Horticulture New Zealand Nutrient Management Code of Practice

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Document control

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

Change	Reference
Structure change	Whole document
Addition of risk assessments	Section 4
Addition of Nutrient Management Plan workbook and minimum and recommended practice lists	Appendix A

This code of practice will be reviewed, as necessary, by Horticulture New Zealand Limited. 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.

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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. Farm planning drives outcomes for both growing operations and the environment.

It is important that principles of nutrient management drive decisions in each stage of production. There is no 'one size fits all'. Decisions and actions taken will vary between operations and growing locations. Variables include 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 (N) lost from the crop rooting zone via soil drainage can enter groundwater and surface water. The use of synthetic N fertiliser can also lead to nitrous oxide (N2O) emissions to the atmosphere. Phosphorus (P) lost during erosion and sediment loss events, especially on cropping operations, can reach surface water. This Code of Practice signposts to the Erosion and Sediment Control Guidelines. These guidelines contain methods and practices for managing erosion and therefore P losses.

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.

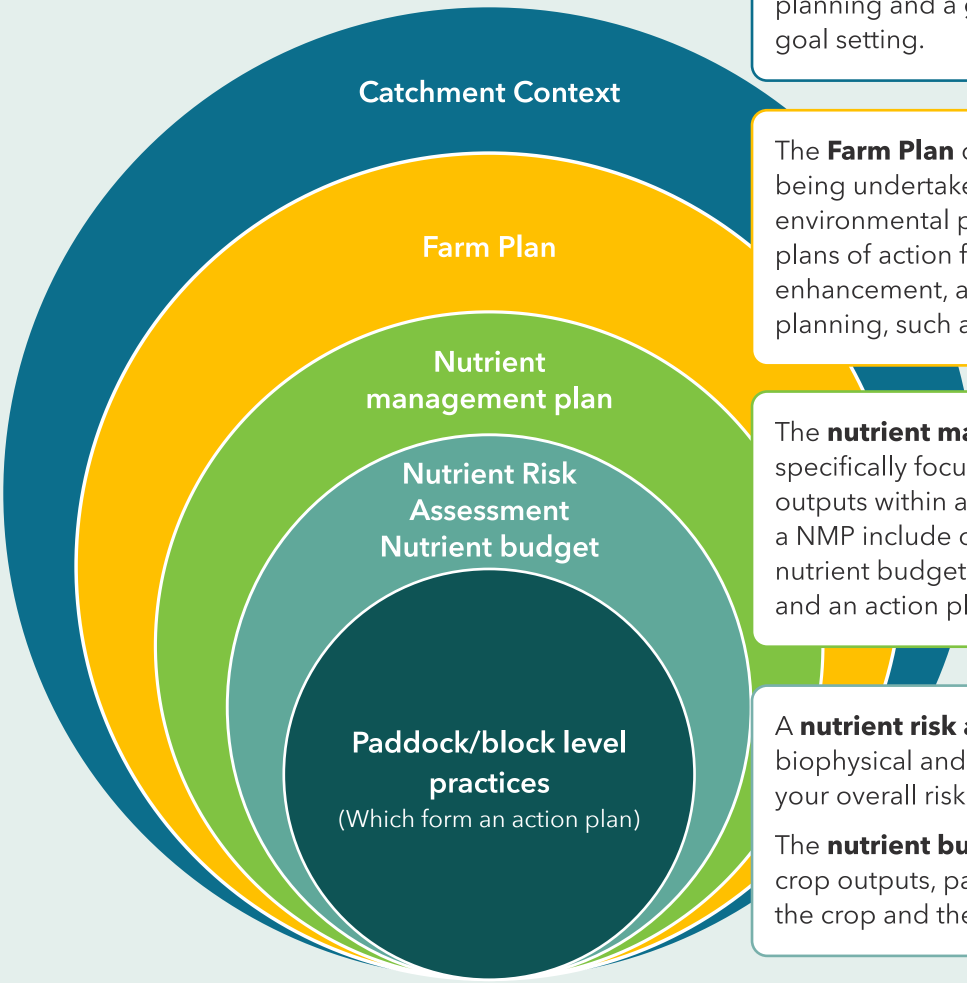
1.2 How to use this Code of Practice

The Code starts with catchment context. It places the need for these efforts in the context of the local environment. It then provides background information about nutrient use and how losses occur. It then steps through how to determine an operation's risk for N and P loss. Based on the level of risk, growers select practices in their nutrient management plan to appropriately manage the risk.

Nutrient management planning is the vehicle to guide sustainable nutrient use in operations. Growers are encouraged to use this Code of Practice guided by the nutrient management plan outline (and template in Appendix A), to complete:

- 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, and
- An action plan to illustrate commitment to continuous improvement.

Figure 1.1 sets out how farm planning, nutrient risk assessment, and on-farm actions, fit together.



The **catchment context** refers to the values and challenges for freshwater in the surrounding catchment. It significantly influences whole farm planning and a growers' operational activities and goal setting.

The **Farm Plan** considers the full range of activities being undertaken on the farm, often from an environmental perspective. The plan may include plans of action for freshwater, or biodiversity enhancement, as well as broader operational planning, such as training.

The **nutrient management plan** (NMP) specifically focuses on major nutrient inputs and outputs within a growing operation. Key aspects of a NMP include objective setting, risk assessments, nutrient budgeting, practices including soil tests, and an action plan.

A **nutrient risk assessment** includes both biophysical and management risks to understand your overall risk level.

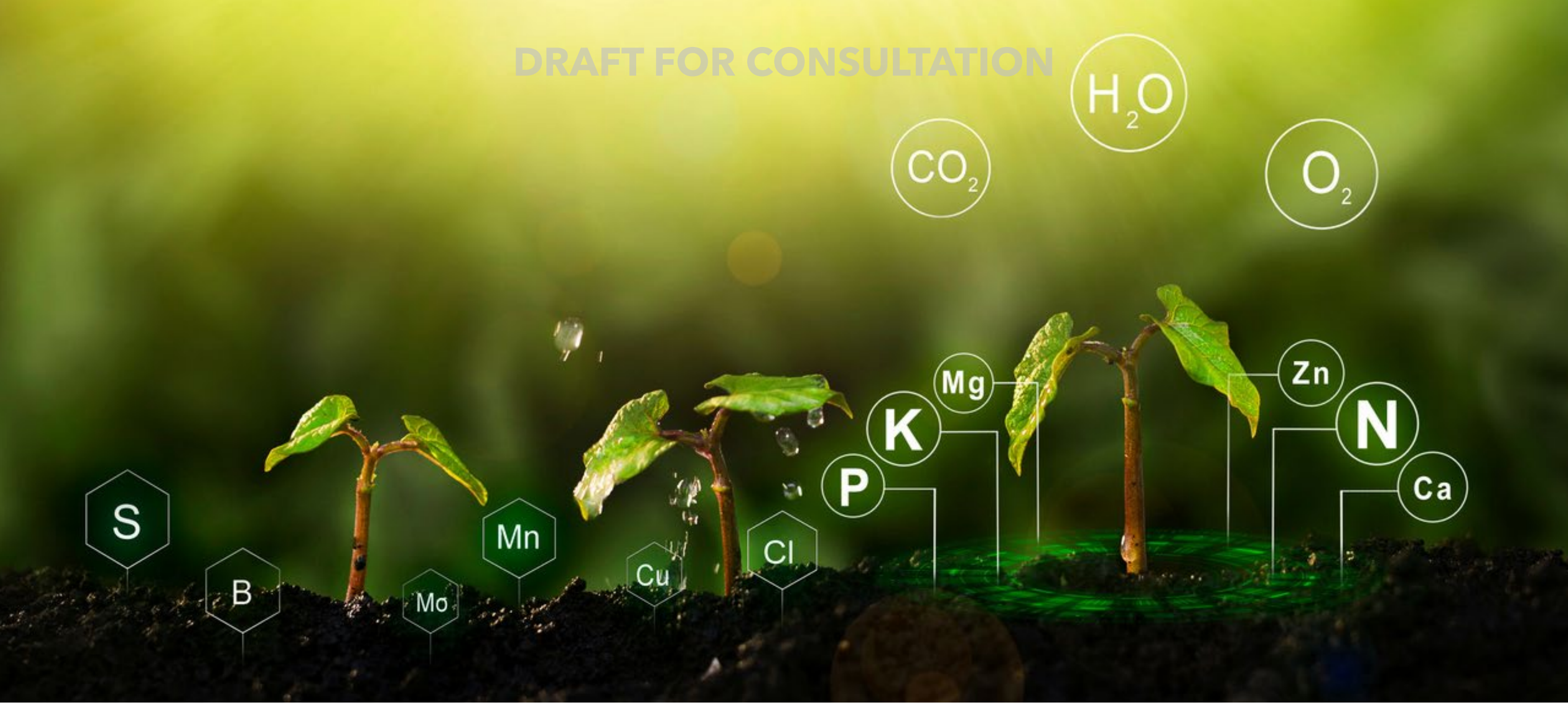
The **nutrient budget** compares crop inputs with crop outputs, partitioning the nutrients between the crop and the environment.

Paddock/block level practices include all practices on-farm that relate to the sustainable management of nutrients, which forms the basis of nutrient budgeting, as well as the wider nutrient management plan.

Figure 1.1. The context of nutrient management planning within a wider farm/operation 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-plan.



1.3 Catchment context

Growers need to consider the catchment's context in their freshwater farm plan. Regional Councils are responsible for making catchment context information available.

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 or below national bottom lines. 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.
2. Setting of short, medium, and long-term objectives in their farm plan. Objectives related to environmental impact of the growing operation 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 plans integrate risk management across food safety, environment and employment law.

The 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/mahinga kai.

The Freshwater Farm Plan Regulations apply nationally and focus on addressing adverse effects from agriculture on freshwater. Freshwater farm plans contain farm maps, risk assessments, action planning, and records. Farm maps identify environmental features and growing activities. Risk assessments look at key biophysical and operation risk factors. Action plans contain a hierarchy of actions to manage risks across the operation, over time. Freshwater farm plans are one method to manage catchment water quality, that will be used in regional plans.

This Code of Practice supports growers to develop a Nutrient Management Plan. **Section 3.1** below introduces nutrient management planning, and how this Code of Practice supports growers to build and maintain a plan for their operation.

1.5 Nutrient Management Plan

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

Once risk levels for N and P 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 should include flexibility to manage uncertainty such as extreme weather resulting in unexpected nutrient losses. Using this approach, nutrients are used efficiently, and environmental risks minimised.

A well-communicated NMP supports both performance and compliance. This Code of Practice helps growers develop NMPs that meet minimum expected practice and 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, perhaps relating to finance, overall productivity, or soil health.

The 4Rs—Right Product, Right Rate, Right Time, Right Place—form the foundation of effective nutrient planning. It is an evidence-based approach to keeping nutrients in the field for optimal plant growth and minimise 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 N and P (Section 4),
- **Practices and tools t**o improve nutrient use and minimise 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 plan
- **Comprehensive records** of practices, for example, maps, test results, fertiliser recommendation
- **Action plan** of all actions, responsibilities and timeframes (Appendix A), and
- **Review process t**o track and adapt over time.

Figure 1.2 illustrates the steps to build and update an NMP using this Code of Practice.

The risk that is being addressed is of uncontrolled nutrient losses. The outcome is that nutrient losses are minimised and well controlled once a Nutrient Management Plan is fully implemented.

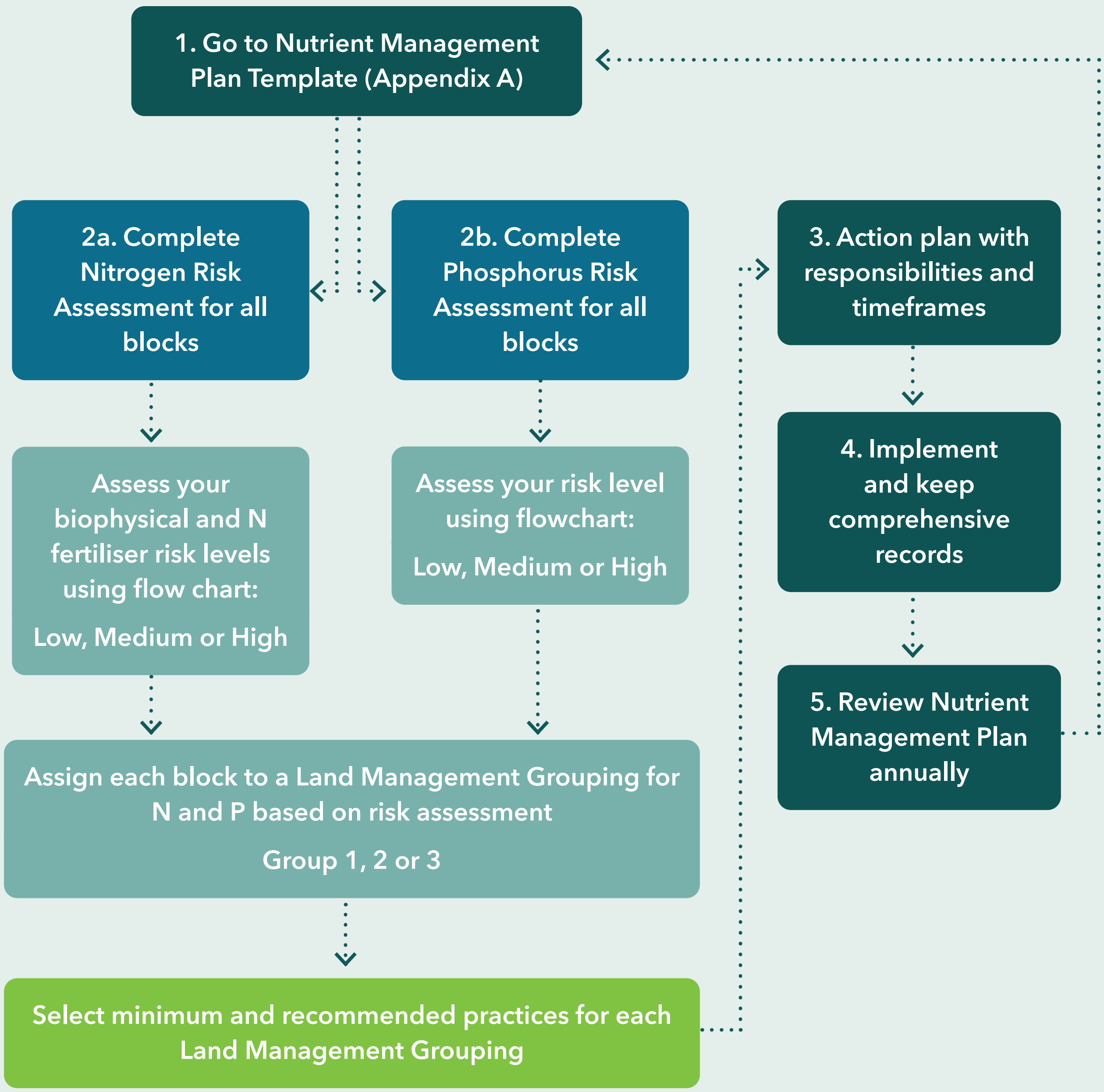


Figure 1.2: Steps to building and updating a Nutrient Management Plan.

