, ideally before and after installation and over time or after major rainfall events<br>Landowner permission (as required) |
| **References** | Erosion and Sediment Control Code of Practice |

### 5.4.7 Implement controlled traffic farming (CTF)

| Field | Description |
|---|---|
| **Purpose and description** | Controlled traffic farming restricts the movement of machinery to dedicated tramlines in and around a block. It helps to maintain soil structure by reducing soil compaction, therefore improving nutrient uptake and overall crop production. |
| **Relevant risk factors** | Ground preparation and planting method, topography |
| **Key requirements** | Blocks have designated permanent tramlines, with aligned turning areas, headlands and access points.<br>Dedicated wheel tramlines are used, and no machinery operates outside of these lines. Tramlines are never cultivated.<br>Tramlines may require maintenance (compaction, rutting). |
| **Considerations** | GPS guided machinery<br>Tramlines managed using gravel, cultivation or compaction repair tools |
| **Decision support tools** | - |
| **Scale of application** | Operation |
| **Frequency/timing** | At all times when machinery is operating on a block |
| **Records / evidence** | Standard operating procedures (SOPs) for machinery use on tramlines<br>Tramlines identified on farm maps<br>Photos of implementation and maintenance |
| **References** | LandWISE Controlled Traffic Farming Resources - www.landwise.org.nz |

### 5.4.8 Adopt new cultivation and planting technologies

| Field | Description |
|---|---|
| **Purpose and description** | Advancements over time in cultivation and planting equipment has the potential to improve soil structure, reduce compaction, and increase plant uptake of nutrients. |
| **Relevant risk factors** | Ground preparation and planting method, soil texture |
| **Key requirements** | Plan machinery operations to align with Controlled Traffic Farming (see 5.4.7) to minimise compaction and erosion, for example, permanent wheel tracks, reduced overlap and passes.<br>Planting decisions support soil health and nutrient efficiency, considering soil moisture. |
| **Considerations** | GPS guided machinery |
| **Decision support tools** | - |
| **Scale of application** | Operation |
| **Frequency/timing** | During cultivation and planting |
| **Records / evidence** | Field operation records including planting, cultivation, harvest |
| **References** | - |

### 5.4.9 Retire or manage marginal land

| Field | Description |
|---|---|
| **Purpose and description** | Marginal land, such as areas with steep slopes, poor drainage, shallow soils, or low fertility, often contributes disproportionately to nutrient loss and sediment runoff. Retiring these areas from production can significantly reduce environmental risk. |
| **Relevant risk factors** | Topography, critical source areas |
| **Key requirements** | Steep, erosion-prone, or low-performing land managed with soil conservation practices or retired from cropping. |
| **Considerations** | Where full retirement is not practical, targeted practices (e.g. permanent vegetation) should be considered to improve water quality outcomes and soil health. |
| **Decision support tools** | - |
| **Scale of application** | Operation |
| **Frequency/timing** | As needed |
| **Records / evidence** | Evidence in farm maps |
| **References** | - |

### 5.4.10 Construct treatment wetlands or protect existing wetlands

| Field | Description |
|---|---|
| **Purpose and description** | Wetlands are highly effective at reducing nitrate and sediment losses from water leaving cropped areas. Natural or strategically located treatment wetlands—such as those at the bottom of a slope or gully—can intercept and treat runoff. Constructed wetlands can also reduce sediment and nutrient loads in drain outflows. |
| **Relevant risk factors** | Rainfall, topography (runoff-prone slopes and gullies), critical source areas, block history and cropping intensity. |
| **Key requirements** | Wetlands must be designed and sized appropriately for the catchment and inflow volume in accordance with accepted design guidance, by a suitably qualified and experienced professional. |
| **Considerations** | Pre-treatment of inflows may be needed (e.g. sediment traps or vegetated buffers)<br>Consent or approval may be required by your regional council<br>Consider ongoing maintenance needs |
| **Decision support tools** | - |
| **Scale of application** | Subcatchment/operation |
| **Frequency/timing** | As needed |
| **Records / evidence** | Photographs of installation, design and consent documents, maintenance logs, water quality monitoring (optional). |
| **References** | Refer to Horizons Regional Council guide and NIWA Constructed Wetlands Guidelines in the resources appendix for design considerations and check your regional council's consent requirements. |

## 5.5 Nutrients are applied accurately and responsibly

This section outlines the practices that support efficient nutrient use, so that crops receive the right nutrients, at the right rate, at the right time, and in the right place. These practices help maintain soil health, optimise yield, and reduce the risk of nutrient losses.

| Practices in this section | Section |
|---|---|
| Prepare crop nutrient budgets | 5.5.1 |
| Plan nutrient rates and timing based on crop needs – fertiliser recommendation | 5.5.2 |
| Test soil and leaf/tissue to inform nutrient budgets | 5.5.3 |
| General soil fertility testing | 5.5.3.1 |
| Laboratory soil mineral nitrogen testing | 5.5.3.2 |
| Nitrate Quick Test | 5.5.3.3 |
| Potentially mineralisable nitrogen (PMN) testing | 5.5.3.4 |
| Annual testing if nutrient imbalance is detected | 5.5.3.5 |
| Leaf/tissue testing | 5.5.3.6 |
| Representative soil sampling for soil testing | 5.5.3.7 |
| Document soil sampling protocol | 5.5.3.8 |
| Use split fertiliser applications | 5.5.4 |
| Use enhanced fertiliser products | 5.5.5 |
| Use GPS-based or targeted application methods | 5.5.6 |
| Use well granulated fertilisers for ground application to minimise off-target drift | 5.5.7 |

### 5.5.1 Prepare crop nutrient budgets

| Field | Description |
|---|---|
| Purpose and description | A nutrient budget informs a fertiliser recommendation. A basic nutrient budget quantifies the nutrients applied through fertiliser (inputs) and what is removed in the harvested crop (outputs).<br><br>More sophisticated nutrient budgets include the flow of nutrients between different nutrient pools, including soil mineral levels, plant and soil mineralisation, and losses. Tools, for example, the SVS Tool, prepare a nitrogen budget that shows the movement of N between different pools. The tool integrates soil testing to better estimate the nitrogen pools and tracks change between crops and during crop growth. |
| Relevant risk factors | Rate of nutrient application, block history, previous crop / residues |
| Key Requirements | **Account for inputs** like fertiliser and compost/manure, current levels of nutrient (e.g. nitrogen or phosphorus), and mineralisation.<br><br>**Account for outputs**. What the crop takes up and removes based on target yield, remaining crop residue and soil nutrient levels.<br><br>**Conduct soil testing**. Currently available soil tests for nitrogen can tell you the level of plant available nitrogen (see practices 5.5.2.2 and 5.5.2.3) and the level of potentially mineralisable N (see practice 5.5.2.4). Tracking results over time helps growers confirm that nutrient applications are maintaining optimal soil nutrient levels for the crop and adjust for seasonal variation.<br><br>**Account for environmental variables**. Long term weather conditions are accounted for in terms of mineralisation and losses.<br><br>**Account for organics and manures**. Compost or animal manure adds nutrients. Conduct a nutrient test on the product being used if the nutrient profile is unknown.<br><br>Use crop calculators or nutrient budgeting tools when available. |
| Considerations | Consult a qualified and experienced fertiliser advisor or agronomist.<br><br>A budget should form the basis for discussions between growers and advisors. A budget informs the fertiliser recommendation, but it is not a fertiliser recommendation itself.<br><br>Not all operations will need a formal nutrient budget, for example, blocks in NRG Green. In those cases, growers still need to provide evidence (e.g. soil or leaf tests) to demonstrate evidence based decisions are being made to minimise nutrient losses.<br><br>Consider residue from previous crops. Some crops leave more residual nitrogen than others. For example, brassicas leave large amounts of plant organic nitrogen that will potentially become available, compared to onions or carrots. Estimate this nitrogen source based upon the quantity of residue and its nitrogen content. |
| Decision support tools | The SVS Tool - see Section 6.1.1<br>Zespri N balance calculator - see Section 6.1.3<br>LandWISE-Nutrient-Budget-Guide-and-Templates-June-2021.pdf |
| Scale of Application | Crop |
| Frequency/timing | During cultivation and planting |
| Records / Evidence | A nutrient budget per crop for blocks with AMBER and RED risk levels |
| References | Refer to description of nutrient budget tools in Section 6 |

