Farm Environment Plans – Implementation to Audit and Reporting (Consenting)

NZGAP Environmental Management System Add-on

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AGRILINK

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1 Overview

Joining the Dots is a structured approach to progressing from problem recognition, through research and supported guidelines, to the use of Farm Environment Plans (FEP) that provide a time bound structure for implementing mitigations. Assurance is provided through third party auditing. Through a centralised database a range of qualitative and quantitative metrics can track and report progress. Individualised benchmarking reports also supports a feedback loop to growers, which in turn can lead to problem recognition and links through to existing industry guides or identify areas for further research.

Farm Environment Plans (FEPs) that are audited under the New Zealand Good Agricultural Practice (NZGAP) Environmental Management System (EMS) add-on, provide assurance to regional councils that the outdoor fresh vegetable industry is undertaking continuous improvement with the goal of increasing sustainability.

As part of the work to date, Agrilink NZ, commissioned by the Vegetable Research and Innovation Board (VR&I), Potatoes NZ, and NZGAP, have stepped individual growers and now grower catchments through their FEPs', auditing, and reporting. This included the collection, aggregation, analysis, and display of national and regional scale metrics via NZGAP EMS. These metrics and dashboards can be used to report on the industry's sustainability progress over time. Individualised benchmarking reports were also generated for growers to inform future decision making and priority management areas.

This report incorporates the experiences from Levin where 1,090 ha, comprising of 22 operations and 263 paddocks progressed through to an audited FEP. Consequently, a range of qualitative and quantitative metrics have been developed that tell a very powerful story about where these growers have come from, where they are currently, and their trajectory towards implemented good and best management practice.

The next priority area is Gisborne where vegetable growers are currently working through to an FEP audit ready deadline of 1 May 2021.

2 Problem Recognition

The first step towards improved practice is problem recognition. Without recognition and consequently motivation to change, none of the steps described in Joining the Dots through to implementation are likely to occur.

Vegetable production needs to minimise its environmental impact primarily in the areas of sediment and nitrogen loss. The extent to which this is an issue is location specific. Therefore, a paddock risk assessment forms the first step in an operation's Farm Environment Plan (FEP).

In our example problem recognition came in the form of a major storm in May 1996, resulting in sediment and stormwater flooding parts of Pukekohe. Grower members of the Pukekohe Vegetable Growers Association needed to find a way of reducing the effects of erosion. The Franklin Sustainability Project (FSP) was born.

The path to implementation was described in the final FSP report (Barber, 2004) and is shown in the diagram below.

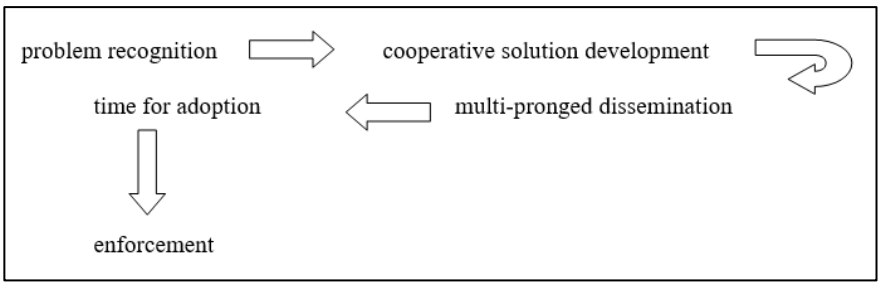


Figure 1. The path to implementation proposed by FSP in 2004.

3 Research

NZGAPs EMS takes their good and best management practices from industry developed guidelines and codes of practice. These have been built upon years of CRI and grower research and practice.

We have used erosion and sediment control to demonstrate the research component of Joining the Dots. Sediment discharge is a significant issue, particularly in the vegetable industry where the ground is cultivated. Hence it has been an area of significant work for many years. Therefore, it provides a great example to follow through from problem recognition, through research, guidelines, and now incorporation into FEPs and implementation.

3.1 Erosion and Sediment Control

Cultivated vegetable cropping research into erosion and sediment control included trials as part of the Franklin Sustainability Project in the mid '90s and later the MPI SFF / HortNZ project Don't Muddy the Water.

Don't Muddy the Water (2015-2019) was conducted to quantify the effectiveness of several sediment mitigation measures on cultivated horticultural land. The research was conducted by Agrilink NZ, NIWA, and Landcare Research. The primary focus was quantifying the effectiveness of sediment retention ponds (SRPs) and vegetated buffer strips. Trial details and results can be found in the final report (Barber et. al., 2019).

The most effective sediment reduction mitigation measure on flat cultivated land is well installed vegetated buffer strips. The assumptions and modelling behind this mitigation are included in the paper *Factors and Assumptions Used in the Don't Muddy the Water Erosion and Sediment Rate Calculator* [accessed through the DMTW app http://agrilink.co.nz/wp-content/uploads/2020/02/Factors-and-Assumptions-for-DMTW-App.pdf]. The greatest impact on effectiveness is the degree of channelising.

Don't Muddy the Water built upon previous research on erosion control, including the use of cover crops and wheel track ripping.

On-going research includes MPI and FARs effectiveness of vegetated buffer strip trials.

This body of research over the past 25 years has either helped develop or later supported the *Erosion & Sediment Control Guidelines for Vegetable Production* (Barber, 2014) https://www.nzgap.co.nz/NZGAP_Public/Growers/Guidelines.aspx.

3.2 Nitrogen Leaching

The other significant issue is nitrogen leaching. While this to has been a focus of research over many years, it is now an industry wide MPI supported project called Sustainable Vegetable Systems. Collecting the data and modelling the system are key workstreams in this four-year project (2020/21 to 2023/24) and places it at a similar point that sediment was in in 2015 when Don't Muddy the Water was established.

3.2.1 Nutrient Management for Vegetable Crops in NZ

The primary source of information on the nutrient management of vegetable crops is the recently released *Nutrient Management for Vegetable Crops in NZ* (Reid and Morton, 2019). This built upon the 1986 MAF published *Fertiliser Recommendations for Horticultural Crops*. The nutrient use in the Reid & Morton guide takes into account 30 years of subsequent research since the MAF publication.

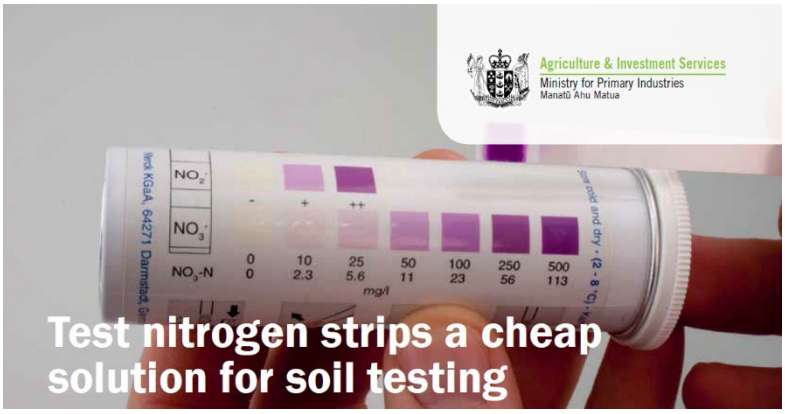
3.2.2 Sustainable Vegetable Systems

The four-year Sustainable Vegetable Systems (SVS) project is an MPI and industry funded project with the outcome of achieving greater understanding of vegetable crop nitrogen management in order to reduce the risk of nitrate leaching. Just like Don't Muddy the Water, SVS is focused on collecting robust data that in turn can be used to support Overseer and other crop nutrient models.