Appendix contains an NMP Workbook template to guide growers through developing and updating their plan. The next section describes how to nutrients are used in horticulture, and cycle through the environment.

2 UNDERSTANDING NUTRIENTS IN HORTICULTURE

This section describes the nitrogen and phosphorous 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 maintain environmental and human health.

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.

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 nitrogen), nitrous oxide (N_2O), 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 N currently in the soil in plant available forms (nitrate and ammonium).
- **Mineralisation of nitrogen from soil organic matter:** As the volume of organic matter increases, the amount of mineral N increases over time and becomes available to plants.
- **Mineralisation of nitrogen from incorporated crop residues:** Some crops such as brassicas contain large amounts of N. 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 N_2 in the air 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 and excreted.
- **Fertiliser applications**, including organic inputs such as compost.
- Application of **animal manures** / grazing animals.

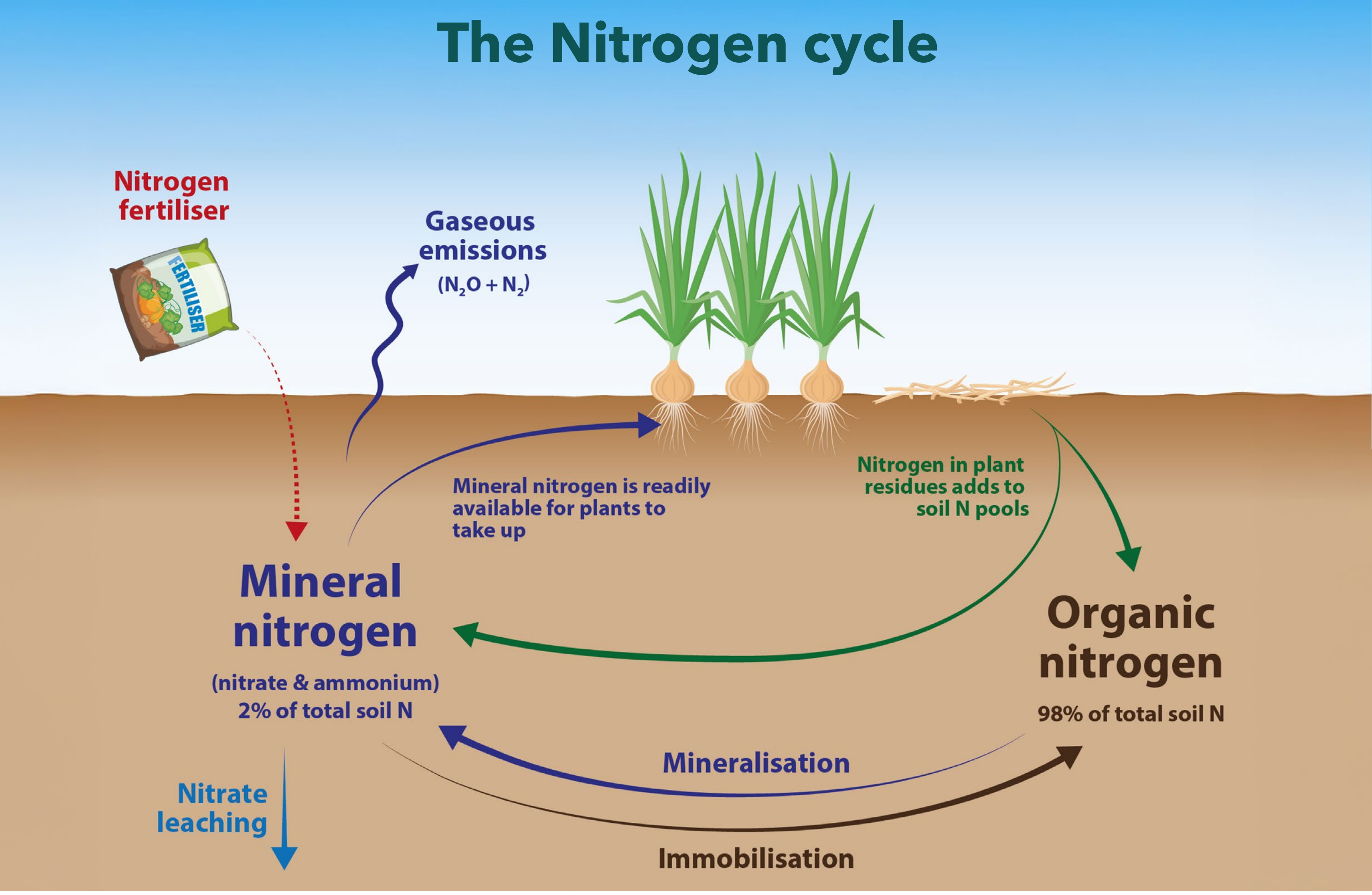


Figure .1. Figure .1. Nitrogen cycle in horticulture systems. Adapted from original produced by Plant & Food Research (addition of nitrogen fixation by legumes).

Nitrogen loss pathways include:

- **Leaching:** This is the major process by which nitrogen as nitrate is lost to groundwater. Nitrate pools in soils are flushed below the root zone in drainage events. Drainage is caused by rainfall and irrigation. 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 is lost via surface runoff during rainfall events.
- **Denitrification:** Where microorganisms convert plant available nitrate back to N2O (nitrous oxide), and this greenhouse gas is released into the atmosphere.

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

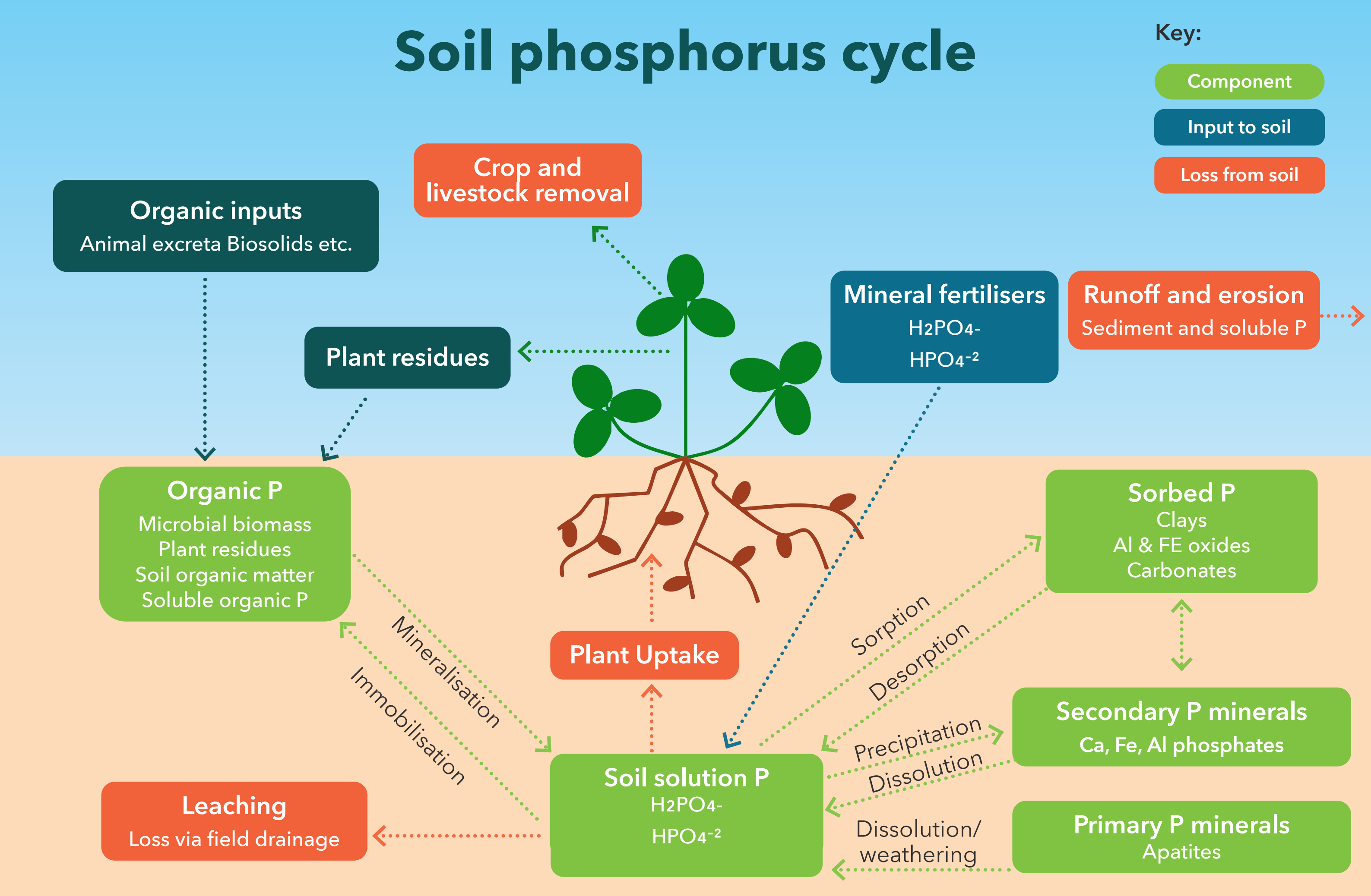


Figure .2. Phosphorus cycle in horticulture production systems[4].

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] Fink, J. R., Inda, A. V., Tiecher, T., & Barrón, V. (2016). Iron oxides and organic matter on soil phosphorus availability. *Ciência e Agrotecnologia 40*(4):369-379.

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 a considerable time to be adsorbed (fixed) by the soil. The risk of loss is higher when fertiliser containing soluble phosphorus is applied to wet soils at risk of overland flow[5].
- **Leaching:** The loss of soluble phosphorus through drainage when soil is saturated with phosphorus.
- **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 via erosion and surface runoff. A small amount of phosphorus in solution (dissolved reactive phosphorus [DRP]) can be lost via leaching, particularly if soils are saturated with phosphorus.

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. Understanding these two nutrients within horticultural production systems, is fundamental to managing nutrients.

Nitrogen and phosphorus lost to the environment can impact on 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, it uses 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-N)[7] have the potential to cause blue-baby syndrome[8]. Sustainably managing N and P 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, phosphorous, algal growth and dissolved oxygen, and how land is used. 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 R's - Right Product, Right Rate, Right Time, Right Place. Using practices like nutrient budgets and soil/leaf tests are key to demonstrating the 4 R's 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://info.health.nz/keeping-healthy/environmental-health/nitrate-in-drinking-water#potential-effects-of-high-nitrate-levels-3687.

3 NUTRIENT LOSS RISK FACTORS

3.1 What risk factors influence nutrient loss?

Many, often interacting factors influence the risk of nitrogen and phosphorus P 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 and Land Management Group practice checklists in Appendix A.

3.1.1 Biophysical risk factors

Biophysical risks relate to the natural surrounding environment. Examples of biophysical risks are climate, soils and terrain. Table .1 describes each risk factor in relation to the risk of nitrogen and phosphorus loss.

Table .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 erode8.
Topography	While a secondary risk, 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 (< 30%), e.g., peat soils, podzols, have a higher risk of P loss through leaching. 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 in relation to the risk of N and P loss. Practices specific to vegetable/cropping operations are coloured **brown**.

Table .2: Management risk factors and their influence on nitrogen and phosphorus losses.

<table>
<tr><th>Risk factor</th><th>Nitrogen (N)</th><th>Phosphorus (P)</th></tr>
<tr><td>Rate of nutrient application</td><td colspan="2">Exceeding the optimum rate of nutrient required by the crop will increase the risk of both N and P losses to the environment. For example, exceeding the optimum N levels required (based on crop needs and soil testing N levels) will increase the risk of excess N lost from the paddock.

As the total amount of N and P applied increases there is a corresponding increased risk of loss. It is important to recognise that as the risk increases so too does the level of management and mitigations required to mitigate this risk.</td></tr>
<tr><td>Timing of nutrient applications</td><td>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.</td><td>There is greater risk of P loss through surface runoff if applied during wetter months (April – October), and on sloped ground.</td></tr>
<tr><td>Placement</td><td colspan="2">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. banded below the seed at planting) or is applied very gradually over a lengthy growing period (e.g. fertigation in horticulture).

Placement will also affect the degree of interaction between the fertiliser and the soil, which is particularly important where nutrients can become unavailable due to reactions with soil minerals (e.g. phosphorus fixation) or organic matter (e.g. nitrogen immobilisation).

The best placement method will depend on the nutrient(s) concerned, topography and individual production situations.

Fertiliser spread across non-target areas is inefficient and can be environmentally harmful, for example, near waterways where fertiliser can directly enter water.