### 5.5.2 Plan nutrient rates and timing based on crop needs – fertiliser recommendation

| Field | Description |
|---|---|
| **Purpose and description** | Assessing crop nutrient requirements and planning inputs to support optimal plant health and productivity. By matching nutrient inputs to crop demand, tailored to increase, decrease or maintain soil fertility, and or to achieve specific crop quality characteristics, growers can improve nutrient use efficiency, reduce input costs, and minimise the risk of nutrient losses. |
| **Relevant risk factors** | Type, rate and timing of nutrient applications |
| **Key Requirements** | **Nutrient budget.** Understanding the movement between different nutrient pools.<br>**Factor in environment.** Include soil type, test results (adjust mineral levels), rainfall, and climate when planning fertiliser use. Split applications generally reduce the risk of a large amount of nutrients being washed into the subsoil. Split applications if needed, for example, in regions with high rainfall.<br>**Weather conditions are checked before application.** Forecasts help schedule nutrient applications for optimal uptake and minimal loss. Records of application timing and rainfall support compliance and planning. |
| **Considerations** | GPS guided machinery.<br>**Consider residue from previous crops.** Some crops leave more residual mineral than others. For example, brassicas leave large amounts of plant organic nitrogen that will potentially become available, compared to onions or carrots. Estimate this nitrogen source based upon the quantity of residue and its nitrogen content.<br>**Soil mineralisation.** Minerals released from the activity of soil microorganisms. For nitrogen this can be estimated using the Potentially Mineralisable N test (Hot Water Extractable Organic Nitrogen). |
| **Decision support tools** | - |
| **Scale of Application** | Crop |
| **Frequency/timing** | Prior to planting / start of growing season |
| **Records / Evidence** | Nutrient requirements of crop, nutrient budget/evidence of planned inputs, recent soil test results, type, rate and timing of fertiliser applications, crop type, planting date, expected and actual yields. Nitrogen timing and rates based on agronomic advice, grower knowledge, or crop guidelines |
| **References** | Reid and Morton, 2018, Nutrient Management for Vegetable Crops in New Zealand |

### 5.5.3 Test soil and leaf/tissue to inform crop nutrient budgets

Testing improves nutrient budget accuracy at both the planning stage for that crop, as well as tracking throughout the growing season. Considerable research has gone into nitrogen, most recently through the Sustainable Vegetable Systems project for vegetables, and Zespri kiwifruit research. This has given rise to improved understanding, budgeting and testing of nitrogen.

Phosphorus is considered the next focus from an environmental risk perspective. Decades of research and trials have been dedicated to erosion and sediment control, the main loss pathway for phosphorus. However, phosphorus use and build up in soils particularly in commercial vegetable growing systems is the current focus of nutrient research. This new focus will help test, and further inform, management practices like soil testing and guidance.

#### 5.5.3.1 General soil fertility testing

| Field | Description |
|---|---|
| **Purpose and description** | Shows levels of major nutrients like nitrogen (N), phosphorus (P), potassium (K), sulphur (S), and magnesium (Mg), and pH.<br>There are several commercial laboratories that offer soil testing in New Zealand, including Hill Labs, ARL, and Eurofins. The laboratories offer different types of soil tests depending on requirements. |
| **Relevant risk factors** | Soil texture, block history, previous crop / residues |
| **Key Requirements** | Submit soil samples for a basic soil test and soil health test |
| **Considerations** | Your local fertiliser/orchard supplies rep/agronomist may be able to help with soil sampling and interpretation of test results. |
| **Decision support tools** | - |
| **Scale of Application** | Block |
| **Frequency/timing** | For general soil fertility, test annually for three years, and then every 3 years |
| **Records / Evidence** | Laboratory results<br>Block history/rotations (vegetable specific). Records are kept to monitor change over time |
| **References** | Hill Labs (https://www.hill-labs.co.nz/)<br>ARL (https://arllab.co.nz/soil-testing/)<br>Eurofins (https://www.eurofins.co.nz/agricultural-testing/) |

#### 5.5.3.2 Laboratory soil mineral nitrogen testing

| Field | Description |
|---|---|
| **Purpose and description** | Soil mineral nitrogen testing measures nitrate and / or ammonium in soil that is immediately available to plants. This test is used to inform crop nitrogen budgets and plan nitrogen applications. Mineral nitrogen is very dynamic and levels change rapidly over a short period of time, especially when crops grow quickly. |
| **Relevant risk factors** | Soil texture, block history, previous crop / residues |
| **Key Requirements** | Submit soil samples to the laboratory by adding on a 'MinN' or 'Mineral N' test to other tests required. Collect samples using clean equipment, at target depths (typically 0-15 cm, ideally 0 – 30 cm in vegetable production), and correctly label samples with depths and unique location information. Samples must be chilled, sometimes frozen, to prevent mineralisation occurring while in transit to the lab. Ensure samples are < 4°C when they arrive at the lab. Use a certified soil testing laboratory. |
| **Considerations** | In some situations, soils will likely have high mineral N, for example:<br>Recently cultivated, blocks that have been intensively grazed, following a crop that did not achieve its planned yield, previous crop residues that have not decomposed in the soil (e.g. brassica).<br>It is important to test for mineral N in these soils before the next crop in rotation is established so that applications can be matched to the crop demand.<br>The best time to collect a soil sample for mineral N analysis is the week prior to base, planting or side dressings of nitrogen fertiliser (giving sufficient time for the lab to return the results). |
| **Decision support tools** | Enter into the SVS Tool |
| **Scale of Application** | To inform crop nitrogen budgets |
| **Frequency/timing** | Frequency of testing is dependent on block nitrogen loss risk level |
| **Records / Evidence** | Laboratory test results<br>Record of blocks sampled and tested |
| **References** | Plant & Food Research – Guidelines for Soil Nitrogen Testing and Predicting Soil Nitrogen Supply (August 2022) in Appendix B<br>Further guidance can be found in Appendix B: Resources |

### 5.5.3.3 Nitrate Quick Test

| Field | Description |
|---|---|
| **Purpose and description** | The Nitrate Quick Test is a fast and cost-effective method for estimating soil mineral nitrate concentrations to inform fertiliser decisions. This enables fertiliser applications to be better matched to the crop's nutrient requirements. |
| **Relevant risk factors** | Soil texture, block history, previous crop / residues |
| **Key Requirements** | Consistent sampling depth and method, using clean equipment to avoid contamination, and testing samples shortly after they are collected for best accuracy. Test strips, or electronic probes, must be used according to manufacturer instructions, with proper calibration and storage. Interpreting results requires understanding of the crop's growth stage and soil conditions to make informed nutrient decisions.<br>A Nitrate Quick Test can be used instead of a laboratory mineral N test. However, it is important to note that the Nitrate Quick Test results are in mg $NO_3$ (nitrate), while laboratory mineral N testing measures both nitrate and ammonium. The Quick Test result in mg$NO_3$ (top line – larger number on the test tube, or electronic probe) can be entered directly into the SVS Tool to calculate kg N/ha. |
| **Considerations** | The best time to collect a soil sample for mineral N analysis is just prior to base, planting or side dressings of nitrogen fertiliser.<br>A Nitrate Quick Test can be entered directly into the SVS Tool to improve the accuracy of the nitrogen budget. |
| **Decision support tools** | Enter into the SVS Tool |
| **Scale of Application** | To inform crop nitrogen budgets |
| **Frequency/timing** | Frequency of testing is dependent on block nitrogen loss risk level |
| **Records / Evidence** | Record of blocks sampled and tested and entered into the SVS Tool |
| **References** | Foundation for Arable Research website: Quick test nitrate guide |

### 5.5.3.4 Potentially mineralisable nitrogen (PMN) testing

| Field | Description |
|---|---|
| Purpose and description | Estimates how much soil N may mineralise due to microbial activity and become available to plants over the season, helping adjust fertiliser needs. This is also known as a Hot Water N test.<br><br>PMN testing is reasonably stable as it is linked to the soil type, climate and practices. It will vary throughout the year. Once established and results are consistent, testing only needs to occur every 5 years or so. When a block is coming out of longer-term pasture, where there can be considerable stores of nitrogen released, PMN testing should be conducted annually until a new equilibrium is reached. |
| Relevant risk factors | Soil texture, block history, previous crop / residues |
| Key Requirements | Collect fresh soil samples using clean equipment, send samples promptly to the laboratory, and include relevant sample and site information. Can be conducted alongside the basic nutrient testing. |
| Considerations | - |
| Decision support tools | Enter into the SVS Tool |
| Scale of Application | To inform crop nitrogen budgets |
| Frequency/timing | Annually for three years or until equilibrium is reached, then every 5 years |
| Records / Evidence | Laboratory results |
| References | Soil nitrogen testing and predicting nitrogen supply · Plant & Food Research |

### 5.5.3.5 Annual testing if nutrient imbalance is detected

| Field | Description |
|---|---|
| Purpose and description | Regular soil testing (fertility) helps adjust applications and avoid excess nutrient build-up and correct pH balance. |
| Relevant risk factors | Soil type, block history, previous crop / residues |
| Key Requirements | Where significant variability occurs across a block (e.g. different soil type, topography, multiple prior crops), multiple soil tests need to be taken. |
| Considerations | - |
| Decision support tools | - |
| Scale of Application | To inform crop nutrient budgets |
| Frequency/timing | Annual |
| Records / Evidence | Laboratory |
| References | For more results see the soil nitrogen testing factsheet for vegetable production developed by Plant and Food Research, referenced in Appendix B: Resources. |