The modelling workstream aims to provide a tool or suite of tools to help growers implement good management practice and provide leaching assessments to regulators.

This project will review current tools, and if suitable develop a tool(s) for a wide range of vegetable crops across different locations and land use practices. Modelling will include OverseerFM and APSIM and their calibration and validation against Plant and Food Research trials, as well as regional monitoring sites. Alternative tools that can be integrated into guides like Nutrient Management for Vegetable Crops in NZ (Reid and Morton, 2019) are also being developed.

3.2.3 Quick-N Test



A recently completed MPI SFF project with industry partners has tested and refined the use of Quick Test nitrogen strips.

The testing process involves collecting and mixing soil samples in a calcium chloride solution. The test strip is dipped in and a colour change on the strip shows the current nitrate level in the soil.

While the gold standard is a laboratory test, it is hoped that these quicker turnaround lower cost tests will result in more soil testing and fine tuning of side dressings.

3.2.4 Future Proofing Vegetable Production

This MPI SFF project is being delivered by LandWISE. The project draws on and supplements recent and current research to develop and disseminate good fertiliser management practices. This includes Quick-N test and precision application - ensuring the prescribed rate of fertiliser is applied.

3.2.5 Hot Water Nitrogen Test

Mineralisable N to improve on-farm N management is a MPI SFF project (2019) being conducted by Plant & Food Research. This project is running on-farm demonstration trials in arable and vegetable cropping systems to validate use of a new laboratory test (published 2017) to predict in-field N mineralisation. Trials will demonstrate the benefits of the new test in minimising unnecessary fertiliser N use and reducing the risk of N losses to the environment.

The overarching goal is to provide agronomists and growers with a tool that can provide more confidence in the wise use of nitrogen fertilisers for both production and environmental stewardship goals.

The test has been shown to predict Potentially Mineralisable Nitrogen (PMN) i.e. nitrogen likely to be mineralised from organic matter, that can then be taken up by crops over a growing season.

4 Guidelines and COPs

4.1 Erosion and Sediment Control Guidelines

The Erosion & Sediment Control Guidelines for Vegetable Production[1] was prepared in 2014 and specifies the four-step process needed to conduct a risk assessment and to generate an E&S Control Plan. The guidelines details a large array of E&S control measures suitable for cultivated horticultural land. Measures in the guideline include vegetated buffers, sediment retention ponds (SRPs), cultivation practices, interception drains, and wheel track ripping amongst many others.

FOUR STEPS TO MINIMISING SOIL EROSION & SEDIMENT LOSS

1. Paddock assessment

Map and describe the paddock (slope, area, history)

Identify where water is coming from

Identify where water leaves the paddock

2. Implement control measures for stopping or controlling water entering the paddock

Interception drains

Correctly sized culverts

Benched headlands

Bunds

Grassed swales
(controlled overland flow through the paddock)

3. Implement erosion control measures to keep soil on the paddock

Cover crops

Wheel track ripping / Wheel track dyking

Contour drains

Using short row lengths

Cultivation practices including minimising passes

Harvest management – timing / all-weather facilities

Post-harvest field management

Wind break crops (wind erosion)

4. Implement sediment control measures to manage the water and suspended solids that move off the paddock

Ensure access ways are not at the lowest point

Raised access ways / Bunds

Vegetated buffers / Riparian margins / Hedges

Super silt fences

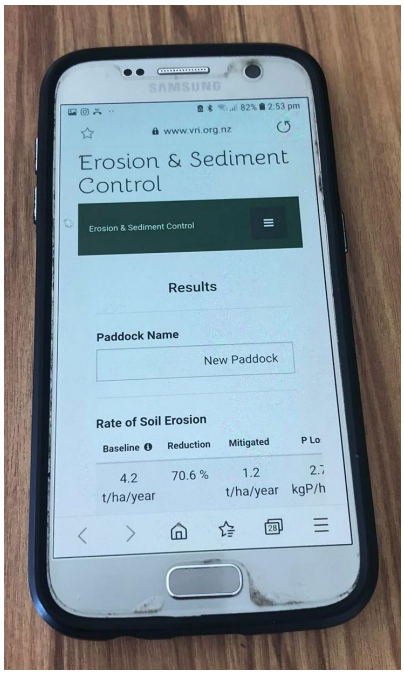
Stabilised discharge points and drains

Decanting earth bunds and silt traps

Version 1.1 - 2014 7

[1] Barber, A. 2014. Erosion & Sediment Control Guidelines for Vegetable Production. Prepared for Horticulture New Zealand. Prepared by Agrilink NZ, Kumeu.

4.1.1 Don't Muddy the Water App



A key tool developed as part of the Don't Muddy the Water project, and later refined through grower use and feedback, was the DMTW app.

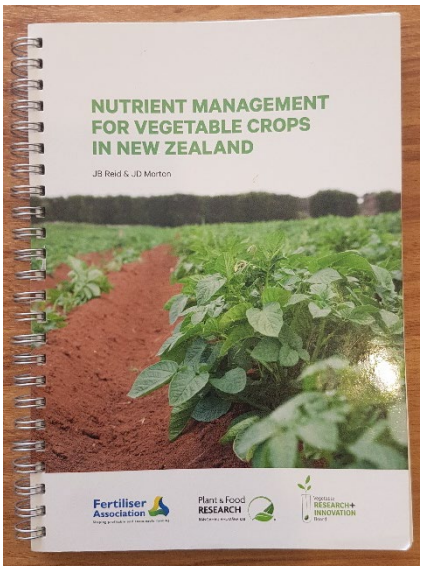
Growers and regional authorities now have an app that estimates a range of sediment loss rates for a paddock, including unmitigated, current practice and enhanced future practice. This research and app has been used to aggregate paddock losses to estimate catchment sediment loads.

The app allows growers to do a paddock risk assessment and subsequently prioritise their actions as part of their Farm Environment Plan.

This allows growers to provide robust evidence to support consent applications, proving to regional authorities that their mitigation measures are effective. In turn this helps growers to make better decisions about how to control erosion and sediment entering New Zealand waterways.

Specifically, the app quantifies the impact of various mitigation practices for reducing sediment and phosphorus loss. The user enters factors such as soil type, slope, and location to establish the unmitigated baseline. Erosion mitigations, such as cover crops and wheel track ripping, can be added. Sediment mitigations, such as vegetated buffer strips and sediment retention ponds can then be added to assess the impact of these practices.