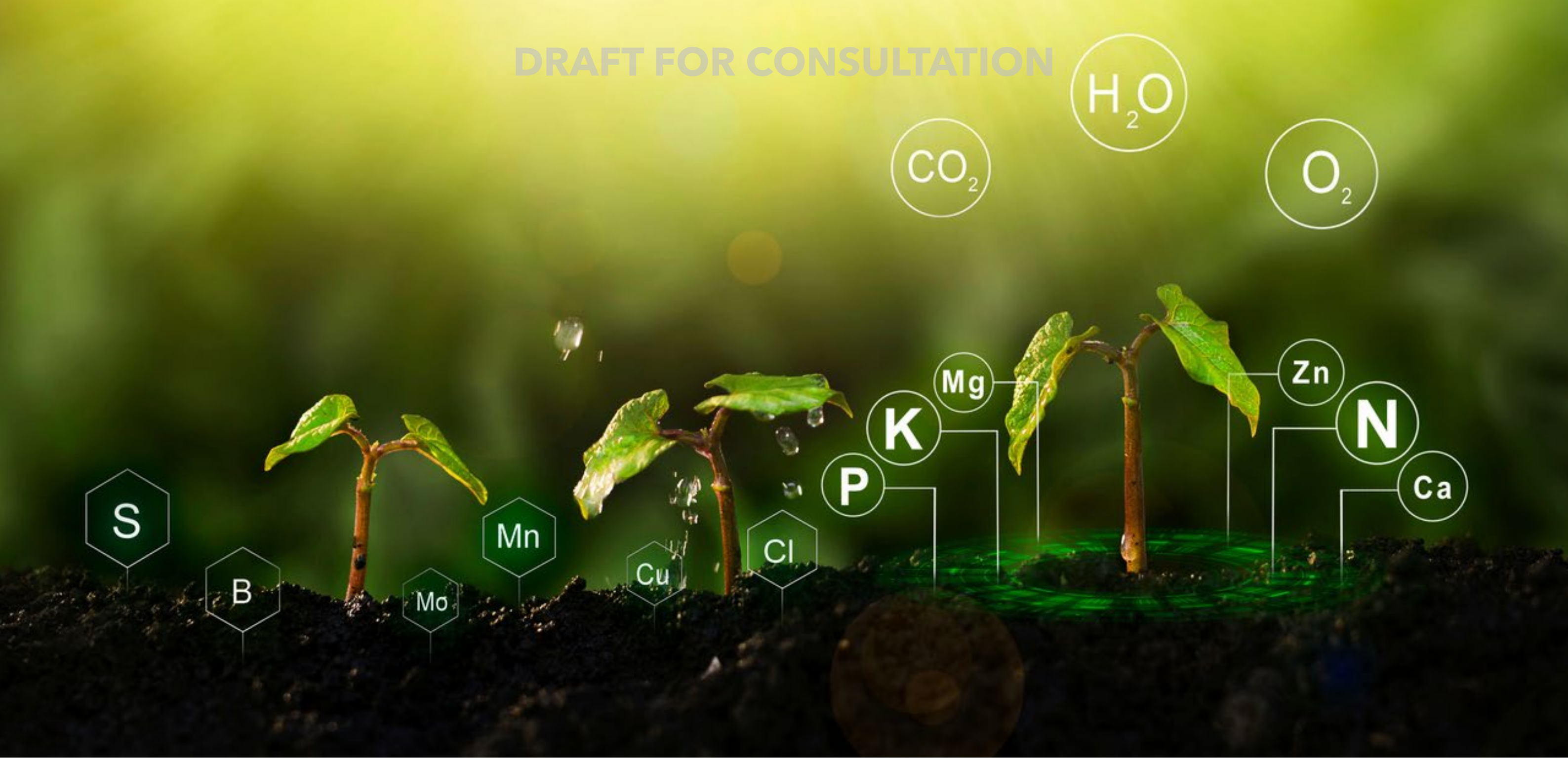
For further guidance, refer to the Spreadmark 2022 Code of Practice for the Placement of Fertiliser in New Zealand.</td></tr>
</table>

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. 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. 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. Ammonium must first be converted to nitrate by soil bacteria, before plant uptake can occur.	The type of P fertiliser applied will impact the risk of losses. Especially if applied at high-risk times (April to October), and on high-risk soils (low ASC). Using slow-release P fertilisers (e.g. RPR; serpentine super) can reduce the risk of large amounts of phosphate sitting in the soil waiting for plant uptake (thus at risk of loss in drainage events).
Nutrient application method	Application methods that place nutrients closer to the site of uptake (fertigation, GPS-banding) have a lower risk of loss compared to broadcast spreading.	
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],[12]. 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. 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. 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\
[12] Waikato Regional Council-critical-source-areas.pdf. Environment Southland_critical_source_areas.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 not accounted for in a nutrient budget. Understanding the release rate is part of on-going work. 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. Animals bring in and take away nutrients. The nutrients that they bring in also tend to be in concentrated patches, with high N loading in urine. This N needs to be considered when budgeting N for the next crop.	Excess P in the soil from the previous crop(s). Without soil testing to understand available P stores, additional P fertiliser applied could increase P levels above optimum and increase the risk of losses. Animals can disturb the soil structure, and when combined with sloped land, can lead to increased risk of erosion and sediment loss, and consequently P loss.
Fallow periods	A period when a paddock is left unplanted, allowing beds to be formed, the soil to rest and recover before the next crop is planted. The impact of crop residues on potential nitrate leaching depends on the length and timing of fallow periods. Other factors influencing leaching including climate, season, soil nutrient status, and crops in rotation.	Fallow periods contribute to P loss indirectly by making the soil more vulnerable (soil is more exposed due to less plant cover) to erosion and sediment loss. On their own fallow periods do not cause P loss unless combined with other factors like slope and/or soil type (more erodible soils).
Cropping intensity	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 and increase the risk of compaction. This increases the risk of soil and sediment erosion, and P losses as P attaches to soil particles. Poor soil structure and compaction impacts on crop growth and nutrient uptake.

Risk factor	Nitrogen (N)	Phosphorus (P)
Cropping 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.	-
Ground preparation and planting method	Poorly timed cultivation, too early before planting, exposes soil organic matter to oxygen, accelerating nitrogen mineralisation which means nitrogen becomes highly mobile and if not taken by plants quickly can be prone to leaching.	Over cultivation of soils lead to fine soils becoming tighter on the surface and leading to compaction. This can increase runoff from the paddock and increased risk of P losses.



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** (Section 4.3)

4.1 Risk assessment approach

This section contains risk assessments for nitrogen and phosphorus loss. Risk assessments are completed for every block in an operation where commercial horticultural production is occurring.

The purpose of assessing the level of block risk is to help identify the suite of practices that will be used to manage the risk over time.

Risk assessment is a core part of a Nutrient Management Plan. Managing the risk of nutrient losses through a Nutrient Management Plan supports production and environmental outcomes, as well as compliance requirements. Risk assessments may need to be updated to reflect any relevant changes to your growing operation, as part of the annual review of the Nutrient Management Plan.

Each block will be assigned to a Land Management Group, based on the level of risk. Each Land Management Group has a set of minimum and recommended practices (see Section 5.3 and Appendix A). These groups allow blocks with similar risk profiles to be managed together. This makes it easier to plan and implement a similar suite of management practices.

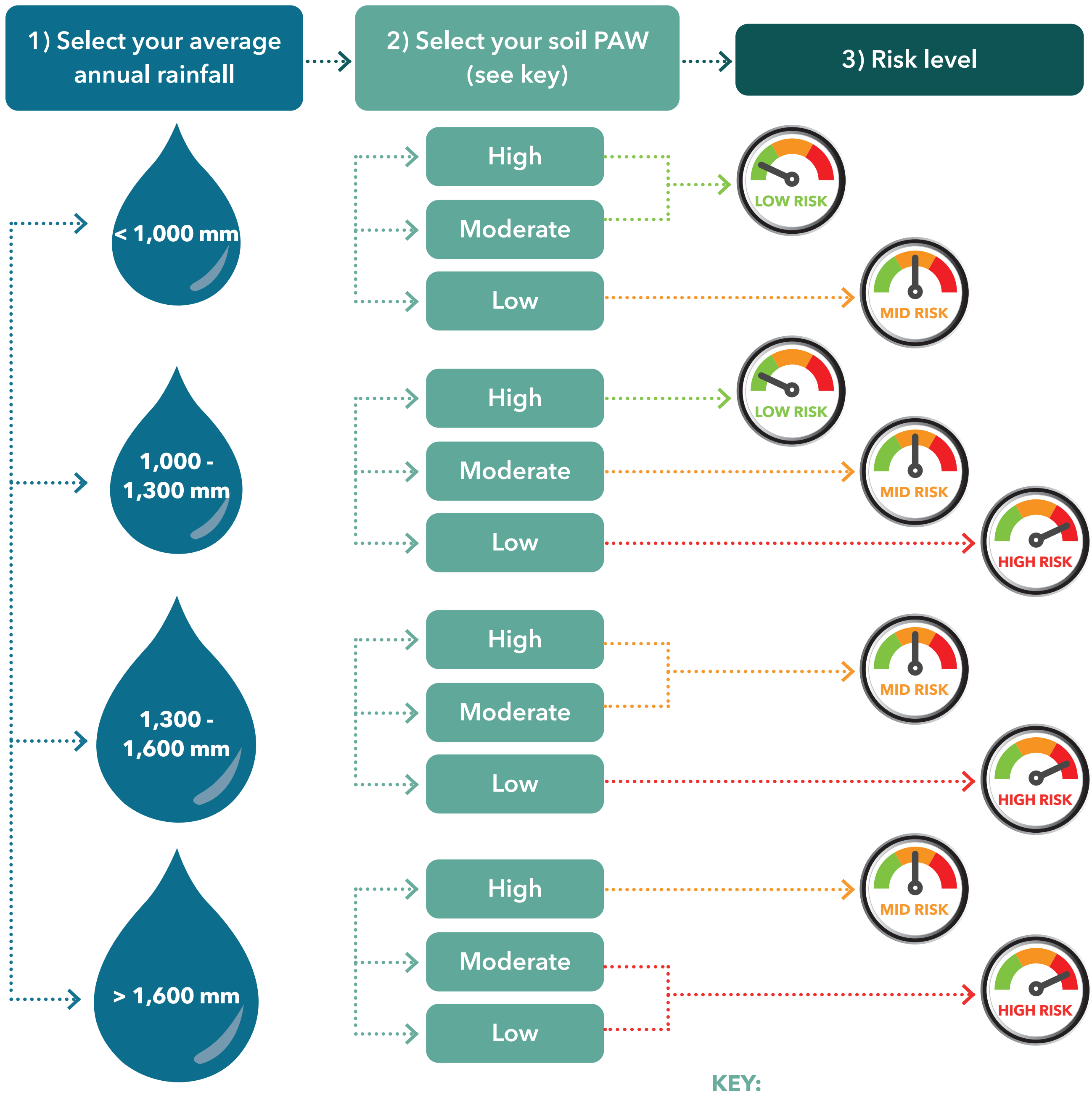
Practices for each Land Management Group are listed in Appendix A, as part of a Nutrient Management Plan Workbook template. Steps to building a Nutrient Management Plan are depicted in Figure 1.2.

4.2 Nitrogen loss risk

The N loss risk assessment for each block is divided into three steps. Firstly, biophysical risk is assessed, followed by N fertiliser risk, and in the last step, results are combined to assign a Land Management Group.

Step 1: Biophysical risk

The dominant leaching pathway for N is through the soil, below the plant's active root zone. The dominant risk factors are rainfall and soil texture. Note, a high biophysical risk does not necessarily mean more N is being lost to the environment. Use the risk decision tree on the following page to understand the biophysical risk level(s) for your block(s).



KEY:

Clay = High PAW (> 150 mm/m)

Loam = Mod PAW (61-150 mm/m)

Sand/gravel = Low PAW (< 60 mm/m)

Figure 4.1: Nitrogen biophysical risk assessment decision tree.

Profile available water (PAW) is the total amount of water that soil can hold and supply to plants within the root zone. PAW varies with soil texture. Medium-textured soils like loams generally hold more available water than sandy or heavy clay soils. The primary reference for PAW in soils is S-map. This online resource S-map is managed by Manaaki Whenua Landcare Research. It estimates PAW based on soil texture, structure, depth, and other properties[13]. Figure 4.2 on the following page illustrates the intersection of the PAW and rainfall classes in the biophysical risk assessment, for New Zealand.

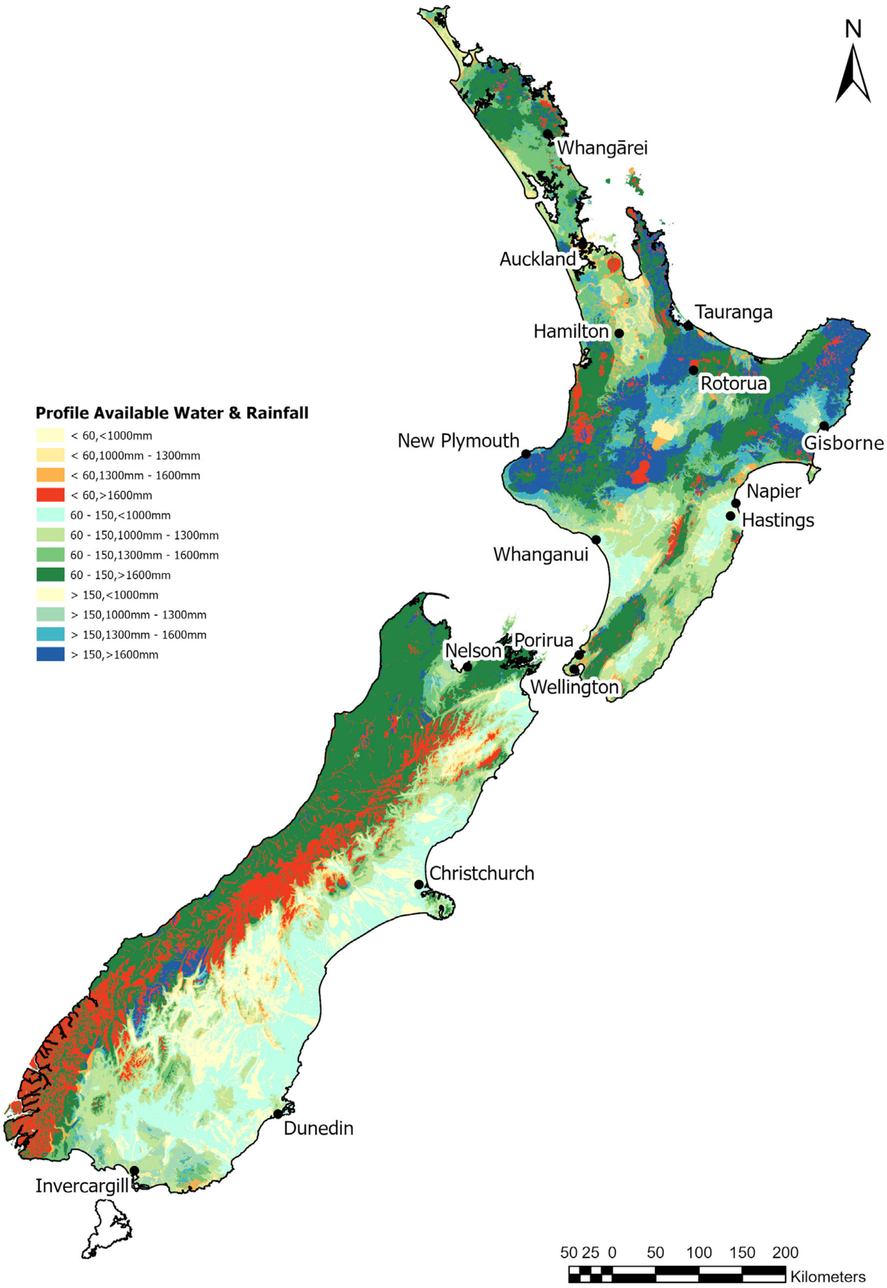


Figure 4.2: A map showing intersecting the PAW and rainfall classes in the risk assessment[14].