### 5.5.3.6 Leaf/tissue testing

| Field | Description |
|---|---|
| **Purpose and description** | Leaf and tissue testing helps monitor nutrient levels of N, P, K and Mg in the plant. It is especially important in fruit crops to maintain crop optimum nutrient balance.<br><br>Use during key growth stages alongside soil moisture and crop health monitoring. Leaf testing is important as a monitoring tool for fine tuning fertiliser programmes in fruit production and seeking advice on optimum balance for the crop. |
| **Relevant risk factors** | Rate and timing of nutrient application |
| **Key Requirements** | Sample the correct tissue (e.g. most recent fully expanded leaf) and at the recommended growth stage for the crop. Follow crop-specific guidelines e.g. amount of tissue in sample and timing.<br><br>Collect tissue from multiple plants across the block. Clearly label samples with unique identification and location information.<br><br>Store samples appropriately, send to lab same day or refrigerate.<br><br>Use certified lab that can analyse for key nutrients required. |
| **Considerations** | Interpret results alongside visual information, soil tests and crop stage.<br><br>Use trends over time to guide nutrient management, rather than relying on a single test. |
| **Decision support tools** | - |
| **Scale of Application** | To inform crop nutrient budgets |
| **Frequency/timing** | As needed |
| **Records / Evidence** | Laboratory test results |
| **References** | See Appendix B: Resources |

### 5.5.3.7 Representative soil sampling for soil testing

| Field | Description |
| --- | --- |
| Purpose and description | Soil samples collected for testing, especially for blocks, should be representative of the area to which the results will be applied. Soil samples from across a block will contain a degree of variability, which, if unaccounted for, can lead to soil test results that drive the wrong management decision. Taking multiple cores from representative areas of a block, as well as accounting for known sources of natural variation (e.g. soil type, contour), will improve the reliability of soil data collected. |
| Relevant risk factors | Soil texture, block history |
| Key Requirements | Take samples in a consistent pattern across a block (e.g. a "W" or zigzag) to get representative results. In tree crops, monitoring trees are selected on a transect and should be returned to each year. Avoid unrepresentative areas like boundaries, tracks, headlands or variable parts of the block. Use 15-20 cores (0 – 15 cm or 0 – 30 cm) per block. Cores can be combined into a composite sample for a representative cropping area/soil type. |
| Considerations | GPS soil sample locations, so that the same pattern can be repeated in future. It improves consistency year to year by marking testing locations. A significant amount of error in soil testing comes from inconsistent sampling points year-to-year. |
| Decision support tools | - |
| Scale of Application | Block |
| Frequency/timing | To support representative soil testing |
| Records / Evidence | Locations of soil samples taken on a block |
| References | Refer to Appendix B: Resources |

### 5.5.3.8 Document soil sampling protocol

| Field | Description |
| --- | --- |
| Purpose and description | In large operations, multiple staff may be carrying out soil tests across different blocks, or over multiple years. A documented soil sampling protocol for staff to follow helps ensure best practice for taking soil samples, such as representative sampling (see previous table), is being followed. As soil test results drive decision making on nutrients applied, a protocol that drives consistent sampling technique across an operation, and over time, helps to improve the reliability of the results obtained. |
| Relevant risk factors | - |
| Key Requirements | A soil sampling protocol is available for anyone within an operation that carries out soil testing. The protocol should contain information on equipment needed, number of cores, sampling depth, sampling pattern/ GPS coordinates, and general sampling practices to follow (e.g. avoid leaving samples in a hot ute). Special instructions may be required for some tests (e.g. Mineral Nitrogen). |
| Considerations | Ensure staff are aware of the protocol and have it on hand (e.g., printed/ laminated in their vehicle) when testing. A short training sessiomay also be useful – a local soil testing rep may be available for this. |
| Decision support tools | - |
| Scale of Application | Operation |
| Frequency/timing | As needed |
| Records / Evidence | Sampling protocol on file and/or hard copy, training records |
| References | Refer to Appendix B: Resources |

### 5.5.4 Use split fertiliser applications

| Field | Description |
|---|---|
| **Purpose and description** | Smaller, timed applications match crop demand more closely and reduce losses. This is especially important for high-risk periods (e.g. early-season planting under cool and/or wet conditions). |
| **Relevant risk factors** | Rate and timing of nutrient application |
| **Key Requirements** | Timing aligned with crop nutrient demand and growth stages. Use appropriate fertiliser types and rates for each application based on recent soil tests, crop needs, soil moisture conditions, tool outputs or expert advice received.<br><br>Use calibrated fertiliser spreading equipment. |
| **Considerations** | Monitor soil nutrient levels between splits to adjust rates if needed |
| **Decision support tools** | SVS Tool can inform decision making on split applications |
| **Scale of Application** | Crop |
| **Frequency/timing** | For crops on blocks with AMBER and RED risk levels |
| **Records / Evidence** | Product type (incl. organic/compost applications), composition, rates/ quantities, dates, location, method of application, and weather conditions (rain before/during/after).<br><br>Field/orchard walk notes/photographs as evidence to support application of nutrients, if more than budgeted or required outside of recommended optimum. |
| **References** | - |

### 5.5.5 Use of enhanced fertiliser products

| Field | Description |
|---|---|
| **Purpose and description** | Coated or slow-release fertilisers (e.g. urease inhibitor coated urea) can reduce volatilisation or leaching and improve uptake. These products are designed to release nutrients more gradually or protect them from losses under certain environmental conditions, helping to align nutrient availability with crop demand. |
| **Relevant risk factors** | Type and rate of nutrient applied, nutrient application method |
| **Key Requirements** | Select appropriate products based on crop type, timing, and soil conditions.<br><br>Apply according to manufacturer guidance.<br><br>Ensure compatibility with existing application equipment. |
| **Considerations** | Consider integration with other nutrient management practices (e.g. split applications, soil testing).<br><br>Performance may vary based on soil temperature, moisture, and pH. Not all products are effective under all conditions. |
| **Decision support tools** | - |
| **Scale of Application** | Block |
| **Frequency/timing** | As needed |
| **Records / Evidence** | Product type, rate, date of application, block applied |
| **References** | Fertiliser company resources e.g. product specific technical information |

### 5.5.6 Use GPS-based or targeted application methods

| Field | Description |
|---|---|
| Purpose and description | Applying nutrients close to where the roots can access them, rather than broadcasting, improves efficiency and helps to minimise losses.<br>Technologies like banding (applying nutrients to the soil alongside the growing crop) and incorporation (placing nutrients directly in the crop root zone) place nutrients directly where needed and reduces fertiliser loss in wheel tracks.<br>Fertigation or foliar application is also a form of targeted application. |
| Relevant risk factors | Placement of nutrients applied and nutrient application method |
| Key Requirements | Select placement method based on crop type, soil, and equipment.<br>Nutrient application aligns with crop growth stage and uptake timing.<br>Calibrate equipment to apply fertiliser uniformly and at correct depth. |
| Considerations | May require specialised equipment or modifications to existing gear.<br>Potential labour or operational cost increase, offset by fertiliser savings and improved yield. |
| Decision support tools | - |
| Scale of Application | Crop |
| Frequency/timing | Required for blocks with RED risk level , at planting or side-dressings |
| Records / Evidence | Product type, rate, date of application, block applied |
| References | - |

### 5.5.7 Use well granulated fertilisers for ground applications to minimise off-target drift

| Field | Description |
|---|---|
| Purpose and description | Using well-granulated fertilisers helps accurate and even application, reducing the risk of off-target drift to non-crop areas such as waterways, headlands, shelterbelts, and neighbouring properties. Consistent granule size and weight improve spreading accuracy, especially when using centrifugal spreaders, and help ensure nutrients are delivered where intended. |
| Relevant risk factors | Placement of nutrients applied and nutrient application method |
| Key Requirements | Use high-quality, well-granulated fertiliser suitable for the spreader type.<br>Check compatibility with spreader equipment. Calibrate spreader to match product characteristics and desired application pattern.<br>Avoid application during windy or unstable weather conditions.<br>Maintain buffer zones near sensitive or off-target areas. |
| Considerations | Inconsistent granule size can lead to uneven nutrient distribution. |
| Decision support tools | - |
| Scale of Application | Crop |
| Frequency/timing | Ground fertiliser applications |
| Records / Evidence | Product type, rate, date of application, block applied |
| References | Product supplier supporting information |

## 5.6 Soil management to maximise nutrient uptake and minimise losses

Improving and maintaining soil quality is essential for nutrient use efficiency, crop performance, and reducing nutrient losses to the environment. This is especially critical in vegetable and cropping systems, where soil is frequently disturbed and more prone to degradation. Practices specific to vegetable/ cropping operations are coloured **brown**.