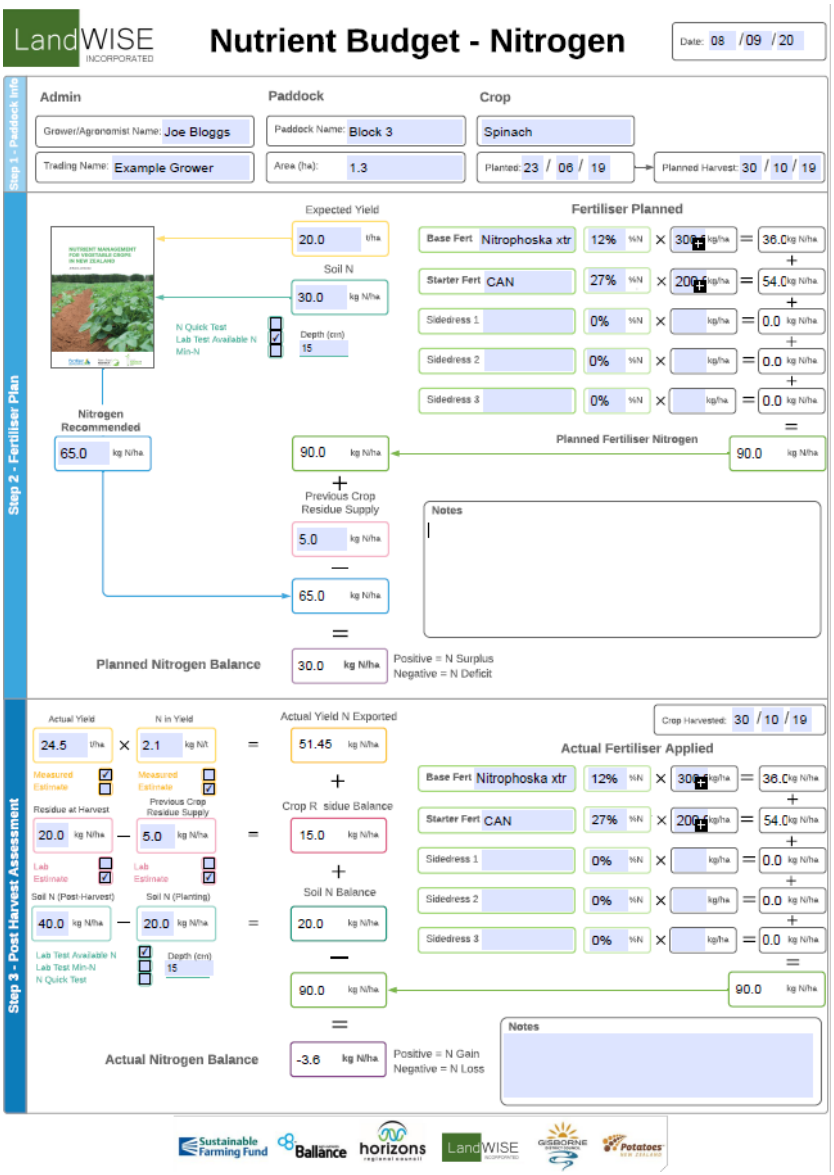
4.2 Nutrient Management Guidelines and Budget Template



The culmination of years of nutrient research has been synthesised into the publication *Nutrient Management for Vegetable Crops in NZ*. This has been distributed to growers and has a dissemination programme associated with it, albeit currently being revised in the new covid-19 environment.

For those crops covered by the guide they provide the most up-to-date synthesis of current crop nutrient research and modelling.

4.3 Nutrient Budget



The LandWISE project, Future Proofing Vegetable Production, has developed single page nitrogen and phosphorus budgets that integrate with the nutrient management guide and soil testing –laboratory, quick-N test, and hot water N.

An example is given below. This template provides evidence that a process has been followed that involves reference to the industry guide and does it in a way that documents on a single page the fertiliser plan.

The nutrient budget has both a planning (step 2) and review or assessment of performance (step 3) components.

The planning step documents what may have previously occurred informally between a fertiliser adviser and the grower prior to placing an order.

The crop type, target yield, and soil nitrogen availability prior to planting is used to determine the crop nitrogen requirements. This plus a target surplus at the end of the crop determines the nitrogen fertiliser requirement.

Two key drivers are the guideline crop requirements and the level of risk reflected in the planned nitrogen surplus at the end of the crop. A low surplus assumes very little leaching, which runs a higher risk of crop failure. A high surplus has an elevated leaching potential and possible crop quality issues. The guidelines provide an average, tuned against a range of factors such as soil mineral nitrogen levels, yields, and location. They should however not be used as a maximum, and naturally can not account for seasonal variability.

In the nutrient budget, Step 2- Fertiliser Plan can be used as evidence in the NZGAP FEP (Nutrients: 7C – 1 Plan fertiliser inputs for the crop).

7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop	○	○	○	○				GMP

Most crop fertiliser decisions are made pre-planting. Changes to the plan can be made around side dressings based on the climate and how the crop is performing. However, this tends to be more tweaks than significant changes.

The post-harvest review in Step 3, is where all of the uncertainties of growing and the markets come in. The actual nitrogen gain or loss is the reality of growing in an unpredictable climate. While from a continual learning perspective it is important to review the season, estimated nitrogen losses in this review step should not be a point of compliance. Potentially a grower could have leaching losses due to factors outside their control such as high rainfall, crop disease, or there being no market for their crop at the time of harvest. Clearly these scenarios are not envisaged when the fertiliser plan was prepared in Step 2.

Nevertheless, a review is important for both planning the next crop - including soil testing and crop residue carry over, and to record why there was a deviation from the plan (e.g. high rainfall, crop or market failure). However, there are a lot of unknowns in this review step, including how to determine residue levels and their associated nitrogen contribution and release timing.

Consequently, many aspects of the review step have become the focus of current research. This includes better understanding of crop residues such as estimating the quantity, availability, and nutrient release timing. Likewise, the research described in Section 3.2 includes new soil nitrogen testing such as Quick-N and hot water laboratory analysis. While research being conducted by SVS is developing better understanding of crop growth models and soil nitrogen dynamics.

5 Farm Environment Plans

The NZGAP EMS has developed a Farm Environment Plan (FEP) Template.

There are 5 management areas, with multiple sub sections:

1. Property Plan (map)
2. Soil
3. Nutrients
4. Water and Irrigation
5. Mahinga Kai and Biodiversity

The FEP process for each management area:

1. Assess the environmental risks
2. Identify GMPs (and BMPs if applicable) currently completed/implemented
3. Identify GMPs (and BMPs if applicable) yet to be completed/implemented and set target date for completion/implementation
4. Make progress towards GMP (and BMP if applicable)
5. Actions and improvement will be assessed during your next EMS audit

The FEP Template has been developed and refined over the past few years. One of the biggest benefits is that it documents the timeline for the implementation of GMPs and BMPs. It collates the suite of practices and if a practice is not being used it requires a justification for a No response or a timeframe for its implementation. Likewise, where practices are being used the grower must provide evidence of such.

The risk assessment and GMP / BMP assessment is then used to assemble a timebound Action Plan.