[13] For information on PAW of your soils, create a login and view the layer in S-map online https://smap.landcareresearch.co.nz

[14] **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/
Total Annual Precipitation – from the NZ Environmental Data Stack (NZEnvDS) (accessed via the LRIS Portal) https://lris.scinfo.org.nz/layer/105725-nzenvds-total-annual-precipitation-v10/

Step 2: Inherent nitrogen fertiliser risk

This decision tree in Figure 4.3 helps growers understand the level of **inherent risk** from their **nitrogen fertiliser use** on each block in commercial horticulture production. Inherent risk refers to the level of risk that exists before any mitigations are put in place.

To work out the total annual nitrogen used across each block, add up all the nitrogen components of your fertiliser products used on the block. Then, divide by the block's productive area. The productive area is the block's total productive vegetable growing area, which 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 area calculated. Both owned and leased blocks should be included in this assessment.

It is important to keep in mind that the purpose of the risk assessment is not to achieve a specific risk score. Rather, it is to identify the level of inherent risk to inform the selection of practices that are proportionate and effective for managing that risk.

Note: N inputs include synthetic fertiliser (and compost if used).

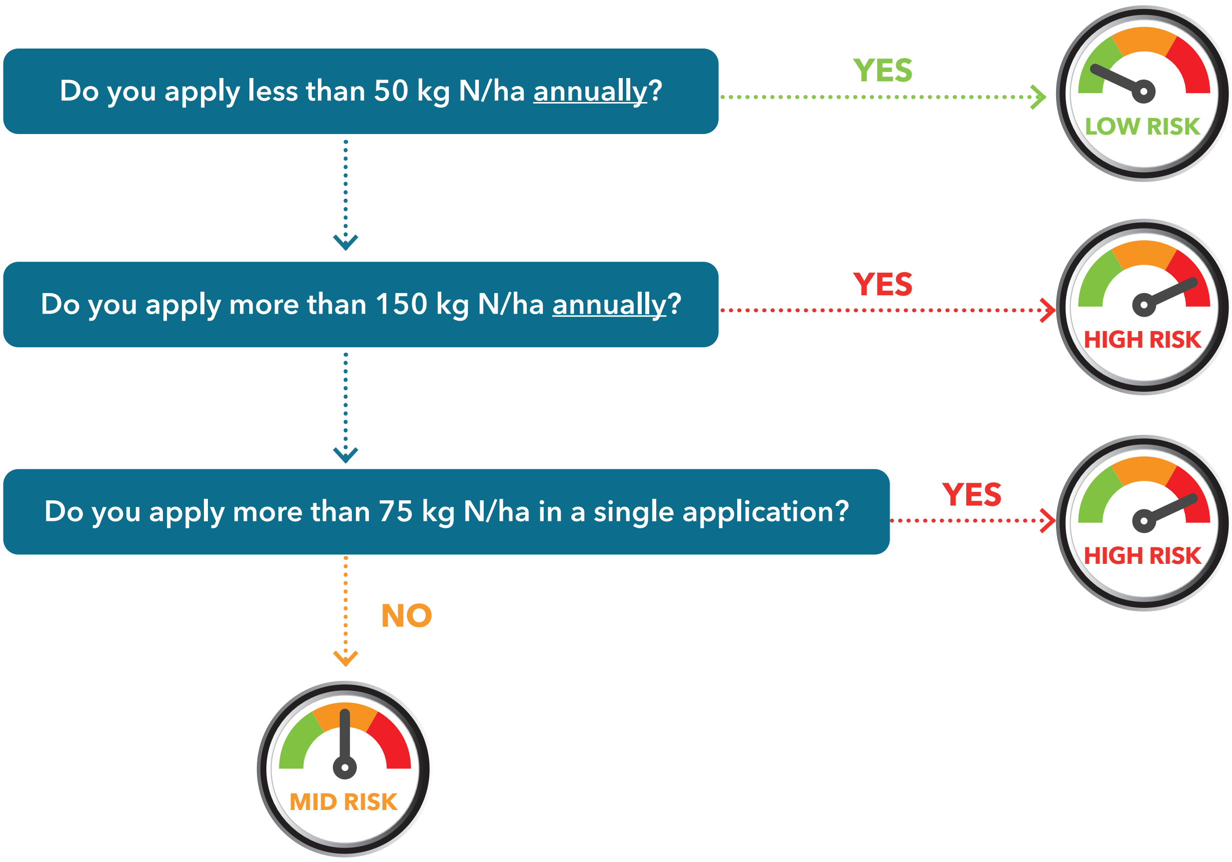


Figure 4.3: Inherent nitrogen fertiliser risk assessment.

Step 3: Land Management Groups

Based on the assessment of each block in Steps 1 and 2, determine your block's Land Management Group (LMG) using the matrix in Table 4.1.

Table 4.1: Land Management Groups based on level of risk.

	Inherent nitrogen fertiliser risk		
Biophysical risk	**Low**	**Medium**	**High**
Low	**LM Group 1**	**LM Group 1**	**LM Group 2**
Medium	**LM Group 1**	**LM Group 2**	**LM Group 3**
High	**LM Group 2**	**LM Group 3**	**LM Group 3**

Repeat these steps for all your blocks. Record the risk assessment results for each block in your Nutrient Management Plan. A template is provided in Appendix A.

Each land management group has a list of minimum and recommended practices.

Management practices and land management groups are described in the following Section 5.3.

In the next section, assess each block for phosphorus loss risk using the erosion risk decision tree.

4.3 Phosphorus loss risk (from erosion)

The phosphorus loss risk assessment is divided into two steps. The first step is an erosion risk assessment for each block, followed by assignment of land management groups.

Phosphorus typically binds to particles of sediment (particulate phosphorus - PP), or in solution as dissolved reactive phosphorus (DRP) either in overland flow or leached below the active rootzone in water.

The project Don't Muddy the Water (Barber, et. al., 2019) found that in the overland flow pathway, PP comprises about 95% of the total phosphorus leaving a paddock (entering the sediment retention pond - SRP), and the remaining 5% as DRP. The total quantity of phosphorus entering the pond was between 10.4 and 17.2 kg P/ha/year. Using the correctly sized SRPs reduced this by more than 98%. Once mitigated using an SRP, phosphorus discharge ranged between 0.7 to 3.3 kg P/ha/yr.

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 (Norris et al., 2019). This is just 0.06% of the overland component, hence why phosphorus practices are focused on erosion and sediment control.

Step 1: Erosion (P loss) risk

This Code of Practices uses the erosion risk decision tree from the Erosion and Sediment Control Code of Practice to assess phosphorus loss risk. This decision tree helps growers understand their risk of phosphorus loss based on erosion risk, for each block.

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 requirements for more significant erosion and sediment control projects.

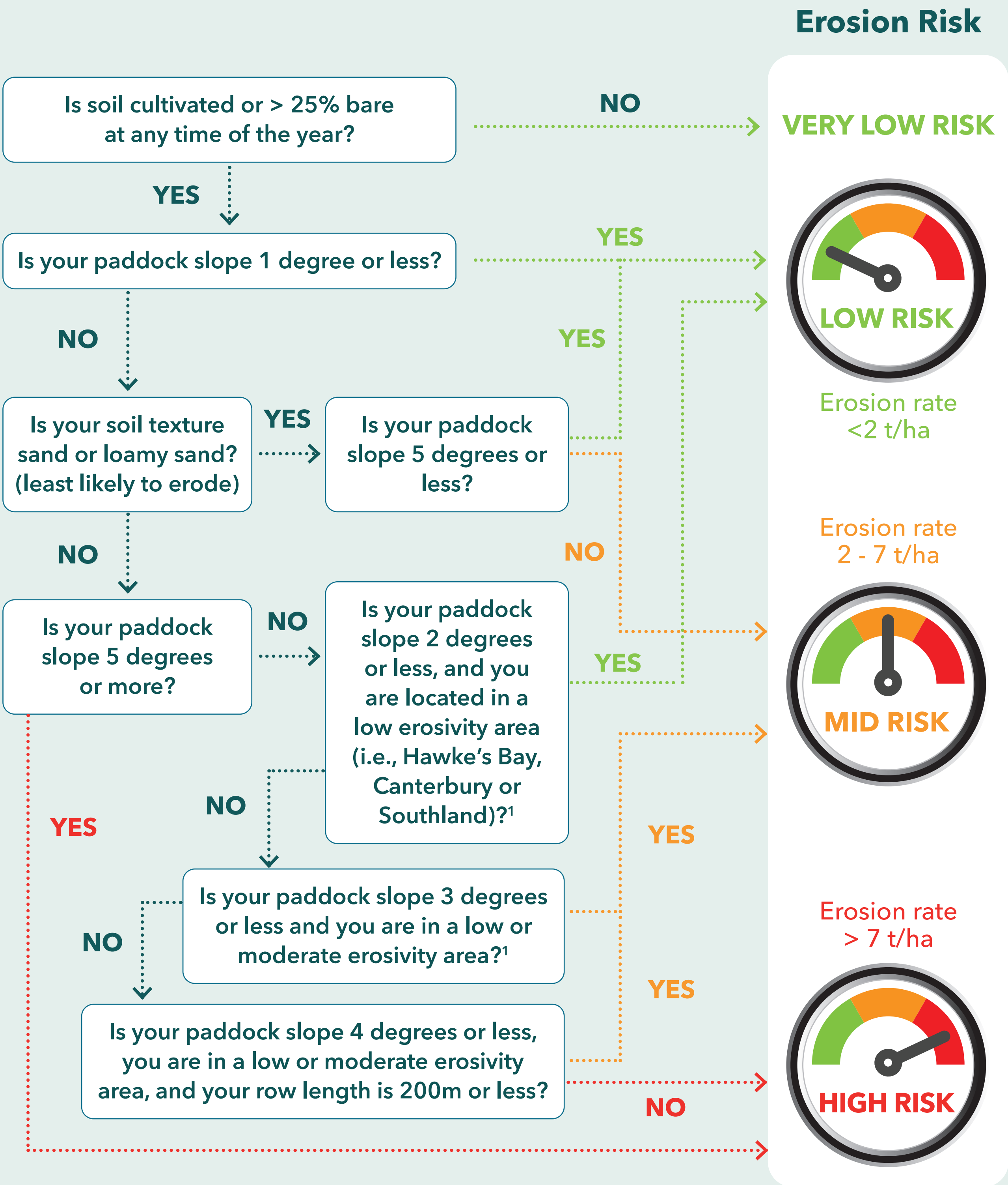


Figure 6.4: Erosion risk decision tree to determine risk of phosphorus loss in a horticulture. operation.

* When cultivated rows are present, paddock 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 App to determine the best estimate of your erosion rate. Low erosivity R factor is <1,000; moderate is 1,000 to 1,5000; high >1,500.

Step 2: Land Management Groups

Based on the assessment for each block in Steps 1 and 2, determine the land management group for your blocks using the matrix in Table 4.2.

Table 4.2: Land Management Groups based on level of risk.

Biophysical risk	Land Management Group
Very Low / Low	**LM Group 1**
Medium	**LM Group 2**
High	**LM Group 3**

Repeat the risk assessment for each block. Record the risk assessment results in your Nutrient Management Plan. A template is provided in **Appendix A**. Each land management group has a list of minimum and recommended practices. Management practices and land management groups are described in the following **Section 5**.

5 PRACTICES TO MANAGE NUTRIENT LOSSES

5.1 Introduction

This section contains practices that all outdoor fruit and vegetable growers can use to manage nitrogen and phosphorus use and minimise environmental losses. The combination of practices will depend on an operation's overall level of risk. For a checklist of minimum and recommended practices based on risk (three land management groups) see Appendix A Workbook.

These practices may also help growers meet regulatory or market requirements. Practices align with the Fertiliser Association's Code of Practice for sustainable nutrient use in New Zealand.

Practices are grouped into key areas:

Practice sections

- Practices operate at different scales (5.2)
- Land Management Groups (5.3) and description of minimum and recommended practices (5.3.1, 5.3.1)
- 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)

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

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[15].

[15] https://www.fertiliser.org.nz/site/about/caring-for-our-environment/managing_nutrients.aspx.

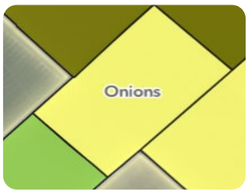
5.2 Practices operate at different levels

Nutrient management practices can be applied at multiple spatial and management scales, depending on the nature of the practice and/or the risk being addressed. Recognizing these different levels means nutrient management plans remain effective and practical, addressing risk at the appropriate scale.

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 land management groups see **Section 5.3**.

Block scale practices 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(s) at which they apply.

5.3 Land Management Groups

A land management group (LMG) is a set of blocks that share a similar level of nutrient loss risk, as determined through the risk assessments in **Section 4**. LMGs determine the set of minimum practices, and range of recommended practices that apply to similar blocks. Similar blocks are treated consistently, for targeted and effective risk management. It supports audit and compliance by simplifying record keeping.

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

5.3.1 Minimum practices

Minimum practices are required for all blocks in an LMG. They are designed to give growers a clear and practical starting point. They have been chosen in combination as the most effective at minimising nutrient losses, and achievable for growers no matter the size or location of operations. Minimum practices form part of the foundation of a Nutrient Management Plan, ensuring there is a consistent, evidence-based approach to nutrient management across the industry.

The level of minimum expected practices is proportionate to the level of risk. At a medium level of nitrogen loss risk, at a minimum it is important to test mineral nitrogen annually and feed this into the nitrogen budget. As the risk increases then more testing is required to both inform the budget and to track in-season performance against that budget. At a minimum this involves a mineral nitrogen test at the start and end of the crop. Testing at the end of a crop will both establish how the actual nitrogen levels (measured) compared to the budget (modelled), and it will help inform the following crop choice.

All minimum practices must be fully implemented within 3 years of the freshwater farm plan being certified.

5.3.2 Recommended practices

Recommended practices provide further risk management options for growers. For each LMG, growers must adopt a selection of practices, as follows:

LMG 1 – 25% or more of recommended practices,

LMG 2 – 50% or more of recommended practices,

LMG 3 – 75% or more of recommended practices.

Growers can choose which combination practices to implement across those blocks, based on what is most practical and effective for their production system. This approach recognises the diversity of horticultural operations and locations where horticulture is grown.

Sections 5.5 – 5.8 describe each practice in more detail.

5.3.3 Worked examples

A case study example of block level risk assessments and level of minimum and recommended practices.