| Practices in this section | Section |
|---|---|
| Assess soil type, structure, drainage, and profile | 5.6.1 |
| Maintain soil pH at crop-optimal levels | 5.6.2 |
| Assess and manage soil compaction | 5.6.3 |
| Minimise tillage | 5.6.4 |
| Minimise fallow periods | 5.6.5 |
| Use cover crops to improve soil health | 5.6.6 |
| Budget and monitor soil moisture | 5.6.7 |
| Monitor soil organic matter | 5.6.8 |
| Monitor soil biology | 5.6.9 |
| Use catch crops | 5.6.10 |
| Crop rotation is implemented to optimise nutrient use and soil health | 5.6.11 |

### 5.6.1 Assess soil type, structure, drainage, and profile

| Field | Description |
|---|---|
| **Purpose and description** | Understanding soil characteristics helps identify areas at higher risk of nutrient loss and informs targeted management. Compacted or poorly drained zones reduce plant uptake, therefore reducing nutrient use efficiency, and increase the risk of nutrient losses. |
| **Relevant risk factors** | Soil texture, soil anion storage capacity |
| **Key Requirements** | Identify and map soil types across blocks.<br>Assess structure and depth to any barriers (e.g. pans, high water tables).<br>Flag areas with poor drainage or compaction for risk mitigation. |
| **Considerations** | Soil characteristics can vary across short distances–use representative sampling.<br>Consider GPS or digital mapping for more precise soil zone delineation. |
| **Decision support tools** | Visual Soil Assessment (VSA) guides |
| **Scale of Application** | Block |
| **Frequency/timing** | Baseline and reassess periodically |
| **Records / Evidence** | Soil maps and annotations if needed<br>Soil test results/VSA results<br>Notes from field assessments (e.g. compaction tests, drainage observations) |
| **References** | Manaaki Whenua Landcare Research. S-map Online (https://smap.landcareresearch.co.nz/) |

### 5.6.2 Maintain soil pH at crop-optimal levels

| Field | Description |
|---|---|
| Purpose and description | Soil pH affects nutrient availability and crop uptake e.g. molybdenum, zinc, aluminium and manganese toxicity, and nitrogen mineralisation rates. Soils with pH levels outside the optimal range can lead to nutrient deficiencies or toxicities, reduce root growth, and increase risk of nutrient loss. |
| Relevant risk factors | Soil texture |
| Key Requirements | Regular soil testing to monitor pH (see general soil fertility testing practice).<br>Apply lime or other pH modifiers based on test results and soil type to achieve optimal pH levels of the crop(s). |
| Considerations | For lime application timing consider crop growth stage and weather conditions.<br>Consider subsurface acidity if deep rooting crops are affected.<br>Consider pH-related specific crop disease management requirements e.g. powdery scab (potatoes), clubroot (brassicas) |
| Decision support tools | - |
| Scale of Application | Block |
| Frequency/timing | As needed |
| Records / Evidence | Lime type, source, rate, and application date |
| References | Supplier technical product information |

### 5.6.3 Assess and manage soil compaction

| Field | Description |
|---|---|
| Purpose and description | Compacted soils limit water and nutrient movement, restrict root growth, and affect potential yield. |
| Relevant risk factors | Soil texture, ground preparation and planting method |
| Key Requirements | Use simple tools like penetrometers or spade tests to check compaction. Address compaction with practices like deep ripping or rotations with cover crops to re-establish soil structure.<br>Avoid cultivation or trafficking when soils are saturated.<br>Monitor over time. Compaction can re-form with repeated traffic. |
| Considerations | Consider controlled traffic systems (designated tramlines). |
| Decision support tools | Visual Soil Assessment Guide (VSA) – see Section 6.3.1 |
| Scale of Application | Block |
| Frequency/timing | Annually, or during soil preparation if cultivating |
| Records / Evidence | Soil compaction assessment results |
| References | MWLR Visual Soil Assessment (VSA) Field Guides |

### 5.6.4 Minimise tillage

| Field | Description |
|---|---|
| Purpose and description | Frequent cultivation degrades soil structure, accelerates nitrogen mineralisation, reduces organic matter, and increases risk of erosion and phosphorus loss. |
| Relevant risk factors | Ground preparation and planting method |
| Key Requirements | Evaluate the need for each tillage pass–avoid cultivation when not essential.<br>Use reduced or no-till systems, for example, direct drilling.<br>Use appropriate equipment suited to reduced tillage. |
| Considerations | Transitioning to reduced tillage may require changes in crop rotation, weed control, and fertiliser placement.<br>No-till systems may initially show variable performance on compacted or poorly drained soils.<br>Consider impact on pest and disease cycles when changing tillage practices. |
| Decision support tools | - |
| Scale of Application | Block |
| Frequency/timing | At each planting or ground preparation stage where possible |
| Records / Evidence | Cultivation method and frequency per paddock or block |
| References | |

### 5.6.5 Minimise fallow periods

| Field | Description |
|---|---|
| Purpose and description | Minimising fallow periods helps to reduce erosion and nutrient losses, and support nutrient cycling and soil biology by maintaining continuous ground cover, typically a cover or catch crop.<br>Other practices to minimise fallow are described in the Erosion and Sediment Control Code of Practice. |
| Relevant risk factors | Previous crop |
| Key Requirements | Refer to cover crops (5.6.6) and catch crops (5.6.10) |
| Considerations | Refer to cover crops (5.6.6) and catch crops (5.6.10) |
| Decision support tools | The SVS Tool can support use of cover/catch crops |
| Scale of Application | Block |
| Frequency/timing | After harvest of every crop |
| Records / Evidence | Planting and harvest records, yields. |
| References | Erosion and Sediment Control Code of Practice |

### 5.6.6 Use cover crops to improve soil health

| Field | Description |
| --- | --- |
| **Purpose and description** | Cover crops can be incorporated into the soil (green manure) to improve soil quality and long-term productivity, or they can be sprayed off and direct-drilled into for the next crop.<br>Following crops with high nitrogen residues, cover crops can:<br>• Take up excess soil nitrogen<br>• Improve organic matter<br>• Support soil health during fallow periods.<br><br>These crops can be:<br>• Ploughed in to enhance soil quality and long-term production, or<br>• Sprayed off and direct-drilled for the next crop. |
| **Relevant risk factors** | Fallow periods, cropping intensity, cropping root depth, crop residues |
| **Key Requirements** | Choose species based on rotation goals and nutrient needs. Legumes can fix nitrogen, grasses are efficient nitrogen scavengers, and brassicas can help with pest control.<br>Establish cover crops promptly after harvest to maximise benefits.<br>On blocks with AMBER or RED risk levels, where fallow is unavoidable, explain what alternative practices are in place. |
| **Considerations** | Note: Cover crops like legumes may leave additional nitrogen in the soil. Account for this in your next crop's nutrient budget.<br>Avoid species that may exacerbate pest or disease problems in the next crop. |
| **Decision support tools** | The SVS Tool can support the above estimates |
| **Scale of Application** | Block |
| **Frequency/timing** | Between main crop cycles where possible |
| **Records / Evidence** | Cover crop species, sowing/termination dates |
| **References** | Erosion and Sediment Control Code of Practice<br>AgResearch A Practical Guide for Using Green Crops in New Zealand |

### 5.6.7 Budget and monitor soil moisture

| Field | Description |
|---|---|
| **Purpose and description** | Monitoring and budgeting soil moisture helps match water application to crop needs and reduces nutrient losses. This is particularly important during spring and autumn when crop uptake is lower, and rainfall can be unpredictable. Efficient water management supports better nutrient use efficiency, prevents over- or under-irrigation, and helps maintain soil structure and biological activity. |
| **Relevant risk factors** | Soil texture, irrigation, rainfall |
| **Key Requirements** | Monitor soil moisture using appropriate sensors (e.g. tensiometers, capacitance probes, or manual soil checks).<br>Develop a soil water budget.<br>Adjust irrigation scheduling based on soil moisture, evapotranspiration, and forecast conditions.<br>Do not irrigate beyond the soil's water-holding capacity (field capacity).<br>Integrate soil moisture data with nutrient application planning to reduce risk of losses. |
| **Considerations** | Ensure proper sensor placement, calibration, and maintenance – seek professional advice.<br>Combine moisture data with evapotranspiration (ET) estimates for more accurate scheduling.<br>Use moisture information to time fertiliser or fertigation to match crop uptake. |
| **Decision support tools** | FAR Soil Water Budget Tool |
| **Scale of Application** | Block |
| **Frequency/timing** | Continuously |
| **Records / Evidence** | Water budgets linked to irrigation scheduling (if irrigating), proof of correct sensor installation |
| **References** | Irrigation New Zealand SMART Irrigation Scheduling Toolkit |