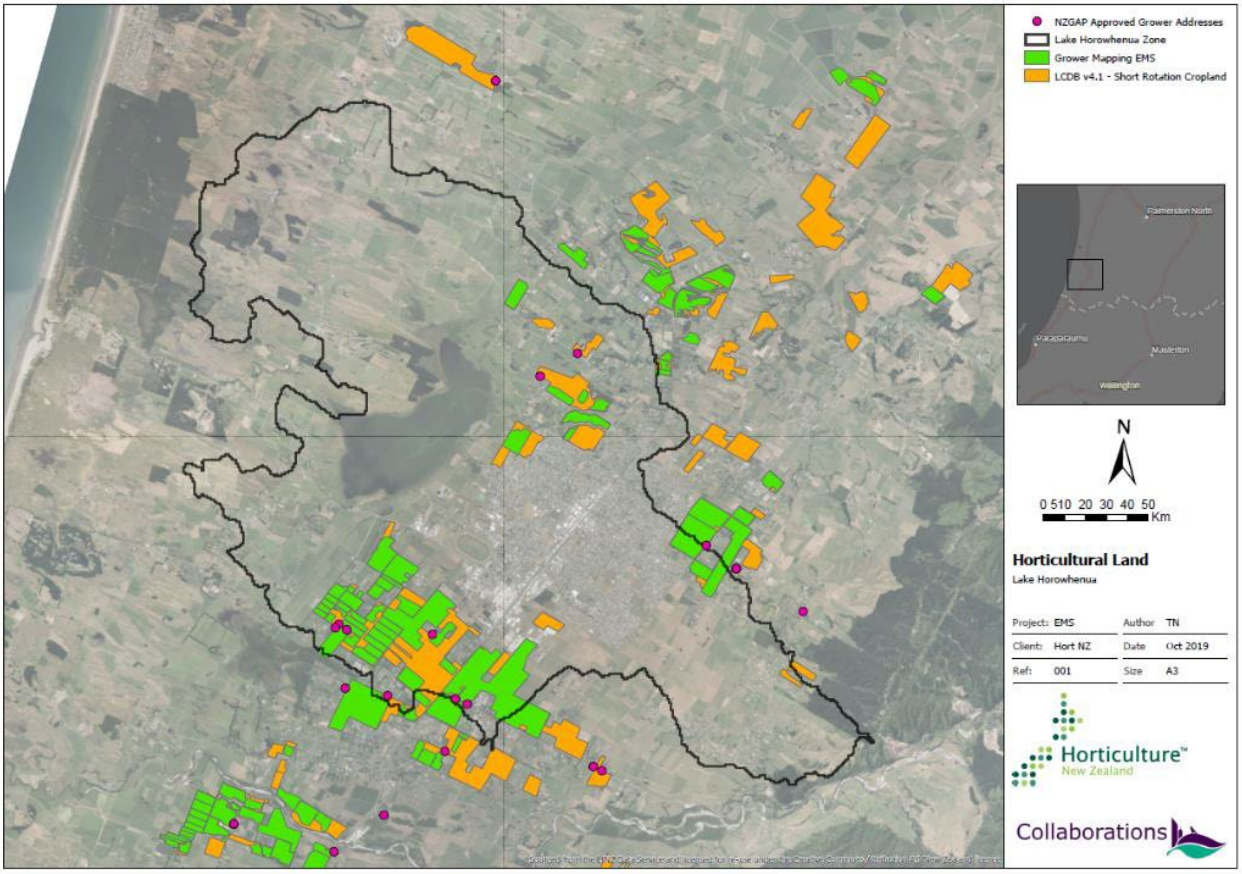
6 Implementation – Growers

An enormous amount of work has recently gone into implementing NZGAP's EMS across the industry. To date over a dozen workshops have been held in four regions, with 5 in Levin, 2 in Pukekohe, 1 in Taupo, 2 in Gisborne, and 3 in Canterbury. A stronger emphasis is also being placed on regional and crop specific case studies to give growers a relatable point of focus.

6.1 Pioneering the EMS in the Horowhenua

The Levin horticultural hub was selected as the first area to collectively go through the EMS. This was due to several factors, including Horizons Regional Council's Plan Change 2. The introduction of the EMS was a good opportunity to prove to the regional council that the local industry was taking its environmental obligations seriously. The second major factor was the environmental focus and small catchment size of Lake Horowhenua. This allowed for a catchment scale approach to the issue and acted as a good first example for the potential of data aggregation and presentation of metrics.

Maps act as a foundation for describing many of the risks and mitigations identified in an FEP. They are the first section of an FEP and while they can be prepared using a variety of tools, in this instance they were prepared in Google MyMaps, and then imported into ArcGIS. This ensured growers had access to a free mapping tool while also giving the industry the ability to conduct catchment level analysis. The maps, in conjunction with the Don't Muddy the Water App, were used to calculate erosion rates across 1,090 ha, comprising of 22 operations and 263 paddocks. Likewise, they were used to model the catchment nutrient load.



Vegetable cropping land in Levin with a complete or partial EMS in green and the balance of the vegetable cropping land in orange

Based on the data collected through the maps it is possible to calculate unmitigated erosion rates and estimated current and projected erosion rates using enhanced mitigation practices. This method of aggregating erosion rate data in conjunction with mapping, provides a powerful tool in telling an industry story for the Levin area.

Results from this analysis are shown in Table 1. Where a grower had not yet completed their EMS, it was assumed no mitigations were installed and any known buffer strips were 50% effective. For enhanced practice we assumed 5m wide buffer strips, that were between 80% and 90% effective. We also tested the impact of including a cover crop in the rotation.

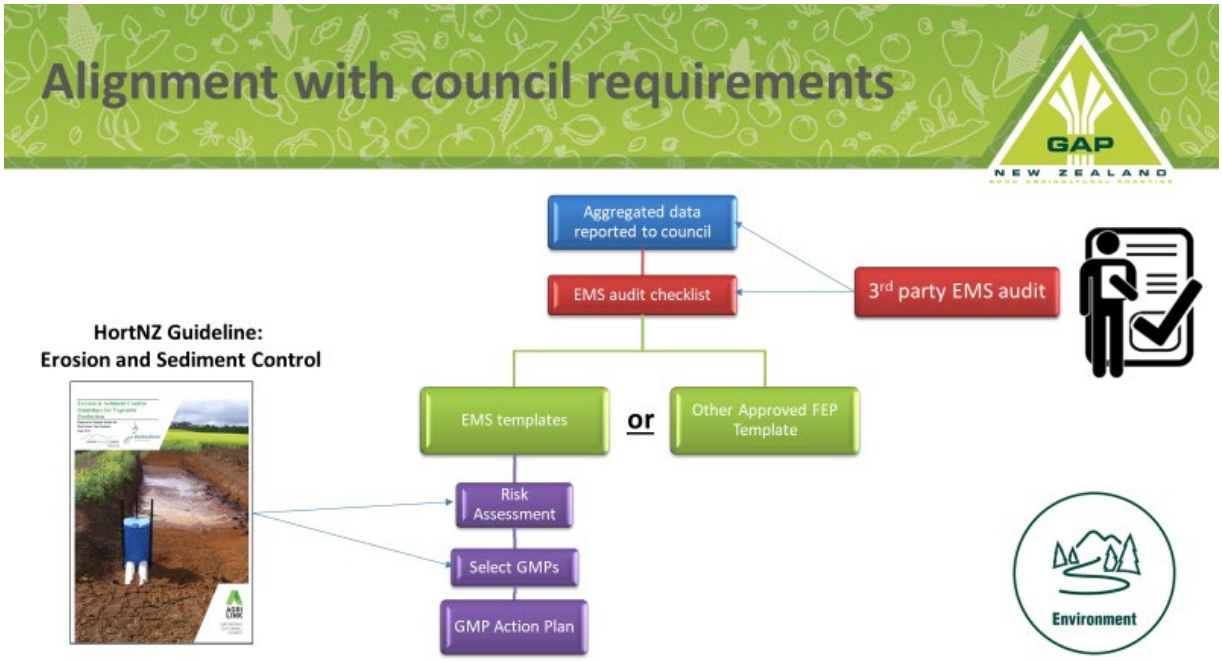
Table 1. Aggregated erosion rates and mitigation practice impacts across 1,090 ha of vegetable cropping land in Levin

Levin	Unmitigated	Current practice	Enhanced practice
Average erosion rate (t/ha/yr)	1.4	0.7	0.3
Total erosion rate (t)	1,480	760	360
Reduction compared to unmitigated (t)	-	720	1,120

7 Assurance – NZGAP

The horticultural industry has a well-established quality assurance programme through New Zealand Good Agricultural Practice (NZGAP). This is a self-assessment and an independently externally audited program. Currently, NZGAP has mostly been involved in food safety, health and safety, and workplace management auditing; however, it has recently added an Environmental Management System (EMS) to empower growers to adopt environmentally sustainable growing practices. The audit is practice based against good and best management practices and environmental outcomes.