Case study 1

Commercial vegetable production, Pukekohe

5-yr rotation: Cabbage → Barley → Onions → Oats → Potatoes → Phacelia → Carrots → Silverbeet

Block 1 (12 month period): Cabbage → Barley → Onions

- Cabbage: Planted Jan–Mar, harvested Apr–Jun
- Barley: Sown Jun–Jul, incorporated Sep
- Onions: Transplanted or sown Aug–Oct, harvested Feb–Mar (following year)

<u>Nitrogen risk assessment</u>

Biophysical risk:

- The soil type is Pukekohe clay loam, with a plant available water (PAW) 100-140 mm/m
- Average annual rainfall is 1,200 - 1,400 mm

- This combination of moderate soil water-holding capacity and relatively high rainfall means that nitrogen can be lost through leaching or runoff under certain conditions.
- Based on these factors, the **biophysical N loss risk is MEDIUM**.

N fertiliser use risk:

- For these crops in rotation, N fertiliser is applied at rates greater than 150 kg N/ha/year.
- This level of input increases the chance of N losses if not managed carefully, particularly during periods of heavy rain or when crops are not actively taking up N.
- This puts the **nitrogen fertiliser management risk at HIGH**.

Overall N risk rating:

- When combining the biophysical and fertiliser risks, the **overall N risk is HIGH**.
- This places the block in Land Management Group 3 for N, meaning a higher level of nutrient management is required.
- Blocks 3,4,6,7,8 are also in LMG 3.

Phosphorus risk assessment

Overall P risk:

- Soil is cultivated
- Paddock slope is 4 degrees
- Low to moderate erosivity location
- Row length is more than 200m

Overall P risk rating:

- The **overall P risk is HIGH**.
- This places Block 1 in LMG 3 for P, meaning a higher level of nutrient management is required.
- Blocks 3,4,7,8 are also in LMG 3.

Land Management Groups

- For nitrogen, blocks 1, 3,4,6,7,8 are assigned to LMG3.
- For phosphorus, blocks 1, 3,4,7,8 are assigned to LMG3.

Use the Nutrient Management Plan Workbook in Appendix A to record actions for blocks in each LMG. All minimum practices must be implemented, and the grower will need to select 75% or more of recommended practices in LMG 3 for those blocks. These may include practices in the Nitrogen Risk Assessment Tool (NRAT). See Section 6.1.2 for an explanation of how and when to use the NRAT.

5.3.4 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 council plan rules

5.4 Operation-wide practices to minimise nutrient losses

These practices focus on minimising nutrient loss risks at the operation-wide level.

Practices in this section	Section
Manage Fertiliser Handling, Transport, and Storage	5.4.1
Fertiliser spreader equipment is calibrated annually	5.4.2
Irrigation systems are well maintained	5.4.3
Fertiliser spreading operators are trained and competent	5.4.5
Implement Erosion and Sediment Control (for P loss risk)	5.4.6
Use border controls near waterways	5.4.7
Implement controlled traffic farming (CTF)	5.4.8
Adopt new cultivation and planting technologies	5.4.8
Retire or manage marginal land	5.4.9
Constructed wetlands or protection of 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's 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 trialled and implemented, particularly during audits. Good records support continuous improvement and demonstrates responsible nutrient management. Your records may include both established practices and trials you're 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. This practice ensures fertiliser is managed to minimise losses to water and air, and meet legal requirements related to 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: An enclosed, dry, clean, and well-ventilated building Away from water bodies, bores, and stormwater drains Clearly labelled and secure to prevent unauthorised access or spills Ensure: Proper staff training Regular inspections and maintenance Spill response kits and emergency procedures in place
Considerations	Proximity to waterways, wells, or stormwater systems Type and volume of fertiliser stored Compatibility with other stored substances Security and access control Emergency and spill management readiness
Decision support tools	-
Scale of Application	Operation.
Frequency/timing	At all times.
Records / Evidence	Inventory of fertilisers, Staff training records, Spill response plans, Incident and inspection logs, and Storage location and safety data sheets (SDSs).
References	Legal requirements: Hazardous Substances and New Organisms (HSNO) Act Health and Safety at Work (Hazardous Substances) Regulations 2017 and guidelines Fertiliser (Subsidiary Hazard) Group Standard 2020 (HSR002571) Resource Management Act (RMA) – regional council rules NZS 8409:2021 Management of Agrichemicals (applicable for mixed storage)

5.4.2 Fertiliser spreader equipment is calibrated 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. Adjust equipment to match product specifications and target rates. Verify both application rate and spread pattern (e.g. tray tests, catch tests). Engage a SPREADMARK certified contractor if fertiliser spreading is outsourced.
Considerations	Type of fertiliser product (granule size, density). Equipment condition and wear. Operator skill and experience. Weather conditions during calibration (e.g., wind affecting spread pattern).
Decision support tools	-
Scale of Application	Operation
Frequency/timing	At least annually or according to manufacturer's guidelines
Records / Evidence	Calibration records (date, who, method), Maintenance logs, and Evidence of operator competency.
References	SPREADMARK Accreditation Scheme (Fertiliser Quality Council)

5.4.3 Irrigation systems are well maintained

Field	Description
Purpose and description	Efficient irrigation (timing, rate, placement) through regular maintenance supports nutrient uptake and minimises losses. Well-maintained irrigation systems mean that water is applied at appropriate times and rates to match plant needs. This reduces the risk of nutrient leaching, surface runoff, and improving nutrient use efficiency.
Relevant risk factors	Irrigation, soil texture, rainfall
Key Requirements	Accounts for rainfall, evapotranspiration, fertiliser inputs Maintain and monitor system components (e.g., pumps, pipes, sprinklers). Schedule irrigation to minimise nutrient losses. Pressure testing and distribution uniformity checks.
Considerations	Crop water budget and irrigation scheduling tools (e.g., IrriCalc, soil water balance). Soil water budgets are simple low cost method to schedule irrigation. Weather forecasts and rainfall. Compatibility with nutrient applications (timing and method).
Decision support tools	IrriCalc
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. Irrigation schedules, areas of irrigation, rates, volumes and timing in relation to rainfall and ET Maintenance, calibration and service logs, Performance checks, Soil moisture data (if applicable).
References	Irrigation New Zealand's Code of Practice for Irrigation System Design Irrigation New Zealand's Maintenance Guidelines IrriCalc – Water Allocation Calculator : IrrigationNZ

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. 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: 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) 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 Operator Spreadmark accreditation/GROWSAFE training certificate
References	Spreadmark Code of Practice Fertiliser Quality Council – Requirements for Accreditation Accredited Operator List www.fqc.org.nz 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 P, 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 P loss risk – see Section 4.3. A copy of the table of erosion and sediment control practices for each risk level is provided in Figure 5.1 below.
Relevant risk factors	Rainfall, topography, soil texture, critical source areas
Key Requirements	Paddock 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. 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's properties. 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. 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 paddock risk assessment process in the Erosion and Sediment Control Code of Practice.
Considerations	Topography – steeper slopes create faster runoff. Rainfall and runoff risk – poorly draining soils increase the need for effective border controls. 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 Detail of installation and type of control used Take photographs, ideally before and after installation and over time or after major rainfall events Landowner permission (as required)
References	Erosion and Sediment Control Code of Practice

5.4.7 Implement controlled traffic farming

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. Dedicated wheel tramlines are used, and no machinery operates outside of these lines. Tramlines are never cultivated. Tramlines may require maintenance (compaction, rutting).
Considerations	GPS guided machinery. 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. Tramlines identified of farm maps. 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 increased 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 5.4.6) to minimise compaction and erosion, for example, permanent wheel tracks, reduced overlap and passes. 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	Frequency/timing
Records / Evidence	Evidence in farm maps
References	-

5.4.10 Constructed wetlands or protection of 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). Consent or approval may be required by your regional council. 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 through runoff and/or leaching.

Practices in this section	Section
Plan nutrient inputs based on crop needs	5.5.1
Crop nutrient budgets	5.5.2
Soil and leaf/tissue tests to inform nutrient budgets	5.5.3
Representative soil sampling practice	5.5.4
Use of enhanced fertiliser products	5.5.5
Split fertiliser applications	5.5.6
GPS-based or targeted application	5.5.7
Well granulated fertilisers for ground application	5.5.8

5.5.1 Plan nutrient inputs based on crop needs

Field	Description
Purpose and description	Assessing crop nutrient requirements and planning inputs accordingly to support optimal plant health and productivity. By matching nutrient inputs to crop demand, 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	**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. **Factor in environment**. Include soil type, test results, 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. **Nitrogen timing and rates** based on agronomic advice, grower knowledge, or crop guidelines.
Considerations	GPS guided machinery. Consider residue from previous crops - Some crops leave more residual N than others. For example, brassicas leave large amounts of residue and potentially available N, compared to onions or carrots. Estimate this N source based upon the quantity of residue and its nitrogen content.
Decision support tools	-
Scale of Application	Operation
Frequency/timing	During cultivation and planting
Records / Evidence	Field operation records including planting, cultivation, harvest.
References	Reid and Morton, 2018, Nutrient Management for Vegetable Crops in New Zealand

5.5.2 Crop nutrient budgets

Field	Description
Purpose and description	A nutrient budget helps growers apply the right amount of nutrients at the right time, for each crop. At its core, a nutrient budget quantifies what nutrients go into a crop system (inputs) and what comes out (outputs). More sophisticated nutrient budget tools, for example, the SVS Tool, also calculates the amount of nitrogen that will become available from the previous crop's residues, and soil nitrogen mineralisation, and potential movement below the current crops active rootzone.
Relevant risk factors	Rate of nutrient application, block history, previous crop / residues.
Key Requirements	**Account for inputs** like fertiliser and compost/manure, and current levels of nitrogen or phosphorus using soil tests. **Account for outputs**. What the crop takes up and removes based on target yield, and remaining levels of nitrogen or phosphorus using soil tests. **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. **Account for environmental variables**. Weather conditions are checked before application. Forecasts help schedule nutrient applications for optimal uptake and minimise losses. **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. Use of crop calculators or nutrient budgeting tools when available.
Considerations	Consult a qualified and experienced fertiliser advisor or agronomist if needed. It's important the budget goes beyond just a printout or fertiliser recommendation. A budget should form the basis for discussions between growers and advisers. Not all operations will need a formal nutrient budget, for example low risk blocks. 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. Consider residue from previous crops. Some crops leave more residual N than others. For example, brassicas leave large amounts of residue and potentially available N, compared to onions or carrots. Estimate this N source based upon the quantity of residue and its nitrogen content.
Decision support tools	The SVS Tool - see Section 6.1.1. Zespri N balance calculator - see Section 6.1.3. LandWISE-Nutrient-Budget-Guide-and-Templates-June-2021.pdf
Scale of Application	Crop
Frequency/timing	Crop nutrient budgets for N and P for medium and high risk blocks.
Records / Evidence	Nutrient budget calculations and relevant reference material Soil and/or leaf test results
References	Refer to description of tools in Section 6, and appendix of resources.

5.5.3 Soil and leaf testing to inform nutrient budgets

Testing improves budget accuracy at both the planning and tracking throughout the growing season. The following testing practices are described below:

- General soil fertility testing
- Laboratory soil mineral N testing
- Nitrate Quick Test
- Potentially mineralisable nitrogen (PMN) testing
- Phosphorus soil testing
- Representative soil sampling
- Leaf/tissue testing

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 N.

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. 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, at least every 3 years per block.
Records / Evidence	Laboratory or in-situ test results. Paddock history/rotations (vegetable specific) Records are kept to monitor change over time.
References	Hill Labs (https://www.hill-labs.co.nz/) ARL (https://arllab.co.nz/soil-testing/) Eurofins (https://www.eurofins.co.nz/agricultural-testing/)

5.5.3.2 Laboratory soil mineral N testing

Field	Description
Purpose and description	Soil mineral N 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 N 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 0-30 cm), 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: 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). 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. The best time to collect a soil sample for mineral N analysis is the week prior (giving sufficient time for the lab to supply the results) 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 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. Further guidance can be found in Appendix B: Resources.

5.5.3.3 Quick N Test

Field	Description
Purpose and description	The Quick N Test is fast and cost-effective method for estimating soil mineral nitrate concentrations to inform fertiliser decisions. Enabling 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. A Nitrate Quick Test can be used instead of a laboratory mineral N test. It is important to note that the Nitrate Quick Test results are in mg NO3 (top line – larger number on the test tube, or electronic probe). The result in mg NO3 can be entered directly into the SVS Tool.
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. 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. PMN testing is reasonable stable as it is linked to the soil type, climate and practices. It will vary throughout the year. However, once established and confident then testing need only occur every 5 years or so. Where a paddock is coming out of longer-term pasture, where there can be considerable stores of N 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 or in-situ test results.
References	Soil nitrogen testing and predicting nitrogen supply · Plant & Food Research

5.5.3.5 Annual testing if nutrient build-up 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 paddock (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 or in-situ test results
References	For more information see the soil nitrogen testing factsheet for vegetable production developed by Plant and Food, referenced in Appendix B: Resources.

5.5.3.6 Phosphorus soil testing

Field	Description
Purpose and description	Olsen P testing estimates plant-available phosphorus in soils, especially suitable for neutral to alkaline soils.
Relevant risk factors	Soil texture, soil anion storage capacity, block history, previous crop / residues
Key Requirements	Sample for standard depth, usually 0-15 cm, using clean tools (non-metallic/ stainless steel tools as chemical interaction could impact test results). Avoid recent fertiliser applications that skew results. Include sample ID and location information.
Considerations	Consider pairing with other tests e.g. pH, cations, organic matter, for a fuller picture.
Decision support tools	-
Scale of Application	To inform crop nutrient budgets.
Frequency/timing	Phosphorus is reasonably stable, so testing every 3 years for blocks on block with low and medium P loss risk is sufficient. On blocks with high P loss risk, this increases to annually where more emphasis is needed to manage these sites.
Records / Evidence	Laboratory or in-situ test results
References	

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. 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. Collect tissue from multiple plants across the block. Clearly label samples with unique identification and location information. Store samples appropriately, send to lab same day or refrigerate. Use certified lab that can analyse for key nutrients required.
Considerations	Interpret results alongside visual information, soil tests and crop stage. 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.

5.5.4 Representative soil sampling practice

Field	Description
Purpose and description	Soil samples collected for testing, especially for blocks, should be a representative of the area the results will be applied to. 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. 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.