### 5.6.8 Monitor soil organic matter

| Field | Description |
|---|---|
| **Purpose and description** | Soil organic matter (OM) improves water holding capacity, nutrient retention, and soil structure. Regular OM testing helps track long-term changes in soil health and guides decisions on tillage, crop rotation, fertiliser inputs, and organic amendments. |
| **Relevant risk factors** | Previous crop / residues, fallow periods |
| **Key Requirements** | Test soil organic matter at consistent depth and sampling locations over time.<br>Use accredited soil testing laboratories with consistent methodology.<br>Identify trends with an aim to maintain or increase OM, particularly in low OM soils.<br>Where OM is declining, implement practices to restore it (e.g. cover crops, compost, reduced tillage). |
| **Considerations** | OM builds slowly—changes may take several years to become measurable. |
| **Decision support tools** | Visual Soil Assessment (VSA) for structure and biological indicators |
| **Scale of Application** | Block |
| **Frequency/timing** | Every 3–5 years for trend analysis, or more frequently if needed |
| **Records / Evidence** | Options can include: Soil test results (OM %, total carbon, etc.) Sampling location maps<br>Notes on changes in management practices influencing OM<br>Photographs or VSA records over time |
| **References** | MWLR Visual Soil Assessment (VSA) Field Guides |

### 5.6.9 Monitor soil biology

| Field | Description |
|---|---|
| **Purpose and description** | Healthy biological activity supports nutrient cycling, organic matter decomposition, disease suppression, and soil aggregation. Several indicators can be used to monitor soil biology, both in the field e.g. earthworm counts and diversity, and using soil testing e.g. nematode analysis. |
| **Relevant risk factors** | Previous crop / residues, fallow periods |
| **Key Requirements** | Select appropriate biological indicators based on cropping system, soil type, and management goals.<br>Use consistent sampling locations and methods for trend analysis. Sample under similar conditions for comparability.<br>Where biological activity is low, choose a practice to improve soil biology e.g. increase organic inputs, reduce tillage, improve pH balance. |
| **Considerations** | Soil biological activity varies with moisture, temperature, and season |
| **Decision support tools** | Visual Soil Assessment (VSA) guides |
| **Scale of Application** | Block |
| **Frequency/timing** | Laboratory soil biology tests every 3–5 years |
| **Records / Evidence** | Lab test results, records of management practices influencing biology (e.g. compost application, cover cropping, tillage changes) |
| **References** | MWLR Visual Soil Assessment (VSA) Field Guides |

### 5.6.10 Use catch crops

| Field | Description |
|---|---|
| **Purpose and description** | A catch crop is any crop that is grown with the primary objective of catching residual nitrogen left over from the previous crop that would otherwise be lost. At harvest, this crop is exported off farm. Catch crop examples include maize and grass grown for silage or hay. |
| **Relevant risk factors** | Previous crop, fallow periods |
| **Key Requirements** | As the goal of catch crops is to remove excess nitrogen, crops planted for this purpose need to have a fibrous root system, capable of removing nitrogen from deep in the soil profile. |
| **Considerations** | Catch crops must be planted as early as possible after the previous crop. This increases their effectiveness in reducing nitrogen and sediment loss, and reduces the risk of losing the excess nitrogen through drainage events. Early planting will also help maximise yields. |
| **Decision support tools** | SVS Tool – The tool models how much nitrogen may become available after a vegetable crop, which supports decision making on whether a catch crop may be useful to plant. |
| **Scale of Application** | Block |
| **Frequency/timing** | Following a main crop, often going into autumn |
| **Records / Evidence** | Catch crop species, sowing / harvest dates, yields |
| **References** | FAR - https://assets.far.org.nz/CB0-3368_BrendonMalcolm_Catch-Crop-Guidelines_UPDATE-Oct-2024.pdf |

### 5.6.11 Crop rotation is implemented to optimise nutrient use and soil health

| Field | Description |
|---|---|
| **Purpose and description** | The purpose of crop rotation is to maintain soil structure, soil nutrient status, reduce pests and diseases, and improve biodiversity. Crop rotation helps to prevent crops' mining of mineral nutrients from the same depth in the soil, which impacts crop performance over time. Additionally, the inclusion of leguminous crops in an annual crop plan can provide nitrogen for the following crop to uptake, reducing nutrient input requirements.<br><br>Crop rotation is also important when considering residual nitrogen leftover from previous crops and understanding how this could be utilised in future crops (see 5.6.10 Catch crops). |
| **Relevant risk factors** | Block history (previous crop), cropping intensity / cultivation, cropping root depth (of planned crop) |
| **Key Requirements** | Rotate between different annual crop families each cropping cycle and plan the annual cropping programme several years in advance. Keep records of previous crops to ensure the same families are not being grown in the same block too often.<br><br>Rotate cash crops with cover crops or pasture and animals to restore soil structure and organic matter. |
| **Considerations** | If a build-up of specific pests or diseases is observed, or crop performance is poor (considering other factors), then rotations should be extended, to reduce the impact on profitability, but also to try and break the pest or disease cycle. |
| **Decision support tools** | SVS Tool |
| **Scale of Application** | Operation |
| **Frequency/timing** | Continuously, as part of crop planning processes |
| **Records / Evidence** | Planting and harvest records, land planning documents |
| **References** | - |

# 6 Decision support tools

Decision support tools can help growers plan, track, and adjust nutrient inputs to improve efficiency and minimise losses. These tools are based on research, grower testing, and designed to support decision making. In this section, we introduce available tools developed to support horticultural production.

## 6.1 Nutrient management tools

Crop calculators and tools can aid the development of a nutrient budget. Details on what is currently available to the horticulture industry is provided below.

### 6.1.1 Sustainable Vegetables System (SVS) Tool (vegetables)

The SVS Tool (www.svstool.co.nz) is a nitrogen budget support tool developed for commercial vegetable production. It helps improve understanding of nitrogen dynamics, increase fertiliser use efficiency, and reduce environmental impacts.

The SVS Tool generates nitrogen budgets and provides fertiliser guidance based on information about the growing system and soil nitrogen test results. It is designed to support the development of Nutrient Management Plans, with modelled soil mineral nitrogen levels tracked and refined through regular soil testing. A forward-looking model is essential, but real-time soil test results allow the fertiliser guidance to be reset and adjusted for the current season.

Nitrogen flows in commercial vegetable systems are extremely dynamic. The rotation of diverse crops, seasonal variability, market demands, and multiple nitrogen sources including crop residues, total soil nitrogen, and fertiliser, make nitrogen management complex.

The SVS project has conducted nearly four years of nitrogen trials and monitored nitrogen flows across nine commercial sites. This research supports the tool's nitrogen budgeting process, making invisible nitrogen flows visible through a research-based, ground-truthed decision support tool.

The snapshots below are from the SVS Tool Guide, showing the tool outputs for current crop nitrogen balance.

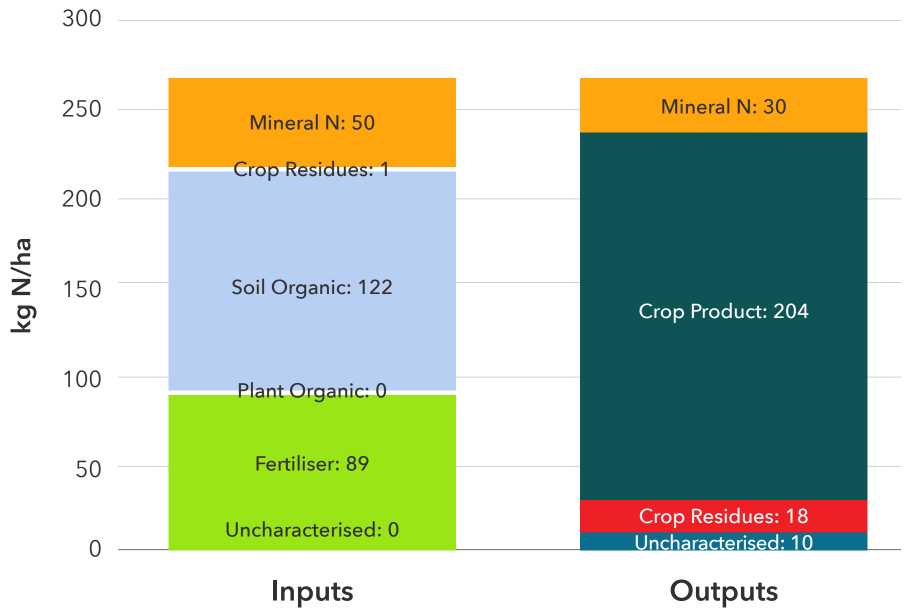



**Figure 6.1:**Model outputs: Current crop nitrogen balance example scenario.

| Inputs | Outputs |
|---|---|
| **Mineral:** Mineral N in the top 30 cm of soil at harvest of the prior crop. | **Mineral:** Mineral N in the top 30 cm of soil at crop finish date. |
| **Crop residues:** Nitrogen in non-product parts (in seed or transplants). | **Crop residues:** Nitrogen in non-product crop parts such as roots, leaves and stems. |
| **Plant organic:** Nitrogen released by decomposition of the previous crop's organic matter (typically referred to as mineralisation of crop residues). | **Plant organic:** Nitrogen absorbed (immobilised) by decomposition of the previous crop's organic matter (typically referred to as immobilisation of crop residues). |
| **Fertiliser:** Nitrogen fertiliser. | **Crop product:** Nitrogen in crop product (including any potential paddock losses). |
| **Uncharacterised:** Adjustment for uncharacterised under prediction in initial mineral or organic residue inputs that would be needed to achieve the soil test value specified. | **Uncharacterised:** Adjustment for uncharacterised losses including percolation below 30 cm (which may still be available), gaseous emissions and over predictions in initial mineral, soil organic, or residue inputs that would be needed to achieve the soil test value specified. |
| **Soil organic:** Mineralised N released from total soil nitrogen pool during crop growth. | |