Growers are externally audited against a Checklist of requirements.



The structure of NZGAPs EMS.

8 Grower and industry reporting

With centralised and audited FEPs, there is a lot of data that is being collected that could be used to help drive practice-based change and tell the industry's story. A regional dashboard for Manawatu-Wanganui has been develop phase, with the first prototype and metrics shown below (Section 8.2.1).

Practice change through the use of benchmarking reports has been used for many years in the wine industry where the NZ Sustainability Dashboard Project developed individualised energy, water, and plant protection reports. Growers and wineries can now assess themselves against tuned benchmarks (e.g. by winery size, vineyard location). These individualised benchmarking reports have been used to track progress and link Sustainable Winegrowing NZ members to learning resources when they are engaged in an issue through seeing their own performance.

A similar approach is being used in the onion industry for plant protection reporting and could equally be applied to the wider vegetable industry, with a soil erosion and nitrogen loss focus.

8.1 Data Collection

Maps are the first Template (5A) with the need to identify areas and key features. Like all Templates a response is required about the level of completeness, which is supported by evidence or in the case of Partial's and No's an associated time bound action.

5A Property Plan (Map): Features to be included on the property plan (i.e. map)

Ref	Map Features	Complete? (Yes, Partial, No, n/a) Y	P	N	n/a	Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No' for GMPs. Justify if 'n/a')	Evidence (e.g. map or description)	Level
1	Property boundaries (currently owned and leased properties)	◉	○	○				Supporting Evidence (SE) 1.1 (Maps)	GMP
2	Land management units (e.g. cropped areas)	◉	○	○				SE 1.1 (Maps)	GMP
3	Potential critical sources (point and area) for contaminants (e.g. erosion risk, fertiliser storage)	◉	○	○				SE 1 (Maps)	GMP

Growers' generally prepare their maps in Google MyMaps, which are then exported to NZGAPs centralised ArcGIS system. Location and area details are incorporated into the metrics described below.

A grower works through their FEP, recording all their responses in each section to the list of good and best management practices. Responses are either Yes, Partial, No, or Not Applicable. Any Partial's, No's, or N/A's need a comment and potentially an action recorded in the Action List.

By way of example in the Nutrients Template (7C) the first GMP is that all fertiliser inputs are planned. In the case study below the grower recorded Yes and commented that they referred to the Nutrient Management book, and their evidence included their application records and calculations. Evidence of this planning could include the LandWISE Nutrient Budget (Section 4.2), OverseerFM, or their nutrient application records against crops and nutrient requirement lookup tables.

The next question asks do you "Take into account any organic manures". In this case the answer was N/A, with the explanation that they did not include organic manure. Had they used organic manure, but didn't account for them in their nutrient budget, then they would of answered No. Consequently their agreed action may have been to stop using organic manures or to take them into account in their next nutrient budget, with an associated date of when that will be complete by. This action would also have been picked up in the Action Plan (10A) and would be the subject of the next audit where evidence would need to be produced. In this case a nutrient budget that recorded the quantity of organic manure applied, its nutrient content, and availability.

7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop	◉	○	○	○		Code of best practice used.	SE 3.1 (Nutrient application records)	GMP
2	Take into account any organic manures used	○	○	○	◉		No organic manures in rotation.		GMP

Other data sources include the auditors' Checklist and auditor reports.

Based on the maps and good and best management responses other modelling is completed, including erosion and sediment loss rates, and nutrient leaching. Examples of these metrics at both an operation and catchment level are shown below.

8.2 Horowhenua FEPs

Starting in mid-2019 the Horowhenua growers were the first to work together, as a whole catchment, on their FEPs. The first FEP grower workshop was held in Levin in September 2019.

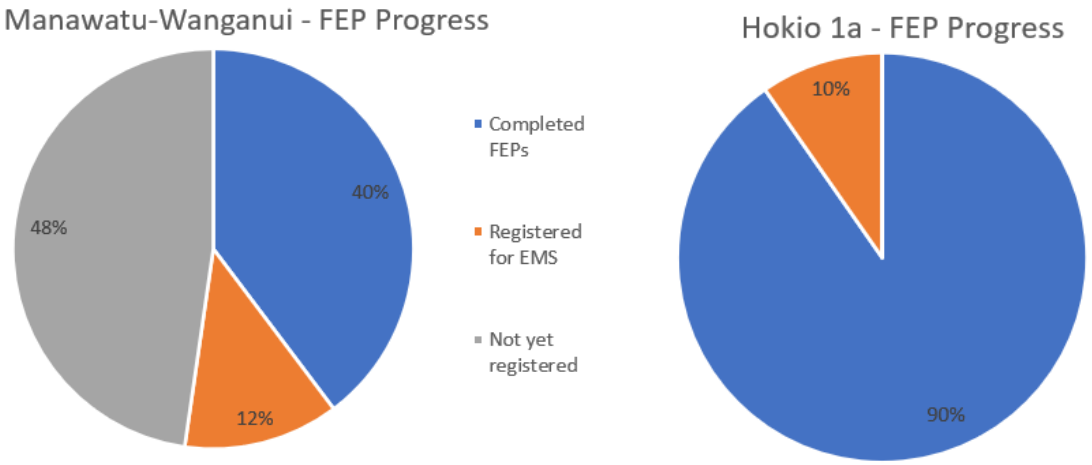
8.2.1 FEP Dashboard

A prototype dashboard has been developed to track and report progress.

8.2.1 FEP Progress

There is approximately 3,600 ha of vegetable cropping land in the Horizons region (FreshFacts 2019). Approximately 40% of the area (1,449 ha) have completed FEPs. A further 12% (458 ha) have registered for the NZGAP EMS and are in the process of working through their FEP towards their audit.

Hokio 1a (Lake Horowhenua) catchment is recognised by Horizons as a Target Water Management Subzone. Seven growers, representing 90% of the area, have completed their FEPs. A further 6 growers that cover the remaining 10% of the area are currently working through their FEPs.



FEP progress in Manawatu-Wanganui

8.2.2 Current GMP & BMP

Across the NZGAP FEP there are 106 questions and mitigations, comprising of 65 GMPs and 41 BMPs. A summary of the responses from the 9 completed FEPs is shown in Table 1 and the Figure below.

Just over half of the assessed practices (55%) were either at the level of GMP or BMP. The 16% of n/a's are practices that do not apply to a particular property, such as in the example above where fertiliser management needing to take into account organic manures where none are used – hence that question would be answered n/a. Almost all of the blanks referred to the catchall question in each section "other practices".

Excluding n/a's and blanks, 82% of practices are currently implemented at the level of GMP's. This increased to 88% when analysed on an area basis. By count 48% of BMP's are currently being implemented, which increases to 63% when weighted by area.