5.5.5 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. 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	Block
Frequency/timing	For crops on medium and high nutrient loss risk blocks.
Records / Evidence	Product type (incl. organic/compost applications), composition, rates/quantities, dates, location, method of application, and weather conditions (rain before/during/after). Field/orchard walk notes/photographs as evidence to support application of nutrients, if more than budgeted or required outside of recommended optimum.
References	-

5.5.6 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. Apply according to manufacturer guidance. Ensure compatibility with existing application equipment.
Considerations	Consider integration with other nutrient management practices (e.g. split applications, soil testing). 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

5.5.7 GPS-based or targeted application

Field	Description
Purpose and description	Applying nutrients close to where the uptake where the roots can access them, rather than broadcasting, improves efficiency and helps to minimise losses. 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. Fertigation 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. Nutrient application aligns with crop growth stage and uptake timing. Calibrate equipment to apply fertiliser uniformly and at correct depth.
Considerations	May require specialised equipment or modifications to existing gear. Potential labour or operational cost increase, offset by fertiliser savings and improved yield.
Decision support tools	-
Scale of Application	Crop
Frequency/timing	For high risk blocks, at planting or side-dressings
Records / Evidence	Product type, rate, date of application, block applied
References	-

5.5.8 Well granulated fertilisers for ground application 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. Check compatibility with spreader equipment. Calibrate spreader to match product characteristics and desired application pattern. Avoid application during windy or unstable weather conditions. 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 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 where practicable	5.6.4
Minimise fallow periods	5.6.5
Use cover crops to improve soil health	5.6.6
Soil moisture is monitored and budgeted	5.6.7
Monitor soil organic matter (OM)	5.6.8
Monitor soil biology	5.6.9
Use green manures (e.g. legumes)	5.6.10

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 leaching or runoff.
Relevant risk factors	Soil texture, soil anion storage capacity
Key Requirements	Identify and map soil types across blocks. Assess structure and depth to any barriers (e.g. pans, high water tables). Flag areas with poor drainage or compaction for risk mitigation.
Considerations	Soil characteristics can vary across short distances—use representative sampling. 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 Soil test results/VSA results 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 N 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). 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. Consider subsurface acidity if deep rooting crops are affected.
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 and 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 wheel track ripping or rotations with cover crops to re-establish soil structure. Avoid cultivation or trafficking when soils are saturated. 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	*AgResearch Visual Soil Assessment (VSA) Field Guides*

5.6.4 Minimise tillage where practicable

Field	Description
Purpose and description	Frequent cultivation degrades soil structure, accelerates N mineralisation, reduces organic matter, and increases risk of erosion and P loss.
Relevant risk factors	Ground preparation and planting method
Key Requirements	Evaluate the need for each tillage pass—avoid cultivation when not essential Use reduced or no-till systems, for example, direct drilling. Use appropriate equipment suited to reduced tillage.
Considerations	Transitioning to reduced tillage may require changes in crop rotation, weed control, and fertiliser placement. No-till systems may initially show variable performance on compacted or poorly drained soils. 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	FAR *Conservation Tillage and Soil Health Guidelines*

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. Following crops with high N residues, catch or cover crops can: • Take up excess soil nitrogen, • Improve organic matter, • Support soil health during fallow periods. These crops can be: • Ploughed in to enhance soil quality and long-term production, or • Sprayed off and direct-drilled for the next crop.
Relevant risk factors	Fallow periods, cropping intensity, cropping root depth
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 Establish cover crops promptly after harvest to maximise benefits. On medium and high risk blocks where fallow is unavoidable, explain what alternative practices are in place.
Considerations	Note: Cover crops like legumes may leave additional N in the soil. Account for this in your next crop's nutrient budget. Avoid species that may exacerbate pest or disease problems in the next crop.
Decision support tools	-
Scale of Application	Block
Frequency/timing	Between crop cycles where possible
Records / Evidence	Cover crop species, sowing/termination dates
References	HortNZ Erosion and Sediment Control Code of Practice

5.6.7 Soil moisture is monitored and budgeted

Field	Description
Purpose and description	Monitoring and budgeting soil moisture helps match water application to crop needs and reduces nutrient leaching. 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). Develop a soil water budget. Adjust irrigation scheduling based on soil moisture, evapotranspiration and forecast conditions. Avoid irrigating beyond the soil's water-holding capacity (field capacity). Integrate soil moisture data with nutrient application planning to reduce leaching risk.
Considerations	Ensure proper sensor placement, calibration, and maintenance– seek professional advice. Combine moisture data with evapotranspiration (ET) estimates for more accurate scheduling Use moisture information to time fertiliser or fertigation to match crop uptake
Decision support tools	-
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. Use accredited soil testing laboratories with consistent methodology. Identify trends with an aim to maintain or increase OM, particularly in low OM soils. 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	Soil test results (OM %, total carbon, etc.) Sampling location maps Notes on changes in management practices influencing OM Photographs or VSA records over time
References	*AgResearch 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, bacterial/fungal ratios.
Relevant risk factors	Previous crop / residues, fallow periods
Key Requirements	Select appropriate biological indicators based on cropping system, soil type, and management goals. Use consistent sampling locations and methods for trend analysis. Sample under similar conditions for comparability. 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	AgResearch *Visual Soil Assessment (VSA) Field Guides*

5.6.10 Use green manures (e.g. legumes)

Field	Description
Purpose and description	Green manure crops are typically fast growing species like legumes, grasses, or brassicas and contribute organic N, reducing the amount of synthetic fertiliser required. It improves soil structure and OM over time, if regularly utilised across the growing operation.
Relevant risk factors	Fallow periods, previous crop / residues
Key Requirements	Choose species appropriate for season, soil conditions, and desired outcomes (e.g. legumes for N-fixation, grasses for biomass). Estimate the quantity of plant material being returned and its N content.
Considerations	May require mowing or rolling before incorporation depending on crop size. Potential for pest/disease. Avoid planting related crops directly after.
Decision support tools	The SVS Tool can support the above estimates.
Scale of Application	Block
Frequency/timing	During fallow or between main crops e.g. over winter or early spring
Records / Evidence	Species used, sowing and incorporation dates
References	AgResearch *A Practical Guide for Using Green Crops in New Zealand*

6 DECISION SUPPORT TOOLS

Decision-support tools can help growers plan, track, and adjust nutrient inputs to improve efficiency and reduce 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 to minimise nutrient losses.

6.1 Outdoor vegetable production

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 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 N, and fertiliser make nitrogen management complex. These complexities contribute to the risk of diffuse nitrogen discharge.

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.

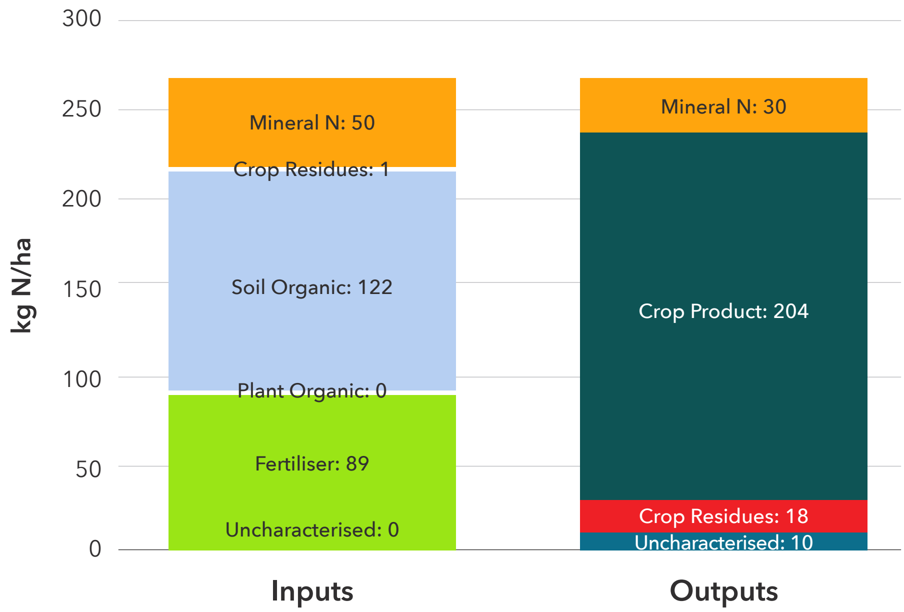


Figure 6. Model outputs: Current crop nitrogen balance example scenario.

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 changes to 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 leaching.

Growers can use the SVS tool for free. Refer to the SVS tool user guide 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 Assessment Tool (**Section 6.1.2**) described below.

6.1.2 Nitrogen Risk Assessment Tool (NRAT) (vegetables)

The NRAT is a **nitrogen management tool** was initially developed by experts and tested by growers for use in the Horizons region. Its purpose is to support nutrient management by driving practice change proportionate to nitrogen loss risk to achieve a target score. An approach that has been well tested and demonstrated during the NRAT's development. The NRAT is a component of a Nutrient Management Plan, within a farm plan.

Target scores are prescribed in the NRAT's nitrogen leaching risk limits table, and are based on biophysical risk. Scores take into account classes of Profile Available Water (PAW) and annual rainfall. The table includes 12 categories, with unitless scores ranging from 72 to 44. A score of 72 indicates the lowest nitrogen leaching risk: low rainfall, high PAW. A score of 44 indicates the highest nitrogen leaching risk: high rainfall, low PAW.

Consequently where the risk is higher, in order 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 NRAT 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 leaching 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 NRAT is designed to support crop rotation while managing any changes in localised risk that may arise when land parcels change.

In this Code of Practice, the NRAT is required for commercial vegetable growing that is medium or high nitrogen loss risk.

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

A copy of the NRAT is provided in Appendix C.

6.1.3 Zespri nitrogen balance calculator (kiwifruit)

The nitrogen balance calculator is a **nitrogen budget tool** is 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. The 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 MANAGEMENT PLAN WORKBOOK

These are snapshots of the Excel-based workbook that will be available to download in the final published version of the Code of Practice.

1. BUSINESS OVERVIEW

1.1 Key business details

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

Business name	Bloggs Kiwifruit
Physical address	1 Kiwifruit Way
Person responsible	J Bloggs
Prepared by	J Bloggs
Date completed	1/01/2025
Next review date	1/01/2026

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. Use this section to fill in your goals relating to this nutrient management plan.

Production *e.g. maximise crop yield, increase soil health to support long-term productivity*	- Increase production by 5%
Financial *e.g. reduce fertiliser costs and improve nutrient use efficiency*	- Reduce agrichemical spend by 10% - Reduce fertiliser spend by 15% through targeted soil testing
Environmental *e.g. reduce nitrogen leaching from high-risk blocks, minimise sediment and phosphorus runoff*	- Plant southern drain with riparian species
Personal *e.g. a clear plan reduces audit burden, leave a positive legacy on the land*	- Develop orchard succession plan with family and lawyer

2. BLOCK INFORMATION

Use the table below to input the key information relating to where you will be operating commercial horticulture activities **for the next 12 months.**

This information will be used for assessing risk of nutrient losses, and planning and implementing practices to manage that risk. The block IDs should be consistent with your farm maps.

There is space for 250 blocks/paddocks. If you require more rows, please contact HortNZ for advice on extending the sheet.

No.	Block ID	Crop(s)	Owned/leased	Productive area (ha)	Soil texture	Soil PAW (mm/m)	Annual rainfall (mm)
1	Block A	Kiwifruit	Owned	2	Sandy loam	120	1010
2	Block B	Kiwifruit	Owned	1.4	Sandy loam	120	1010
3	Block C	Kiwifruit	Owned	1.2	Clay loam	150	1010
4	Block D	Kiwifruit	Owned	0.4	Clay loam	150	1010
5	Block E	Kiwifruit	Owned	0.5	Clay loam	150	1010
6	Block F	Kiwifruit	Owned	0.5	Clay loam	150	1010
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

Block information summary

Row Labels	Sum of Productive area (ha)
Owned	**6.0**
Kiwifruit	6.0
Grand Total	6.0

3. RISK ASSESSMENT RESULTS

Refer to the Code of Practice to complete the risk assessments for nitrogen and phosphorus.
Complete the tables below with results - the Land Management Groupings will be automatically calculated for you.

		NITROGEN			PHOSPHORUS	
No.	Block ID (linked to Blocks tab)	Biophysical risk level	Nitrogen fertiliser risk level	Land Management Grouping (for N practices)	Biophysical risk level	Land Management Grouping (for P practices)
1	Block A	MEDIUM	MEDIUM	2	VERY LOW	1
2	Block B	MEDIUM	MEDIUM	2	VERY LOW	1
3	Block C	LOW	MEDIUM	1	VERY LOW	1
4	Block D	LOW	MEDIUM	1	VERY LOW	1
5	Block E	LOW	MEDIUM	1	VERY LOW	1
6	Block F	LOW	MEDIUM	1	VERY LOW	1
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						

Land Management Grouping summary

NITROGEN			PHOSPHORUS		
LMG 1	LMG 2	LMG 3	LMG 1	LMG 2	LMG 3
Block C	Block A		Block A		
Block D	Block B		Block B		
Block E			Block C		
Block F			Block D		
			Block E		
			Block F		

4. NUTRIENT BUDGET

A nutrient budget is an essential part of your nutrient management plan. A nutrient budget compares **crop inputs** with **crop outputs**, partitioning the nutrients between the crop and the environment.

The template below can be used to produce a simple nutrient budget for one crop, with space to record soil test results, planned nutrient applications, and actual applications, with additional space to justify any changes to the budget. For more complex operations, a dedicated nutrient budgeting tool will be more appropriate.

Please refer to the Code of Practice for more information about tools available.

4.1 Crop information

Crop	Kiwifruit
Variety	Hayward
Target yield	11,000 trays/ha
Information sources used to create your budget	Nutrient advisor
Date completed	1/01/2025

4.2 Soil test results

Use the cells below to input soil test data you used to plan your nutrient inputs. Alternatively, feel free to insert a link or file path to your own soil test results.

Location of soil test results	BloggsKiwifruit/Soil/TestResults/2025
Date of test	1/01/2025

Soil test *(edit to match your normal soil testing)*	MinN	PMN	Olsen P	pH	K	Ca	Mg	Na	S	OM%
Result										
Units										

4.3 Planned and actual nutrient applications

Using the table below, input your planned applications, based on your estimated plant uptake and soil test results. Then, at the end of the season, input your actual applications, which may have deviated from planned, due to weather conditions for example. Particularly for inputs containing nitrogen and phosphorus, justification is required if your actual inputs were significantly different to your plan.

Planned applications		Actual applications		Justification *(if actual different from planned)*
Product & rate	Date	Product & rate	Date	

5a. LAND MANAGEMENT GROUPING 1 - PRACTICES

Each Land Management Grouping (LMG) for nitrogen and phosphorus has a set of minimum and recommended practices for growers to implement. The blocks assigned to LMG 1 are provided on the left of the practice table, linked to the **Risk assessments** tab.
Use this table to work through each practice. All growers must work towards achieving **100% of Minimum practices** and **25% of Recommended practices** in this table, **for the blocks listed on the left.**
If a practice is marked as Partial or No, please provide information on the action to be completed.
If a practice is marked Yes, i.e. is complete/already implemented, use the Evidence column to note where you have information to support this practice.
More information on each practice can be found in the Code of Practice for Nutrient Management.