The tool delivers two of the most significant developments in nutrient management practice: **a nitrogen budget and integrated soil nitrogen testing**. This process improves nitrogen use, enables better timing and reduced rates of fertiliser application, and ultimately lowers the risk of nitrogen losses.

Growers can use the SVS Tool for free. Refer to the SVS Tool user guide on VR&I to see what crops are included in the tool.

The SVS Tool enables accurate nitrogen budgeting and integrates soil tests - two key practices in the Nitrogen Risk Scorecard (Section 6.1.2) described below.

### 6.1.2 Commercial Vegetable Growing Nitrogen Risk Scorecard

The CVG N Risk Scorecard is a **nitrogen management tool**. It was initially developed by experts and tested by growers for use in the Horizons region. Its purpose is to support nitrogen management by driving practice change proportionate to loss risk to achieve a target score. This approach that has been well tested and demonstrated during the Scorecard's development.

Target scores are prescribed in the Scorecard's nitrogen loss risk table and are based on biophysical risk. Target scores are based on rainfall and profile available water classes (as seen in the biophysical risk assessment of this Code of Practice). The table includes 12 categories, with unitless target scores ranging from 72 to 44. A score of 72 indicates the lowest nitrogen loss risk (low rainfall, high PAW). A score of 44 indicates the highest nitrogen loss risk (high rainfall, low PAW).

Consequently, where the risk is higher, to achieve a low score more practices are required. Most likely this will involve additional soil mineral nitrogen testing to help further guide fertiliser decision making.

The Scorecard is split into two main components, nitrogen fertiliser practices and soil health.

Management risk is largely determined by fertiliser application rates. Both annual totals and per-application amounts. Scores associated with each practice are calculated by multiplying the point values for each practice band by the proportion of the productive area it applies to. The overall risk score is then adjusted (up or down) based on the grower's practices and the percentage of total production area each practice covers.

The two fundamental practices that will drive down nitrogen losses is the use of a nitrogen budget and soil nitrogen testing. The SVS nitrogen decision support tool (Section 6.1.1) integrates these two practices, making them feasible and achievable within commercial vegetable growing systems.

Crop rotation is essential for maintaining soil and plant health, and in commercial vegetable growing often involves moving across multiple properties to complete a rotation. The Scorecard is designed to support crop rotation while managing any changes in localised risk that may arise when land parcels change.

Complete the Scorecard once for the baseline and then as required to track practice change.

In this Code of Practice, it is a suitable decision-support tool for commercial vegetable growers planning nutrient inputs and developing crop nutrient budgets.

A copy is available on the HortNZ website.

### 6.1.3 Zespri nitrogen balance calculator (kiwifruit)

The nitrogen balance calculator is a **nitrogen budget tool** based on a yearly (seasonal) nitrogen mass balance at a steady state. A total nitrogen balance is calculated by considering the amounts of all nitrogen inputs and outputs. The amounts are scaled to a hectare level or to a whole orchard level.

Calculator users are required to enter net amounts of nutrient inputs (specified below) and the yield (target or already harvested). The output of the calculator is the amount of surplus or deficit nitrogen.

Nitrogen inputs included:

- Ground applied mineral fertiliser. Based on common fertiliser chemical formulations and application rates.
- Compost. Based on a 15% total N available as mineral nitrogen in the first year. Then 7.5%, and then 3.75% in subsequent years.
- Foliar urea or nitrate. Based on common fertiliser chemical formulations and application rates.
- Budbreak enhancer. Based on common fertiliser chemical formulations and application rates.

The nitrogen balance calculator tool is available as a downloadable hard copy for growers on Canopy, a membership based portal in the Zespri's website Canopy | Home.

### 6.1.4 LandWISE nutrient budget templates (vegetables)

The LandWISE nutrient budget templates for nitrogen and phosphorus offer a practical, low-cost tool for comparing crop nutrient requirements with planned nutrient applications. These templates use simple mass-balance methods to support informed decision-making and encourage continuous improvement in nutrient management.

By incorporating the best available industry guidelines, or other well-justified inputs, the templates can help document and demonstrate nutrient loss risks are being addressed and managed in accordance with industry expected practice.

Before planting, the templates can be used to create or check fertiliser plans and estimate the nutrient status of the field. Following harvest, they can help evaluate how nutrients were used or lost based on what actually occurred during the season.

Because nitrogen and phosphorus require different management approaches, separate templates have been developed for each nutrient.

LandWISE-Nutrient-Budget-Guide-and-Templates-June-2021.pdf.

### 6.1.5 Soil nitrogen supply calculator (all sectors)

Developed by Foundation for Arable Research.

It is an Excel-based nutrient budget tool that allows growers to input their soil test results and estimate nitrogen availability over the season. It is designed to support growers to have information on soil nitrogen supply and help with nitrogen fertiliser decisions making.

Growers can access the tool here: https://www.far.org.nz/resources/soil-nitrogen-supply-calculator.

## 6.2 Soil management tools

### 6.2.1 Don't Muddy the Water (all sectors)

This erosion and sediment calculator web app enables growers to quantify their erosion rates to help with planning management practices. It contains all the information needed to get started in calculating your erosion rates both before and after the installation of mitigations.

The tool and supporting resources can be found on the Vegetable Research and Innovation Board website - https://www.vri.org.nz/esc/.

### 6.2.2 Visual Soil Assessment (VSA) field guide

Manaaki Whenua Landcare Research developed the VSA field guide. These guidelines are designed for cropping and pastoral grazing on flat to rolling country. These guidelines provide methods to sustain soil condition by looking after soil structure and soil organic matter. They cover issues of soil compaction, erosion and loss of soil organic matter. If the VSA of your farm shows that soil structure is deteriorating, these guidelines will suggest management practices to repair the damage. If VSA indicated your soil is in good condition, use the practices in these guidelines to keep it that way.

Link to the resources: VSA field guide » Manaaki Whenua

# Appendix A: Nutrient and Erosion Management (NEM) workbook

These are snapshots of the Excel-based workbook available to download from the HortNZ website.

## NUTRIENT AND EROSION MANAGEMENT (NEM) WORKBOOK

This Excel workbook is designed to support outdoor growers to develop and maintain two plans required for the responsible management of contaminants from horticultural production systems, including nitrogen, phosphorus, and sediment. These plans include:

- Nutrient Management Plan (NMP), in accordance with the Nutrient Management Code of Practice 2026
- Erosion and Sediment Control Plan (ESCP), in accordance with the Erosion and Sediment Control Code of Practice 2026

The Nutrient and Erosion Management (NEM) workbook steps growers through the process of undertaking risk assessments to identify practices to implement, to manage the risk of contaminant loss. This workbook should be supported with additional information required for each plan, for example nutrient budgets, records, and test results, as well as mapped locations of environmental mitigations (e.g. Sediment Retention Ponds).

The information contained in this workbook forms part of a wider farm plan. There is no requirement to use this exact workbook, but it's a helpful tool to meet the criteria set out in the Nutrient Management and Erosion and Sediment Control Codes of Practice.

**Instructions:**
Please use Microsoft Excel to complete this workbook to ensure all the inbuilt formulas function correctly.
This workbook should be reviewed on an annual basis to track progress towards actions.
To do this, we recommend keeping a working or current version of this workbook e.g. "J Apple Farm - NEM workbook.xlsx", and saving a separate dated copy each year before reviewing. This will allow you to demonstrate progress over time.
This workbook has a number of built-in formulas and links to help make information entry and navigation as easy as possible. Each tab contains a template you can fill in to help complete both your Nutrient Management Plan and Erosion and Sediment Control Plan. The tabs and workbook align with the relevant Codes of Practices.