Table 1. Currently implemented BMP & GMP

Practice	Response rate		GMP [1]		BMP [1]	
	Incl. n/a & blanks	Excl. n/a & blanks	By Co.	By area	By Co.	By area
Yes	55%	70%	82%	88%	48%	63%
Partial	5%	7%	4%	3%	10%	8%
No	18%	14%	9%	9%	41%	29%
n/a	16%	-	-	-	-	-
Blank	6%	-	-	-	-	-

1. excluding n/a and blanks.

All Partial and No responses to GMPs (and BMPs in some catchments) requires an explanation, and where appropriate a time bound action recorded in the Action Plan.

Of the 7 completed FEPs in the Hokio 1A catchment, 33 actions were identified. The breakdown of these is shown in Table 2.

Table 2. FEP identified actions

Total number of actions	33
Average number of actions per operation	4.7
Actions addressing soil management or E&S control	18
Actions addressing nutrient management	11
Actions addressing water & irrigation management	4

When viewed out to 2025, 69% of the actions are to be implemented before the end of 2021.

Table 3. Action implementation timeframe

	Actions to be completed		
Ongoing	2	7%	7%
2020	7	24%	31%
2021	11	38%	69%
2022	2	7%	76%
2023	5	17%	93%
2024	1	3%	97%
2025	1	3%	100%

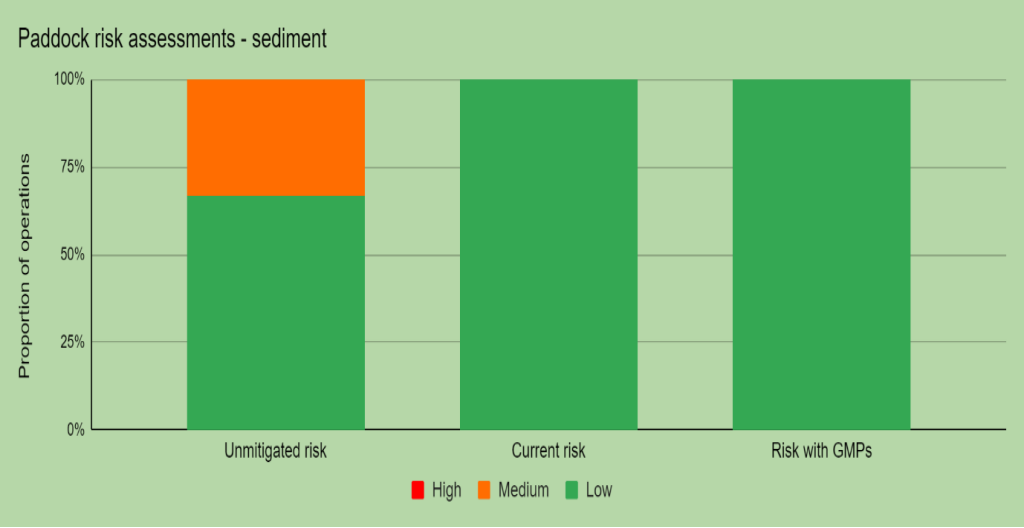
Across the 7 FEPs there were 17 Partial's and 52 No responses to GMP questions (69 in total). These each need an explanation and where appropriate an action included in the Action Plan.

Further guidance has been developed around responding as No or NA. For example, the use of sediment retention ponds on flat land is often not applicable, with vegetated buffer strips being more appropriate. This question was answered with a mixture of Yes (1), No (3) and NA (3). Most likely the 3 No's should have also been NA's, with no associated action required.

8.2.3 Erosion and Sediment Control

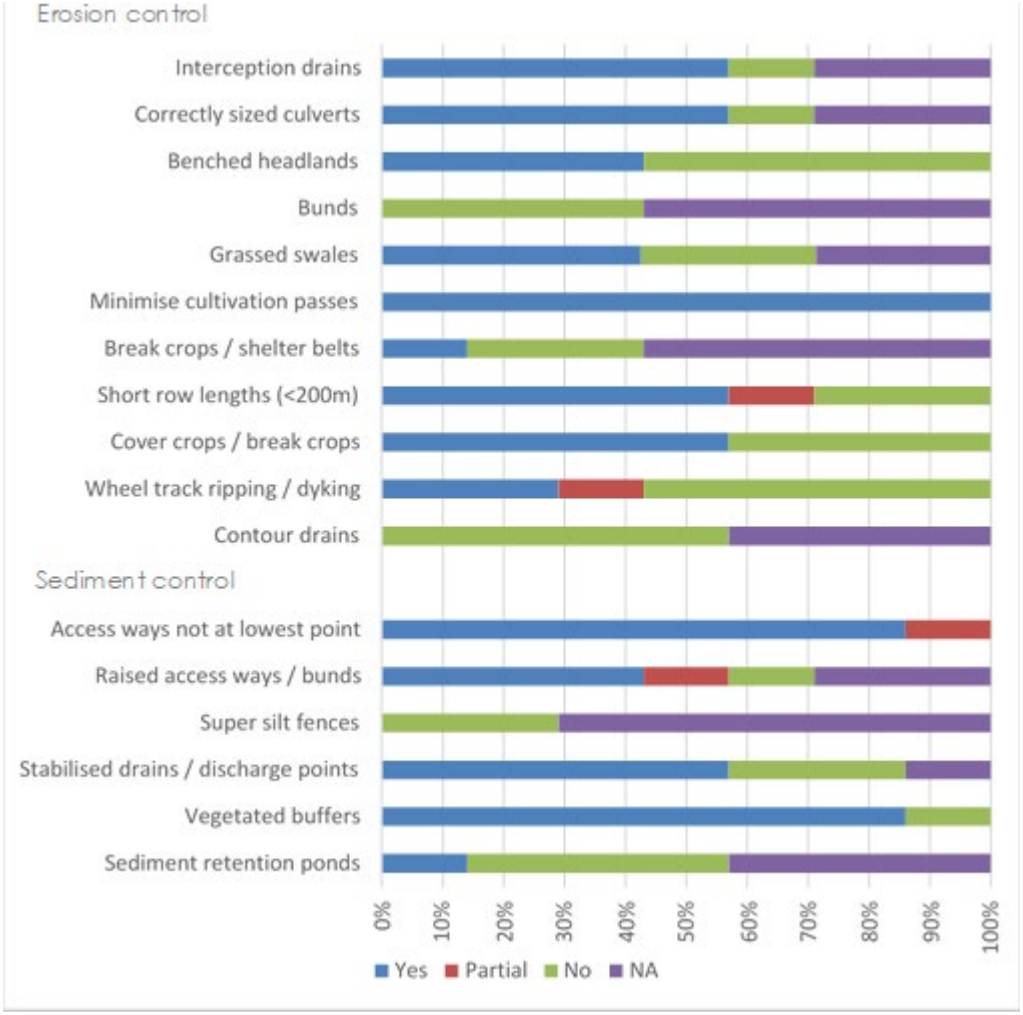
There is now the ability to aggregate and report growers' current practices by sediment control and nutrient management.

Not surprisingly given the generally flat topography the paddock risk assessment for sediment loss was rated low (Figure below). Other regions, such as Pukekohe, will have a very different risk profile.



Paddock risk assessment - sediment

These risk assessments then feed into the selection of mitigation measures (Figure below).