Percentage of **Minimum** practices achieved	**0%**
Percentage of **Recommended** practices achieved	**0%**

Blocks

LMG 1 blocks NITROGEN	LMG 1 blocks PHOSPHORUS
Block C	Block A
Block D	Block B
Block E	Block C
Block F	Block D
	Block E
	Block F

Practices to reduce the risk of nutrient loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
	Nutrient management plan prepared	Minimum										
	Representative soil testing of blocks for N every 3-years (foliage testing if needed).	Minimum										
5.5.1	Nitrogen timing and rates based on agronomic advice, grower knowledge, or crop guidelines.	Minimum										
5.4.2	Annual calibration of fertiliser spreading equipment	Minimum										
5.4.3	Irrigation systems are well maintained	Minimum										
5.4.1	Manage Fertiliser Handling, Transport, and Storage	Minimum										
5.4.5	Fertiliser spreading operators are trained and competent	Minimum										
	Records for practices available	Minimum										
	Action plan implemented	Minimum										
	Review and update NMP annually	Minimum										
5.4.7	Use border controls near waterways	Recommended										
5.4.8	Implement controlled traffic farming (CTF)	Recommended										
5.4.8	Adopt new cultivation and planting technologies	Recommended										
5.4.9	Retire or manage marginal land	Recommended										
5.4.10	Constructed wetlands or protection of existing wetlands	Recommended										
5.5.2	Nutrient budget for each crop	Recommended										
5.5.3.1	General soil fertility testing	Recommended										
5.5.3.2	Laboratory soil mineral N testing	Recommended										
5.5.3.3	Nitrate Quick Test	Recommended										
5.5.3.4	Potentially mineralisable nitrogen (PMN) testing	Recommended										
5.5.3.5	Annual testing if nutrient build-up is detected	Recommended										
5.5.3.6	Phosphorus soil testing	Recommended										
5.5.3.7	Leaf/tissue testing	Recommended										
5.5.4	Representative soil sampling practice	Recommended										
5.5.5	Split fertiliser applications	Recommended										
5.5.6	Use of enhanced fertiliser products	Recommended										
5.5.7	GPS-based or targeted application	Recommended										
5.5.8	Well granulated fertilisers for ground application	Recommended										
5.6.1	Assess soil type, structure, drainage, and profile	Recommended										
5.6.2	Maintain soil pH at crop-optimal levels	Recommended										
5.6.3	Assess and manage soil compaction	Recommended										
5.6.4	Minimise tillage where practicable	Recommended										
5.6.5	Minimise fallow periods	Recommended										
5.6.6	Use cover crops to improve soil health	Recommended										
5.6.7	Soil moisture is monitored and budgeted	Recommended										
5.6.8	Monitor soil organic matter (OM)	Recommended										
5.6.9	Monitor soil biology	Recommended										
5.6.10	Use green manures (e.g. legumes)	Recommended										

Erosion & sediment control practices to reduce P loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
	Minimise water entering the paddock: Intercept overland flow from catchments above with the use of interception drains, diversion bunding, culverts, and benched headlands	Minimum										
	Use of cover crops where possible. Grassed swales installed where appropriate. Follow good management practice for cultivation, harvest, and postharvest paddock management.	Minimum										
	Install and maintain vegetative buffer strips. All access ways should be raised.	Minimum										
	Where appropriate, use wheel track ripping or dyking to increase infiltration rates.	Recommended										
	Consider decanting earth bunds.	Recommended										
	Reduce row length to < 200 m, or use contour drains	Recommended										
	Construction of 0.5% sediment retention ponds (SRPs).	Recommended										

5b. LAND MANAGEMENT GROUPING 2 - PRACTICES

Each Land Management Grouping (LMG) for nitrogen and phosphorus has a set of minimum and recommended practices for growers to implement. The blocks assigned to LMG 2 are provided on the left of the practice table, linked to the **Risk assessments** tab.
Use this table to work through each practice. All growers must work towards achieving **100% of Minimum practices** and **50% of Recommended practices** in this table, **for the blocks listed on the left.**
If a practice is marked as Partial or No, please provide information on the action to be completed.
If a practice is marked Yes, i.e. is complete/already implemented, use the Evidence column to note where you have information to support this practice.
More information on each practice can be found in the Code of Practice for Nutrient Management.

Percentage of **Minimum** practices achieved **0%**

Percentage of **Recommended** practices achieved **0%**

Blocks

LMG 2 blocks NITROGEN	LMG 2 blocks PHOSPHORUS
Block A	
Block B	

Practices to reduce the risk of nutrient loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
	Nutrient management plan prepared	Minimum										
5.5.2	Nutrient budget for each crop											
5.5.3.2	Representative soil testing for mineral N to inform nutrient budgets (foliage testing if needed).	Minimum										
5.5.1	Nitrogen timing and rates based on agronomic advice, grower knowledge, or crop guidelines.	Minimum										
5.4.2	Annual calibration of fertiliser spreading equipment	Minimum										
5.4.3	Irrigation systems are well maintained	Minimum										
5.4.1	Manage Fertiliser Handling, Transport, and Storage	Minimum										
5.4.5	Fertiliser spreading operators are trained and competent	Minimum										
5.5.5	Split fertiliser applications	Minimum										
5.6.5	Minimise fallow periods	Minimum										
5.6.6	Use cover crops / catch crops in your rotation.	Minimum										
6.1.2	Commercial vegetable operations use the Nitrogen Risk Assessment Tool (NRAT) to select additional practice to meet the NRAT target score.	Minimum										
	Records for practices available	Minimum										
	Action plan implemented	Minimum										
	Review and update NMP annually	Minimum										
5.4.7	Use border controls near waterways	Recommended										
5.4.8	Implement controlled traffic farming (CTF)	Recommended										
5.4.8	Adopt new cultivation and planting technologies	Recommended										
5.4.9	Retire or manage marginal land	Recommended										
5.4.10	Constructed wetlands or protection of existing wetlands	Recommended										
5.5.2	Nutrient budget for each crop	Recommended										
5.5.3.1	General soil fertility testing	Recommended										
5.5.3.3	Nitrate Quick Test	Recommended										
5.5.3.4	Potentially mineralisable nitrogen (PMN) testing	Recommended										
5.5.3.5	Annual testing if nutrient build-up is detected	Recommended										
5.5.3.7	Leaf/tissue testing	Recommended										
5.5.4	Representative soil sampling practice	Recommended										
5.5.6	Use of enhanced fertiliser products	Recommended										
5.5.7	GPS-based or targeted application	Recommended										
5.5.8	Well granulated fertilisers for ground application	Recommended										
5.6.1	Assess soil type, structure, drainage, and profile	Recommended										
5.6.2	Maintain soil pH at crop-optimal levels	Recommended										
5.6.3	Assess and manage soil compaction	Recommended										
5.6.4	Minimise tillage where practicable	Recommended										
5.6.7	Soil moisture is monitored and budgeted	Recommended										
5.6.8	Monitor soil organic matter (OM)	Recommended										
5.6.9	Monitor soil biology	Recommended										
5.6.10	Use green manures (e.g. legumes)	Recommended										

Erosion & sediment control practices to reduce P loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
5.5.3.6	Representative soil testing on blocks for P every 3-years.	Minimum										
	Minimise water entering the paddock: Intercept overland flow from catchments above with the use of interception drains, diversion bunding, culverts, and benched headlands	Minimum										
	Use of cover crops where possible. Grassed swales installed where appropriate. Follow good management practice for cultivation, harvest, and postharvest paddock management.	Minimum										
	Install and maintain vegetative buffer strips. All access ways should be raised.	Minimum										
	Where appropriate, use wheel track ripping or dyking to increase infiltration rates.	Minimum										
	Consider decanting earth bunds.	Minimum										
	Reduce row length to < 200 m, or use contour drains	Recommended										
	Construction of 0.5% sediment retention ponds (SRPs).	Recommended										

5c. LAND MANAGEMENT GROUPING 3 - PRACTICES

Each Land Management Grouping (LMG) for nitrogen and phosphorus has a set of minimum and recommended practices for growers to implement. The blocks assigned to LMG 3 are provided on the left of the practice table, linked to the **Risk assessments** tab.
Use this table to work through each practice. All growers must work towards achieving **100% of Minimum practices** and **75% of Recommended practices** in this table, **for the blocks listed on the left.**
If a practice is marked as Partial or No, please provide information on the action to be completed.
If a practice is marked Yes, i.e. is complete/already implemented, use the Evidence column to note where you have information to support this practice.
More information on each practice can be found in the Code of Practice for Nutrient Management.

Percentage of **Minimum** practices achieved	**0%**
Percentage of **Recommended** practices achieved	**0%**

Blocks

LMG 3 blocks NITROGEN	LMG 3 blocks PHOSPHORUS

Practices to reduce the risk of nutrient loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
	Nutrient management plan prepared	Minimum										
5.5.2	Nutrient budget for each crop	Minimum										
5.5.3.2	Representative soil testing for mineral N at the beginning and end of each crop to inform nutrient budgeting (foliage testing if needed).	Minimum										
5.5.3.4	Annual PMN soil testing for 3 years, then every 5 years.	Minimum										
5.5.1	Nitrogen timing and rates based on agronomic advice, grower knowledge, or crop guidelines.	Minimum										
5.4.2	Annual calibration of fertiliser spreading equipment	Minimum										
5.4.3	Irrigation systems are well maintained	Minimum										
5.4.1	Manage Fertiliser Handling, Transport, and Storage	Minimum										
5.4.5	Fertiliser spreading operators are trained and competent	Minimum										
5.5.5, 5.5.7	Use split, incorporated, and banded fertiliser application methods (i.e. targeted application)	Minimum										
5.6.5	Minimise fallow periods	Minimum										
5.6.6	Use cover crops / catch crops in your rotation.	Minimum										
6.1.2	Commercial vegetable operations use the Nitrogen Risk Assessment Tool (NRAT) to select additional practice to meet the NRAT target score.	Minimum										
	Records for practices available	Minimum										
	Action plan implemented	Minimum										
	Review and update NMP annually	Minimum										
5.4.7	Use border controls near waterways	Recommended										
5.4.8	Implement controlled traffic farming (CTF)	Recommended										
5.4.8	Adopt new cultivation and planting technologies	Recommended										
5.4.9	Retire or manage marginal land	Recommended										
5.4.10	Constructed wetlands or protection of existing wetlands	Recommended										
5.5.2	Nutrient budget for each crop	Recommended										
5.5.3.1	General soil fertility testing	Recommended										
5.5.3.3	Nitrate Quick Test	Recommended										
5.5.3.5	Annual testing if nutrient build-up is detected	Recommended										
5.5.3.7	Leaf/tissue testing	Recommended										
5.5.4	Representative soil sampling practice	Recommended										
5.5.6	Use of enhanced fertiliser products	Recommended										
5.5.8	Well granulated fertilisers for ground application	Recommended										
5.6.1	Assess soil type, structure, drainage, and profile	Recommended										
5.6.2	Maintain soil pH at crop-optimal levels	Recommended										
5.6.3	Assess and manage soil compaction	Recommended										
5.6.4	Minimise tillage where practicable	Recommended										
5.6.7	Soil moisture is monitored and budgeted	Recommended										
5.6.8	Monitor soil organic matter (OM)	Recommended										
5.6.9	Monitor soil biology	Recommended										
5.6.10	Use green manures (e.g. legumes)	Recommended										

Erosion & sediment control practices to reduce P loss

CoP reference	Management practices	Minimum or recommended	Yes/Partial/No	Action to be completed (be specific)	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Comments if partial or no (justification if N/A)	Review date
5.5.3.6	Representative soil testing on blocks for P once a year.	Minimum										
	Minimise water entering the paddock: Intercept overland flow from catchments above with the use of interception drains, diversion bunding, culverts, and benched headlands	Minimum										
	Use of cover crops where possible. Grassed swales installed where appropriate. Follow good management practice for cultivation, harvest, and postharvest paddock management.	Minimum										
	Install and maintain vegetative buffer strips. All access ways should be raised.	Minimum										
	Where appropriate, use wheel track ripping or dyking to increase infiltration rates.	Minimum										
	Consider decanting earth bunds.	Minimum										
	Reduce row length to < 200 m, or use contour drains	Minimum										
	Construction of 0.5% sediment retention ponds (SRPs).	Minimum										

6. ACTION PLAN

The table below can be used to record your actions within your nutrient management plan that are not covered by the practices listed in the LMG tables. Links are prepopulated to the LMG tables to reduce double-entering of actions.

No.	Action to be completed	Management area / risk adressed	Expected date of completion	Action frequency	Existing or new action	Person responsible	Actual date of completion OR date last completed	Evidence	Review date
1	LMG 1 actions								
2	LMG 2 actions								
3	LMG 3 actions							N/A - No blocks in LMG 3	
4	Join local catchment group		1/01/2026	One-off	New	JB		Membership sign-up record & meeting attendance	
5	Plan out species to plant on southern drain based on local bush		1/06/2025	One-off	New	JB		Completed planting plan	
6	Investigate feasibility of real-time soil moisture monitoring.		1/06/2025	One-off	New	JB		Feasibility study complete and decision made	
7									
8									
9									
10									

APPENDIX B: RESOURCES

HortNZ Codes of Practice

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

Tool	Sector	Description
Erosion and Sediment Control Code of Practice 2025	All sectors	This Code provides practical direction on managing erosion and sediment loss from horticultural production activities. It includes a paddock erosion risk assessment process, and range of risk-based practices to minimise erosion and soil loss, maintain soil health, and protect waterways.
Nutrient Greenhouse Discharge Code of Practice 2025	Greenhouses	This Code outlines practices for managing nutrient-rich discharges from greenhouses. It includes guidance on treatment, reuse, and responsible discharge methods to protect soil and water resources. The Code helps greenhouse growers reduce nutrient losses and manage environmental compliance expectations.
Vegetable Washwater Code of Practice 2025	Outdoor vegetable production	This Code supports outdoor vegetable producers in managing washwater generated from washing vegetables during post-harvest processing. It provides recommendations for treatment, disposal, and reuse of washwater to minimise environmental impacts.
Farm Machinery Washdown Code of Practice 2025	All sectors	Designed for use across all horticultural sectors, this Code sets out good practice for washing down farm machinery to prevent the spread of pests, diseases, and contaminants. It includes direction on siting washdown areas, managing washwater, and protecting soil and water from contamination.