**Updates to this workbook may occur at any time. As part of your annual review, please check the HortNZ website to ensure you are using the latest version.**

Cells coloured light yellow are fillable.

**Contents**



## BUSINESS INFORMATION

**1.1 Key business details**

Complete all the key information relating to your growing operation below for the next 12 months. To be updated as part of your annual review to reflect any changes.

| | |
|---|---|
| **Business name** | |
| **Physical address** | |
| **Person responsible** | |
| **Prepared by** | |
| **Date completed** | |
| **Next review date** | |

**1.2 Goals and objectives**

Goals keep your plan relevant and focused on what you are trying to achieve. Goals are useful to know if your plan is working and show how you are making decisions tied to risk and desired outcomes.

*If your business goals and objectives are stored elsewhere, there is no need to fill in the cells below. Just include a link or reference to where your goals are stored.*

| | |
|---|---|
| **Production** *e.g. maximise crop yield, increase soil health to support long-term productivity* | |
| **Financial** *e.g. reduce fertiliser costs and improve nutrient use efficiency* | |
| **Environmental** *e.g. reduce nitrogen leaching from high-risk blocks, minimise sediment and phosphorus runoff* | |
| **Personal** *e.g. a clear plan reduces audit burden, leave a positive legacy on the land* | |

## NITROGEN LOSS RISK

This table will help you complete the risk of nitrogen loss assessment in Section 4.2 in the Nutrient Management Code of Practice. The risk assessment needs to completed at a block level. Blocks can be defined at the scale at which decisions are made and practices implemented, and/or delineated based on factors such as crop type, soil type, topography, or practices (e.g. fertiliser use, irrigation, or cultivation).

You will need the following information on hand for each production block, in addition to block area:

- Annual rainfall (<1000 mm, 1000-1300 mm, 1300-1600 mm, or >1600 mm)
- Soil profile available water (high, moderate, or low)
- Total annual nitrogen applied (kg N/ha)
- Quantity of nitrogen applied in a single application (kg N/ha)

The table will calculate biophysical risk and nitrogen use risk, and assign a nutrient risk group (NRG) to each block. Each NRG relates to a set of required practices to manage the level of risk. For more information on nutrient risk groups, refer to Section 5.3 in the Nutrient Management Code of Practice.

| | | | Step 1: Biophysical risk | | |
|---|---|---|---|---|---|
| **No.** | **Block ID** | **Productive area** (ha) | **Annual rainfall** (mm) | **Soil Profile Available Water** (mm) | **Biophysical risk** |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

## EROSION & PHOSPHORUS LOSS RISK

This table will help you complete the erosion risk assessment in Section 2.2 of the Erosion and Sediment Control Code of Practice (ESC COP). This risk assessment is also used to assess the risk of phosphorus loss in Section 4.3 of the Nutrient Management Code of Practice. The same risk assessment is used for both contaminants (i.e. sediment and phosphorus) because soil erosion is the most significant phosphorus loss pathway in horticultural production systems.

The erosion risk assessment needs to be completed at a block level. Blocks from tab 'Risk - N loss' will prepopulate this table. It is useful to have the following information on hand for each production block:

- Slope in degrees
- Soil texture
- Block erosivity
- Block row length

Not all information will be required for each block, depending on slope, soil texture etc. Use the risk assessment in Section 2.2 of the ESC COP for a visual guide on how the assessment uses block information to assign an Erosion Risk Group.

Refer to the blue tabs labelled 'ERG' to identify what practices are to be implemented on each block, based on the level of risk.

**Instructions:**
Your Block IDs and productive areas are copied across from tab 'Risk - N loss'.
As you fill out the table from left to right, cells will change colour, depending on whether further information is required to assign an Erosion Risk Group.
Continue entering in information until a risk group is assigned.
As this follows the Erosion Risk Assessment, feel free to use the flow chart in the Code of Practice instead.
A summary of the groups assigned can be found in tab 'Risk summary'.

| | | | Erosion risk assessment *(see Section 2.2 in the ESC COP)* | | | |
|---|---|---|---|---|---|---|
| **No.** | **Block ID** | **Productive area** (ha) | **Is soil uncultivated or < 25% bare at any time of the year?** | **Slope** (degrees) | **Is the soil texture sand or loamy sand?** (least likely to erode) | **Block erosivity** (see map ESC CoP Page 70) |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

## NUTRIENT RISK GROUP: AMBER PRACTICES

The nitrogen loss risk assessment in tab assigns each block to a nutrient risk group, Green, Amber, or Red.
For each NRG, you are provided with a set of practices to implement to manage the risk of nitrogen loss.
While the practices are almost the same for each NRG, different practices are marked as 'Minimum' or 'Additional', depending on the risk level.
Detailed information on each practice can be found in the Nutrient Management Code of Practice.
The blocks assigned to NRG Amber are provided to the left of the practice table. This list is linked to the tab 'Risk summary'.

**Instructions:**
Use this table to work through each practice for the blocks assigned to Amber risk. Notes are provided for some practices.
If you mark a practice as Yes, use the Evidence column to note how this practice is implemented.
If you mark a practice as Partial or No, provide information on the action to be completed.
If you mark a practice as N/A, justify why this does not apply in your operation.
Once completed, make use of the filter buttons (e.g. practices marked as No or Partial) to focus on the actions to carry out over the next 12 months.

**You should work towards achieving 100% of Minimum practice and 25% of Additional practices across all blocks in this Nutrient Risk Group.**

**Minimum** practices achieved **0%**

**Additional** practices achieved **0%**

**Blocks** | **Practices to reduce the risk of sediment and phosphorus loss**

| AMBER | ESC COP reference | Management practices | Minimum or additional | Yes/Partial/No or N/A |
|---|---|---|---|---|
| | 1.5 | Nutrient Management Plan prepared | Minimum | |
| | 1.5 | Nutrient Management Plan is updated and reviewed annually | Minimum | |
| | 5.4.1 | Manage fertiliser handling, transport, and storage | Minimum | |
| | 5.4.2 | Calibrate fertiliser spreader equipment annually | Minimum | |
| | 5.4.3 | Maintain irrigation systems | Minimum | |

## EROSION RISK GROUP: VERY LOW PRACTICES

The erosion risk assessment in tab 'Erosion & P loss risk' assigns each block an erosion risk group: Very low, Green, Amber, or Red.
Each erosion risk group (ERG) is linked to a set of practices to implement to manage the risk of soil and sediment loss, which is linked to phosphorus loss.
Detailed information on each practice can be found in the Erosion and Sediment Control Code of Practice.
The blocks assigned to Very low are provided to the left of the practice table. This list is linked to 'Risk summary'.

**Instructions:**
Use this table to work through each practice for the blocks assigned to ERG - Very low.
If you mark a practice as Yes, use the Evidence column to note how this practice is implemented.
*Ensure evidence includes links to further plans or details (e.g. vegetated buffer strip maps and specifications).*
If you mark a practice as Partial or No, provide information on the action to be completed.
If you mark a practice as N/A, justify why this does not apply in your operation.
Once completed, make use of the filter buttons (e.g. practices marked as No or Partial) to focus on the actions to carry out over the next 12 months.

**You should work towards achieving 100% of Minimum practice.**

**Minimum** practices achieved **0%**

**Additional** practices achieved **0%**

**Blocks** | **Practices to reduce the risk of sediment and phosphorus loss**

| VERY LOW | ESC COP reference | Management practices | Minimum or additional | Yes/Partial/No or N/A |
|---|---|---|---|---|
| | 2.4 | A block evaluation is conducted on each block to note key features and plan practices to implement. | Minimum | |
| | | Maintain good ground cover with dense vegetation or coarse mulch. Increase infiltration through higher soil organic matter and mechanical aeration. | Additional | |
| | 3.1 | Intercept overland flow: Use a combination of interception drains, diversion bunding, culverts, benched headlands, and grassed swales. | Additional | |
| | 3.3.1 | Raise all accessways. | Additional | |

# Appendix B: Resources

## HortNZ Codes of Practice

The HortNZ Codes of Practice in this suite are listed below. These can be used by growers to build their overall farm or orchard plan.