Current - Erosion and sediment control mitigation measures

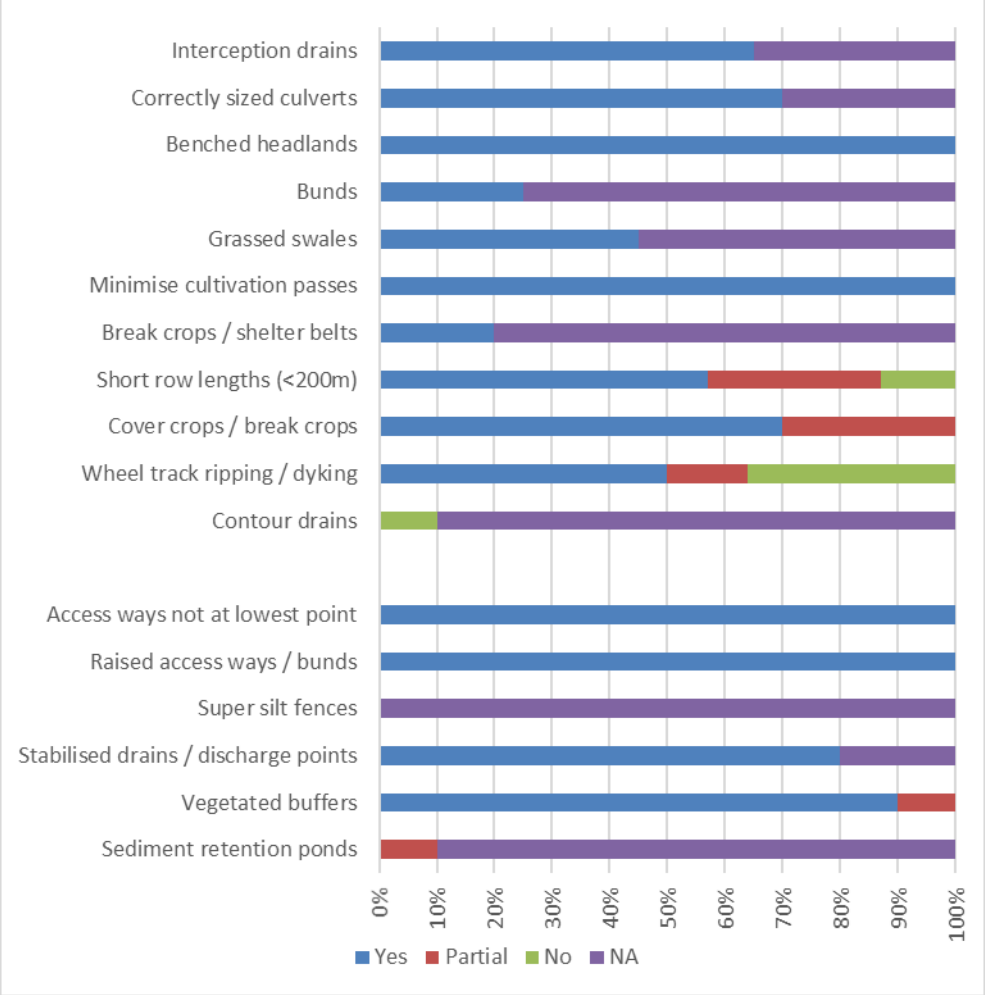
Having established the baseline of current practice, as more GMPs and BMPs are implemented then the proportion of Yes's will increase. Taking for example the first mitigation measure, interception drains, 57% of operations used these, while 29% identified them as not applicable (possibly no overland flow paths from catchments above). One operation recorded No, and then would have an action to install an interception drain. This was 1 of the 18 erosion and sediment control actions shown in Table 2.

The list of mitigation measures is a suite of tools, so at no point in the future would it be appropriate to have implemented them all. For example, in Levin there is very little use of decanting earth bunds or sediment retention ponds. This reflects both the low erosion risk (Figure above) and that SRPs need sufficient outfall to drain, which often is not possible on flat paddocks.

All paddocks require some form of sediment control. At some point in the crop cycle erosion control measures are either not going to be present or enough, hence sediment control is required to minimise soil movement off the paddock. Without SRPs we can see that the main sediment control measure is vegetated buffer strips, recorded as Yes in 86% of FEPs.

The 2025 projections, figure below, highlight that the FEP approach is to list the full toolbox of mitigations, and that even once implemented that does not mean Yes for everything. For example,

contour drains do not suite flat land, hence n/a. Even where a paddock may suite them it could be a No as other mitigations are used instead e.g. short row lengths, or wheel track ripping, all practices designed to reduce erosion rates.



2025 - Erosion and sediment control mitigation measures

Erosion and sediment control is extremely well researched, with the latest Don't Muddy the Water app being able to estimate average sediment loss rates based on a range of factors and mitigation measures (Section 4.1.1). This app has been deployed across all of the completed FEPs, with the results shown in Table 4.

Table 4. Sediment loss rates across the completed FEPs

	Average sediment loss (t/ha/yr)
Unmitigated	0.8
Current Practice - Low Efficiency	0.5
Current Practice - High Efficiency	0.3
Enhanced Practice	0.2

Unmitigated sediment loss averages 0.8 t/ha/yr. Enhanced practice is defined as having implemented all appropriate erosion and sediment control measures to a high standard. At which point sediment loss drops to 0.2 t/ha/yr. Based on the current practices recorded in the FEPs sediment loss is somewhere between 0.3 to 0.5 t/ha/yr. The range reflects the level of implementation. Not all vegetated buffer strips are equally effective, with the extent of channelised flow affecting their efficiency.