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. Available here: 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. Available here: https://www.fertiliser.org.nz/Site/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/Site/resources/nutrient-management-planner.aspx.
Nutrient Management for Vegetable Crops in New Zealand – JB Reid & JD Morton (2020)	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: https://www.nmacertification.org.nz/site/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. Find the factsheet link on this page: 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. It certifies spreading equipment and audits the operators' 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 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

Name	Sector	Description
Foundation for Arable Research	All sectors	Nitrate Quick 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	Plant & Food Research NZ developed a factsheet on testing for soil nitrogen. Find the factsheet link on this page: https://www.plantandfood.com/en-nz/article/soil-nitrogen-testing-and-predicting-nitrogen-supply
Mitigating nutrient loss from pastoral and crop farms: A review of New Zealand literature. Horizons Regional Council.	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. Available on the Association's resources page or here: 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
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. 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: • Wetlands (pages 1-5) • Riparian buffers (pages 6-8) https://www.horizons.govt.nz/HRC/media/Media/Consent/Mitigating-nutrient-loss.pdf

APPENDIX C: NITROGEN RISK ASSESSMENT TOOL: COMMERCIAL VEGETABLE GROWING

1. Nitrogen Fertiliser Practices

(a) Nitrogen fertiliser annual application rate
(b) Nitrogen fertiliser application rate per application (individual)
(c) Nitrogen balance/budget
(d) Nitrogen soil testing
(e) Crop establishment fertiliser application method
(f) Side fertiliser application method

2. Soil Health

(a) Practices between crops
(b) Catch crops (cut-and-carry)

1. Nitrogen Fertiliser Practices

(a) Nitrogen fertiliser annual application rate	Points	Proportion of area (%)
N fertiliser: <100 kgN/ha	0	
N fertiliser: 100-150 kgN/ha	30	
N fertiliser: 151-200 kgN/ha	60	
N fertiliser: 201-250 kgN/ha	90	
N fertiliser: 251-300 kgN/ha	150	
N fertiliser: 301-400 kgN/ha	200	
N fertiliser: >400 kgN/ha	250	
Subtotal (column 2 x 3)		

(b) Nitrogen fertiliser application rate per application (individual)	Points	Proportion of area (%)
N fertiliser: <25 kgN/ha	-30	
N fertiliser: 25-50 kgN/ha	0	
N fertiliser: 51-75 kgN/ha	30	
N fertiliser: 76-100 kgN/ha	60	
N fertiliser: >100 kgN/ha	90	
Subtotal (column 2 x 3)		

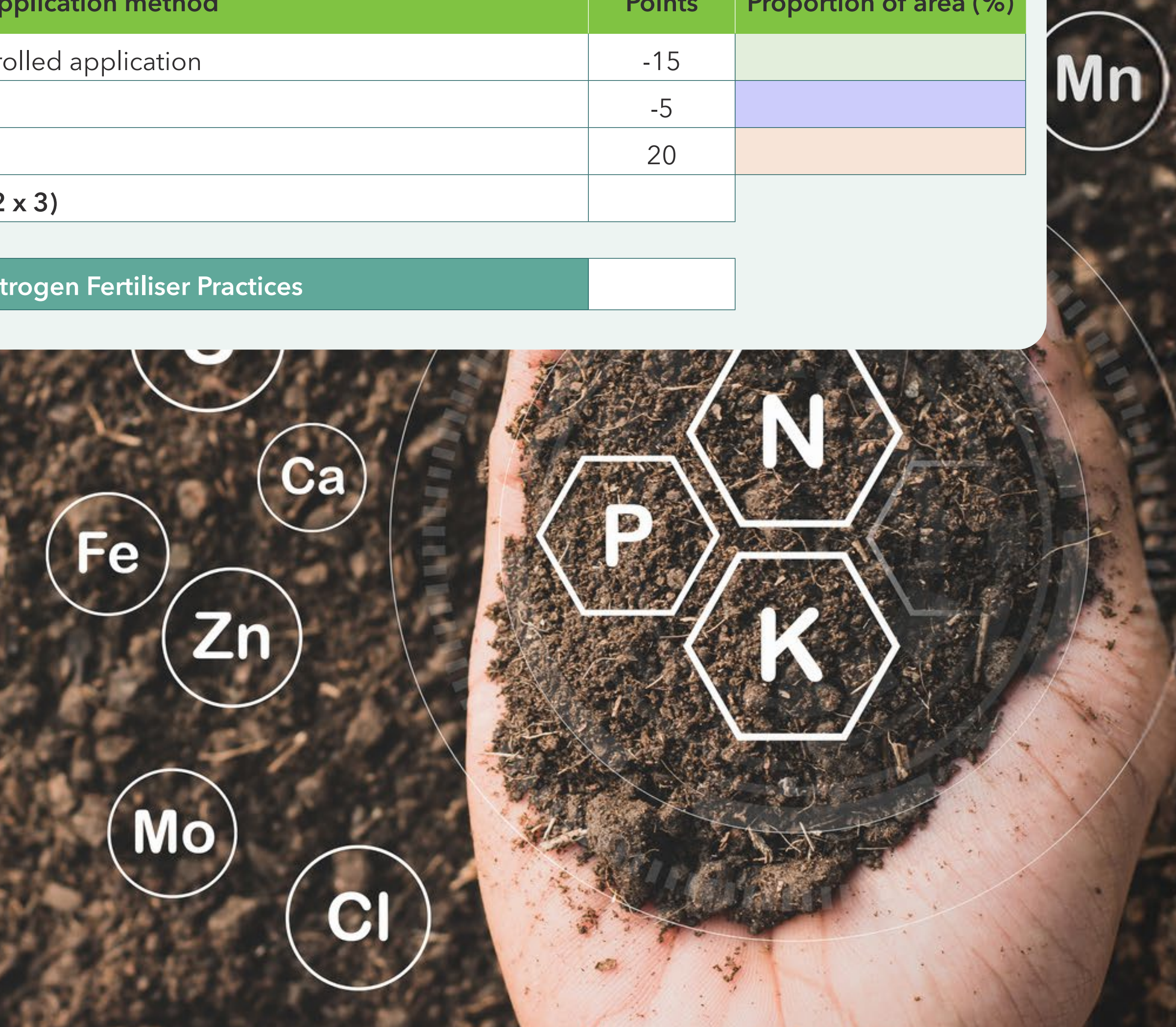
(c) Nitrogen balance/budget	Points	Proportion of area (%)
Yes	-50	
No	0	
Subtotal (column 2 x 3)		

(d) Nitrogen soil testing	Points	Proportion of area (%)
Before every nitrogen fertiliser application	-50	
At the beginning of each crop within the crop rotation	-30	
One a year	0	
Never	50	
Subtotal (column 2 x 3)		

(e) Crop establishment fertiliser application method	Points	Proportion of area (%)
Incorporated, GPS banded, controlled application	-20	
Surface, GPS banded, controlled application	-15	
Incorporated, banded	-10	
Surface, banded	-5	
Surface broadcast, incorporated	10	
Surface broadcast	20	
Subtotal (column 2 x 3)		

(f) Side fertiliser application method	Points	Proportion of area (%)
GPS banded, controlled application	-15	
Banded	-5	
Broadcast	20	
Subtotal (column 2 x 3)		

TOTAL POINTS. Nitrogen Fertiliser Practices	



1. Soil Health

(a) Practices between vegetable crops within the crop rotation	Points	Proportion of area (%)[1]
Cover crop	-30	
Fallow < 4 weeks	0	
Fallow 4 – 12 weeks	25	
Fallow > 12 weeks	50	
Subtotal (column 2 x 3)		

(b) Catch crops (cut-and-carry)	Points	Proportion of area (%)[1]
Yes	-20	
No	0	
Subtotal (column 2 x 3)		

TOTAL POINTS. Soil Health	

TOTAL POINTS. Nitrogen Fertiliser Practices + Soil Health	

Nitrogen Leaching Risk Limits for Commercial Vegetable Growing (for Variations in Soil and Drainage) as determined by the combined points for the two-management practices, Nitrogen Fertiliser and Soil Health.

Points Limit		**Profile Available Water**		
		151 - 350 mm	61 - 150 mm	0 - 60 mm
Rainfall 1	**<1000 mm/year**	72	72	52
Rainfall 2	**1000 – 1300 mm/year**	72	60	48
Rainfall 3	**1300 – 1600 mm/year**	60	52	44
Rainfall 4	**>1600 mm/year**	60	48	44

1.Note the sum of the area for fallow periods will equal 100%, plus the area planted in cover crops, i.e., if cover crops are planted the sum of the area is greater than 100%.

Definitions

Calculation of Subtotal. The subtotals for each practice category are calculated by multiplying the practice score (column 2) by the proportion of the area that the practice applies to (column 3). Then summing the points. For example, if 50% of the area has a nitrogen soil test at the beginning of each crop cycle and 50% of the area is tested once a year the subtotal is -30 x 0.5 + 0 x 0.5 = 15

(d) Nitrogen soil testing	Points	Proportion of area (%)[1]
Before every nitrogen fertiliser application	-50	
At the beginning of each crop cycle	-30	50%
One a year	0	50%
Never	50	
Subtotal (column 2 x 3)	**15**	

Proportion of area (%). The proportion of the area that a practice is applied to. This will always total 100%, except for the Soil Health question (1) Practices between crops, where the sum of the fallow periods will equal 100% plus the proportion of the area that are planted in cover crops.

Risk Rating. The subtotals are summed to determine the overall Risk Rating for both of the farm management practices; (1) Nitrogen fertiliser practice and (2) Soil health.

Productive Area. The area denominator in 1(a) and 1(b) is an operation's total productive crop rotationarea. This includes both owned and leased land.

Productive area is all the area within the boundaries of the productive crop rotation area. This includes the total area where the crop is grown, including wheel tracks and beds that are not cropped, as well as headlands and races. Productive area does not include the land occupied by buildings. Productive crop rotation area does not include areas that cannot be cropped such as bush blocks, nor does it include pasture grown for greater than 2 years.

Commercial vegetable production: means the commercial growing of vegetables intended for human consumption, and other crops as part of crop rotation practices.

Crop Rotation: The practice of the systematic planting of different vegetable and arable crops in sequence, or in combination, over multiple years within the same property, and/or on changing properties across sufficient suitable land, which can and often does include pasture phases and fallow periods. The purpose of this practice is to help reduce soil erosion, maintain soil structure and nutrients in the soil, reduce plant diseases and pests, and improve biodiversity. The practice is critical to the maintenance of productive vegetable yields.

Nitrogen fertiliser annual application rate 1(a). This is the total quantity of elemental nitrogen fertiliser applied per year divided by the productive area. This should be split into the different rate bands based on the proportion of productive area (i.e., 50% at 100 – 150 kgN/ha and 50% at 151 – 200 kgN/ha). This is not a whole operation average.

Nitrogen fertiliser application rate per application (individual) 1(b). This is the amount of elemental nitrogen applied per hectare for a single application. This should be split into the different rate bands based on the proportion of productive area where rates vary between crops. This is not a whole operation average.

Catch crop: A catch crop is any crop that is grown with the primary objective of catching excess nitrogen in soils that otherwise may be lost through leaching. At harvest this crop is exported off farm. Examples include maize and grass grown for silage or hay.

Cover crop: A cover crop is any crop that is grown with the primary objective of catching excess nitrogen in soils that otherwise may be lost through leaching. Before the planting of the next vegetable crop the cover crop is mulched and/or incorporated into the soil.

Fallow: A period of time after crop harvest where the soil remains bare.

Nitrogen soil testing (mineral N): the use of soil mineral N testing. E.g., Quick N test or laboratory based mineral N.

Nitrogen balance/budget: A decision support tool to help a grower understand the inputs and outputs of nitrogen for a crop growing system. Nitrogen outputs are balanced against nitrogen inputs in a graph or table, categorised by source or destination. Nitrogen budgets assist growers with appropriate nitrogen fertiliser recommendations.

Crop establishment fertiliser application methods:

Surface: the application of fertiliser which remains on top of the soil, either banded or broadcast.

Incorporated: the fertiliser is applied into the soil at the time of application.

GPS banded: the placement of fertiliser in continuous narrow ribbons, usually at specific distances from the seeds or plants, recorded using GPS.

Banded: the placement of fertiliser in continuous narrow ribbons, usually at specific distances from the seeds or plants.

Broadcast: The spreading of fertiliser evenly over a large area. The fertiliser then remains on the soil surface to break down.

Controlled application: Controlled application rate of fertiliser is a method of applying fertiliser in a precise and targeted manner using an electronic rate controller that, maintains or adjusts rates during spreading irrespective of speed.

APPENDIX D: DEFINITIONS

Block	A defined area of land in an enterprises' operation that is managed in a consistent way and is used to plan, assess and manage land use activities. Blocks are typically delineated based on factors such as crop type, soil type, topography, or practices (e.g., fertiliser use, irrigation, or cultivation).
Crop Rotation	is the systematic planting of different crops in sequence over multiple years within the same growing space, or across changing land parcels, and often includes a pasture phase. This process helps maintain nutrients in the soil, reduce soil erosion, and prevents plant diseases and pests.
Enterprise	means one or more parcels of land^ held in single or multiple ownership to support the principle land^ use, or land^ on which the land^ use is reliant, which constitutes a single operating unit for the purposes of management.
Catch crop	A catch crop is any crop that is grown with the primary objective of catching excess nitrogen in soils that otherwise may be lost through leaching. At harvest this crop is exported off farm. Examples include maize and grass grown for silage or hay.
Cover crop	A cover crop is any crop that is grown with the primary objective of catching excess nitrogen in soils that otherwise may be lost through leaching. Before the planting of the next vegetable crop the cover crop is mulched and/or incorporated into the soil.
Fallow	A period of time after crop harvest where the soil remains bare.
Nitrogen soil testing (mineral N)	the use of soil mineral N testing. E.g., Quick N test or laboratory based mineral N.
Nitrogen balance/ budget	A decision support tool to help a grower understand the inputs and outputs of nitrogen for a crop growing system. Nitrogen outputs are balanced against nitrogen inputs in a graph or table, categorised by source or destination. Nitrogen budgets assist growers with appropriate nitrogen fertiliser recommendations.
Fertiliser application methods:	
Surface	the application of fertiliser which remains on top of the soil, either banded or broadcast.
Incorporated	the fertiliser is applied into the soil at the time of application.
GPS banded	the placement of fertiliser in continuous narrow ribbons, usually at specific distances from the seeds or plants, recorded using GPS.
Banded	the placement of fertiliser in continuous narrow ribbons, usually at specific distances from the seeds or plants.
Broadcast	The spreading of fertiliser evenly over a large area. The fertiliser then remains on the soil surface to break down.
Controlled application	Controlled application rate of fertiliser is a method of applying fertiliser in a precise and targeted manner using an electronic rate controller that, maintains or adjusts rates during spreading irrespective of speed.

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