| Tool | Sector | Description |
|---|---|---|
| **Nutrient Management Code of Practice 2026** | All outdoor growing systems | This Code provides direction for outdoor fruit and vegetable growers to manage nutrient use responsibly, while maintaining crop productivity. It explains how nutrients cycle through growing systems, how to assess block level nutrient loss risk, and apply appropriate practices to manage those risks. A Nutrient & Erosion Management Excel workbook supports growers to develop a Nutrient Management Plan by documenting current practices, assessing risks, and planning nutrient use in a structured and practical way. |
| **Erosion and Sediment Control Code of Practice 2026** | All outdoor growing systems | This Code provides practical direction on managing erosion and sediment loss from outdoor horticultural production activities. It includes a block erosion risk assessment process, and range of risk-based practices to minimise erosion and soil loss, maintain soil health, and protect waterways. A Nutrient & Erosion Management Excel workbook supports growers to develop an Erosion and Sediment Control Plan by documenting current practices, assessing risks, and implementing erosion and sediment control measures in a structured and practical way. |
| **Vehicle and Machinery Washdown Code of Practice 2026** | All outdoor growing systems | This Code provides direction on practices to implement to reduce the movement of soil offsite, which also prevents the spread of pests, diseases, and contaminants. It includes direction on siting washdown areas, managing washwater, and protecting soil and water from contamination. |
| **Drain Nutrient Solution Management Code of Practice 2026** | Soilless growing systems that generate drain solution requiring management | This Code outlines practices to manage drain nutrient solution from soilless growing systems. It focuses on responsible drain solution land application to protect soil and water resources and optimise resource use. The Code helps growers reduce nutrient losses and manage environmental compliance expectations by developing a Drain Solution Management Plan, which is supported by a Drain Solution Management Plan Excel workbook. |
| **Vegetable Washwater Management Code of Practice 2026** | Vegetable growing operations that generate washwater from vegetable washing | This Code provides guidance for vegetable growers, who use water for washing, to sustainably manage the resulting washwater produced. Guidance focuses on selecting the most appropriate treatment option for each grower's operation, providing high level information on a range of treatment options, with links to further resources where required. |

## Other guides and resources

Several other guides and resources, in addition to this Code of Practice, are available online for growers to refer to for their nutrient, soil and irrigation management planning.

| Name | Sector | Description |
|---|---|---|
| **FAR Focus: Nutrient Management Plans (2012)** | Arable, but principles applicable to all sectors | The FAR Nutrient Management Plan guide provides an overview of nutrient management planning, along with a useful checklist growers may want to refer to when thinking about nutrient management. https://www.far.org.nz/resources/far-focus-6-nutrient-management-plans. |
| **Name** | **Sector** | **Description** |
| **Fertiliser Association Code of Practice (2023)** | All sectors | This Code of Practice for fertiliser nutrient management is intended to provide clear principle-based guidance on supplying the nutrients for growing healthy food, while at the same time avoiding or minimising the loss of those nutrients to the environment. https://www.fertiliser.org.nz/code-of-practice/. |
| **Fertiliser Association Nutrient Management Planner** | All sectors | The Fertiliser Association has an interactive pdf template, prepared by Fert Research, that could be used to prepare a nutrient management plan: https://www.fertiliser.org.nz/resources/nutrient-management-planner. |
| **Nutrient Management for Vegetable Crops in New Zealand – JB Reid & JD Morton (2019)** | Outdoor vegetable production | This guide was developed to provide guidance on nutrient applications for a range of outdoor vegetable crops: https://www.hortnz.co.nz/assets/Compliance/Nutrient-Management-for-Vegetable-Crops-in-NZ-Manual-Feb-2020.pdf. |
| **Nutrient Management Adviser Certification Programme (NMCAP)** | All sectors | The NMACP is an industry-wide certification programme targeted at those who provide nutrient management advice to New Zealand farmers: www.nmacertification.org.nz/nutrient-management/ |
| **Plant & Food Research – Guidelines for Soil Nitrogen Testing and Predicting Soil Nitrogen Supply (August 2022)** | All sectors | Plant & Food Research NZ developed a factsheet on testing for soil nitrogen. https://www.plantandfood.com/en-nz/article/soil-nitrogen-testing-and-predicting-nitrogen-supply |
| **LandWISE Fertiliser Equipment Performance Assessment – Online course** | All operators spreading nutrients | An online course that describes fertiliser application equipment monitoring suitable for growers' applying nutrients with their own equipment. The course covers broadcast and placement fertiliser spreading equipment: https://www.landwise.org.nz/courses/fertiliser-equipment-calibration/ |
| **A Lighter Touch** | All sectors | How to interpret a soil test: Soil-testing-guide-v2.pdf |
| **Fertmark** | All users of fertiliser | Fertmark is quality assurance programme for fertiliser products that independently audits products to ensure what is on the label is in the bag: https://fertqual.co.nz/fertmark/ |
| **Spreadmark** | Nutrient spreaders | Spreadmark is a nutrient spreading quality assurance and risk management programme for spreading contractors. It certifies spreading equipment and audits the contractors' assurance and compliance processes: https://fertqual.co.nz/spreadmark/ |

| Soils | | |
|---|---|---|
| **Visual Soil Assessment (VSA) Field Guide – Graham Shepherd (2000)** | All sectors | Released in 2000, the VSA guide was developed to help farmers understand soil quality, and how to manage their soils sustainably. This guide is targeted towards pastoral and cropping famers: https://www.landcareresearch.co.nz/assets/Publications/VSA-Field-Guide-/VSA_Volume1.pdf<br>FAO (UN Food & Agriculture Organisation) has several VSA volumes published in one (also co-authored by Graham Shepherd), including a guide for orchards (find on page 92): https://www.fao.org/4/i0007e/i0007e00.pdf |
| **Foundation for Arable Research – Nitrate Quick Test User Guide** | All sectors | Nitrate Quick Test Tool Guide describes how and when to take soil samples, and preparing the soil for testing: Quick-test-nitrate-guide.pdf |
| **Fertiliser Association – Sampling pastoral, arable, and horticultural soils (2024)** | All sectors | This booklet sets out to recommend soil sampling methods to ensure consistency in the approach. This consistency ensures valid comparison and interpretation of repeated sampling over time: https://www.fertiliser.org.nz/files/site/Sampling-Pastoral-Arable-and-Horticultural-Soils-Final.pdf |
| **Hill Labs – DIY Self-sampling Guide for soil and leaf.** | All sectors | A guide produced by Hill Labs, one of the major testing labs in New Zealand, on best practice soil and leaf sampling, in addition to an overview of their tests and dispatch instructions: https://www.hill-labs.co.nz/media/msehbkce/hill-diy-test-8pp-web-1.pdf |
| **Irrigation** | | |
| **Irrigation New Zealand** | All sectors | Codes of Practice covering, irrigation design, hydraulics and pumping, water measurement, fertigation, installation and performance assessment: Codes of Practice : IrrigationNZ |
| **Foundation for Arable Research - Soil water budget tool & user guide** | Arable, but applicable to cropping and vegetable sectors | An Excel spreadsheet tool to create a soil water budget for irrigation scheduling:<br>https://www.far.org.nz/resources/soil-water-budget-tool-user-guide |
| **Other** | | |
| **Constructed wetland practitioner guide – NIWA, DairyNZ (2022)** | Written for pastoral but applicable to horticulture | This guide provides design and performance information to establish a surface-flow constructed wetland to reduce contaminant loss (nitrogen, phosphorus and sediment) from subsurface tile drains, shallow groundwater outflows from seeps and springs, and surface drains and small streams in pastoral farming landscapes:<br>https://niwa.co.nz/sites/default/files/wetland%20practitioner%20Guide-web.pdf |
| **Mitigating nutrient loss from pastoral and crop farms: A review of New Zealand literature. Horizons Regional Council.** | All sectors | A compilation of mitigations that a pastoral and/or cropping farm operation could use to reduce its environmental impact. This document provides information on:<br>• Wetlands (pages 1-5)<br>• Riparian buffers (pages 6-8)<br>https://www.horizons.govt.nz/HRC/media/Media/Consent/Mitigating-nutrient-loss.pdf |

# Appendix C: Glossary

| | |
|---|---|
| **Block** | The scale at which nutrient management decisions are made, and practices implemented. Blocks can be delineated based on factors such as crop type, soil type, topography, or practices (e.g. fertiliser use, irrigation, or cultivation). |
| **Nutrient budget** | A statement of the total nutrient inputs and outputs for a specific crop/block. A budget shows the different nutrient pools and how these change between the start and end of the budget period.<br>Inputs include: current soil/plant mineral levels, plant residue, soil mineralisation, and fertiliser.<br>Outputs include: soil/plant mineral levels at the end, predicted nutrients taken up by the harvested product, crop residues (non-productive crop parts), and estimated nutrient losses (below the root zone). |
| **Fertiliser recommendation** | A statement of fertiliser needs, including product choice, rate, timing and placement to achieve desired soil fertility and/or meet nutrient requirements of a plant at a particular growth stage. A fertiliser recommendation uses information from nutrient budgets, soil analysis, plant tissue analysis, and even climate data to meet specific requirements of a crop at a specific growth stage. A fertiliser recommendation may be tailored to increase, decrease or maintain soil fertility, or to achieve specific crop quality characteristics, e.g. protein levels, sugar levels, colour, flowering/vegetative growth, reduced vigour, increase vigour etc. |

Horticulture™
New Zealand
Ahumāra Kai Aotearoa