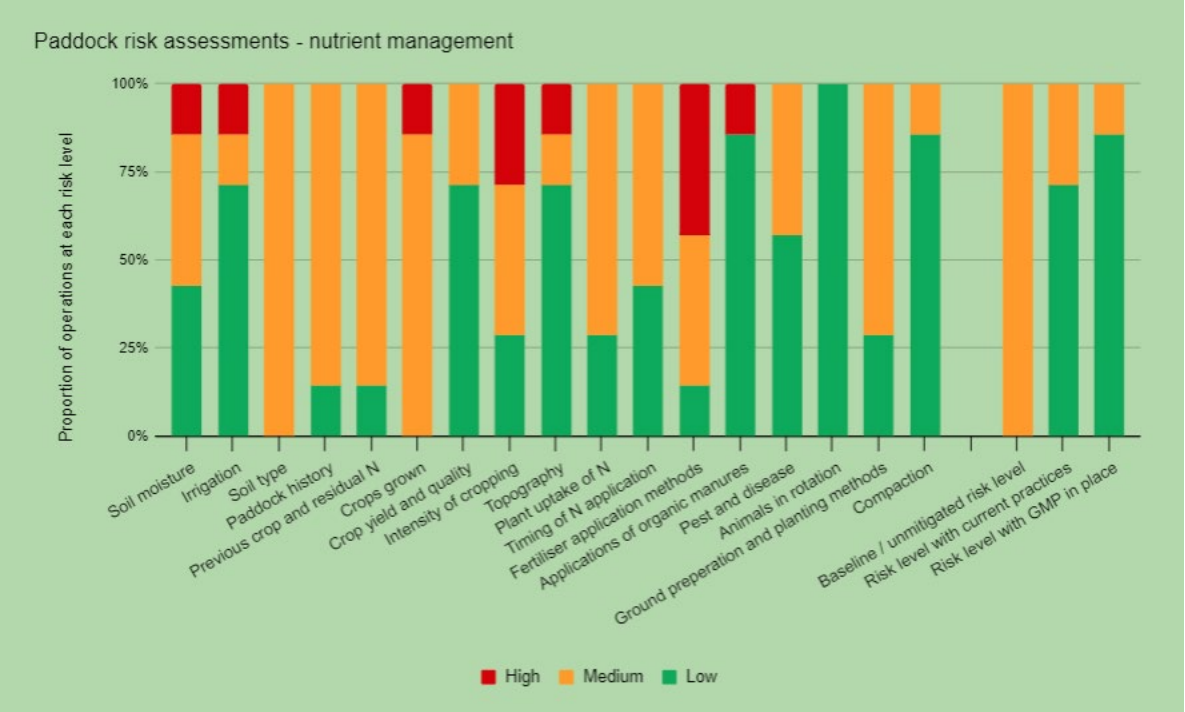
8.2.4 Response Improvements

Having worked through multiple FEPs there were considerable lessons. Scanning across erosion and sediment control above and nutrient practice below, you would expect more 'partial' responses. The fact that there are no partials to the vegetated buffer mitigation suggests that every paddock has a vegetated buffer, with the exception of the one operation that responded with a no. This is extremely unlikely and more realistically probably reflects that most operations have at least 1 buffer and hence answered Yes. Part of the future work programme will involve assessing the grower and auditor responses and developing dissemination programmes around those findings. This may include better FEP response guidance. Likewise, these sorts of metrics will help target workshops and other extension activities. In this case on installing effective buffer strips.

8.2.5 Nutrient Management

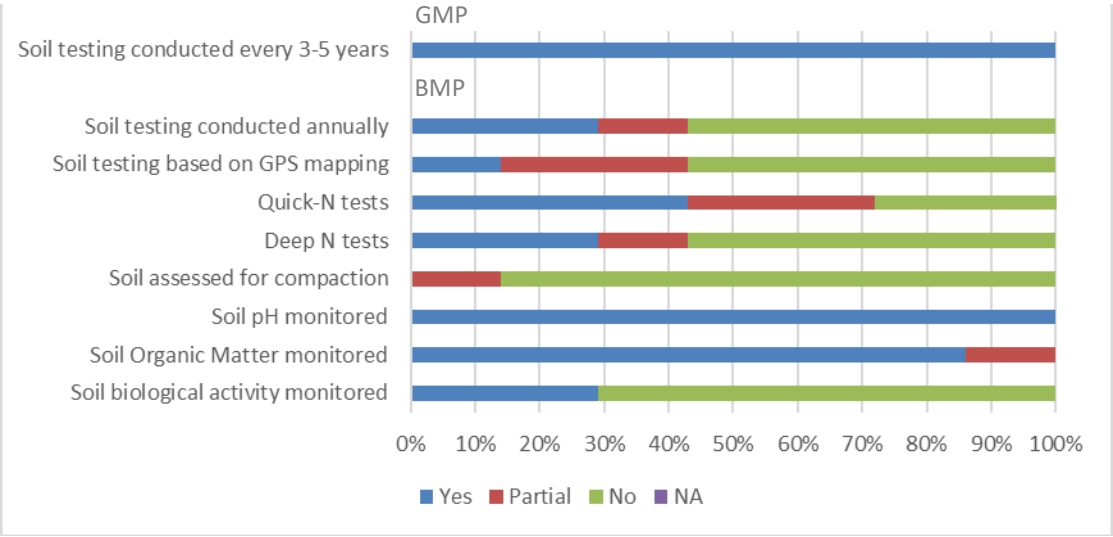
An assessment of the paddock risk assessment for nutrient management is summarised in the Figure below. Through a self-assessment process all growers considered leaching to carry a medium level of risk. With current practice 71% of grower considered the risk became low, which became 86% once all GMPs were implemented.

From the perspective of problem recognition, it shows the growers' considered the application method to be one of the highest risk points. This type of information can then be used to develop dissemination material based around grower recognised need. Paddock history and crop residue are also seen as medium risk factors by almost 90% of operations. This has already been reflected in current research through the Future Proofing Vegetable Systems project, the LandWISE nutrient budget, and new Sustainable Vegetable System project (Section 3.2).



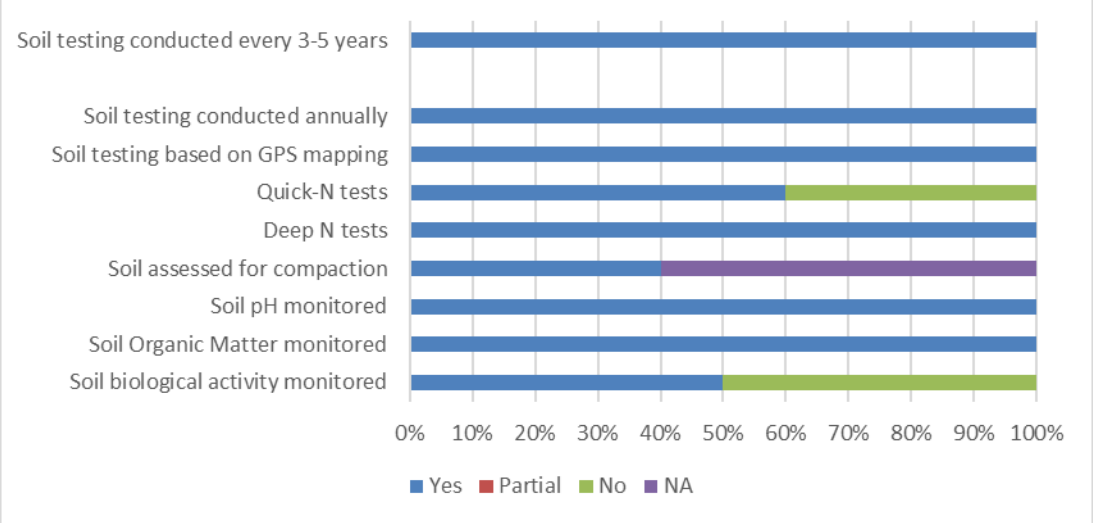
Nutrient loss risk assessment

The current level of nutrient management activity is shown in the Figure below. This can be used to track progress. Currently all growers conduct soil tests at least every 3-5 years, with almost a third in an annual cycle. With greater emphasis on nutrient budgeting - which incorporates soil nutrient testing, plus annual testing being a BMP, we expect to see this annual testing increase. Likewise, with FEPs making mapping more integrated into an operations practices and documentation the proportion of growers linking soil testing to GPS mapping will increase.



Current - Nutrient management practices

Similarly, as we look across the BMP practices, like Quick-N tests, deep N tests, compaction assessment, and soil biological activity, we can track progress on their implementation. The figure below shows the projections by 2025 in Hokio 1a.



2025 - Nutrient management practices

As described previously this is a suite of practices, so not all of them are appropriate in all situations. Quick-N tests for example may not be used if a grower uses laboratory-based nitrogen testing instead. Soil compaction may not be an issue on some properties with deep friable soils, hence the n/a responses. Soil biological monitoring is just in its infancy. While listed in the BMPs a No response could be justified.

8.3 Individualised Benchmarking Reports

Taking the lessons learnt from the wine industry on individualised reporting, it may be possible to take the data supplied through the nutrient budgets or DMTW app to create individualised benchmarking reports.

We are undertaking research and development to identify appropriate metrics to report key information to regulators, and individualised benchmarking reports back to growers.