

Final Report

The EnviroVeg Program 2017 - 2022

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The EnviroVeg Program 2017 – 2022 (VG16063)

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Contents

Public summary	4
Keywords	4
Introduction	5
Methodology	6
Results and discussion	6
Outputs	8
Outcomes	10
Monitoring and evaluation	12
Recommendations	63
Intellectual property	13
Acknowledgements	14
Appendices	15

Public summary

The EnviroVeg program 2017-2022 draws together three previously separate and long-running vegetable industry environmental programs, Freshcare Environmental, Growcom Hort-360 and EnviroVeg.

This project aimed to collaboratively develop and deliver resources to support the improvement and uptake of environmental practices on-farm and deliver recognition advantages to program members.

Its objectives were to:

- Support and improve environmental management on-farm
- Track industry progress regarding sustainable practices
- Facilitate recognition and competitive advantages for improving environmental management

EnviroVeg's goals and aims were closely aligned with Outcomes One, Three, Four and Five of the vegetable industry's *Strategic Investment Plan 2017-2021*. The project had the goal of delivering upon the Australian vegetable industry's strategic investment plan's key priorities: consumer alignment, market and value chain development, farm productivity, resource use and management.

Through the project period, AUSVEG has developed strong research and development connections and links in the EnviroVeg program so that robust, up-to-date science has underpinned the development of project resources and processes; this includes the development of the EnviroVeg Technical Manual as a key output from this project.

The focus of collaborating with existing programs to provide more streamlined, customized pathways for growers to track and improve their environmental credentials has been a key outcome of this project and has resulted in efficient use of industry resources and delivered a strong return on investment for levy-paying growers.

AUSVEG led the development, pilot, and wider launch of a revised EnviroVeg pathway during the project period to ensure the program is aligned and integrated with the Freshcare Environmental 3 (ENV3) standard that enables a certification option for EnviroVeg participants.

Another key output of the program was the successful integration of the first stage of the program, the self-assessment phase, using the Growcom Hort-360 platform and aligned with the Freshcare ENV3 standard.

As a result of this successful integration, the EnviroVeg program now has the capability to capture valuable data that enables industry benchmarking and can support the directing of research and development investments. The EnviroVeg self-assessment phase is hosted within the Growcom Hort-360 platform, which has provided the opportunity for vegetable producers to benchmark environmental performance.

Vegetable growers have continued to show strong engagement with the program in its revamped format. In 2020, AUSVEG invited vegetable producers to join the revised three step EnviroVeg program. In response to ongoing travel restrictions through 2021, both one-on-one interaction with VegNET RDOs and phone capture of self-assessment responses were implemented to continue to support producers to complete their first EnviroVeg self-assessment in a changing operating environment.

Industry has demonstrated its support for the continuation of the EnviroVeg program. It is recommended that levy investment remains for the next iteration of the EnviroVeg program, and to continue to prioritise engagement with industry, including VegNET regional development officers, and continue the successful collaboration of EnviroVeg with the Growcom Hort-360 platform and the Freshcare ENV3 Standard.

Keywords

Best management practice, environment, quality assurance, audit, EnviroVeg, vegetables, vegetable growers, innovation, collaboration, AUSVEG, Freshcare, Growcom Hort-360, Hort Innovation

Introduction

The EnviroVeg program 2017-2022 draws together three previously separate and long-running vegetable industry environmental programs, Freshcare Environmental, Growcom Hort-360 and EnviroVeg.

This project aimed to improve the longevity of vegetable growing regions, benchmark industry data and develop industry recognition for environmentally responsible, sustainable production methods through collaboration with existing industry programs.

Its objectives were to:

- Support and improve environmental management on-farm.
- Track industry progress regarding sustainable practices.
- Facilitate recognition and competitive advantages for improving environmental management.

EnviroVeg promotes best management techniques by providing resources, support, engagement, and a pathway to environmental certification for those businesses looking to take that next step.

A strength of the EnviroVeg program within the vegetable industry has always been its legacy as an industry-led program, aimed at both supporting and promoting environmental best management techniques. To ensure the program was fit-for-purpose for growers into the future, this project aimed to collaboratively develop and deliver resources to support the improvement and uptake of environmental practices on-farm and deliver recognition advantages to program members by drawing together three previously separate and long-running vegetable industry environmental programs: Freshcare Environmental, Growcom Hort-360 and EnviroVeg.

In line with Outcomes One, Three, Four and Five of the vegetable industry's *Strategic Investment Plan 2017-2021*, EnviroVeg's objectives were to:

- Support and improve environmental management on-farm,
- Track industry progress regarding sustainable practices, and
- Facilitate recognition and competitive advantages for improving environmental management

The program sought to build upon resources and momentum developed in earlier projects to provide a platform to integrate key delivery mechanisms to enable a streamlined and integrated approach. The program has been able to harness the complementary capabilities of partner organizations and begin to reduce duplication.

Key outputs from the EnviroVeg Program 2017-2022:

- EnviroVeg Technical Manual
- Updated Three Step EnviroVeg Pathway
- EnviroVeg Sustainability Strategy

AUSVEG, as project lead, was focused on increasing engagement with industry during the project period, not only working with growers to sign up for the program and complete the program's pathway but engaging the VegNET extension team and the industry more broadly to improve the industry's environmental sustainability and to demonstrate the industry's environmental credentials through the aggregated data collected by the program.

The program was guided by a steering committee with vegetable industry representatives from all six states provided guidance and insight into the opportunities that EnviroVeg could provide to both vegetable producers and to the vegetable industry.

Methodology

Key achievements of the EnviroVeg Program 2017 – 2022:

EnviroVeg Project Initiation

Key achievements during the initiation of the EnviroVeg Program 2017 – 2022:

- EnviroVeg Steering Committee providing representation of industry
- Established a Technical Advisory Committee for review and update to the EnviroVeg Resource Manual

Develop a revised EnviroVeg Program

Key achievements involved in developing the revised EnviroVeg Program:

- Delivery of a revised EnviroVeg Resource Manual
- Targeted environmental best management practice training for vegetable producers

Pilot the revised EnviroVeg Program

Key achievements during the piloting process of the EnviroVeg Program:

- Pilot the self-assessment data capture process hosted within Hort360
- Pilot the supported pathway for achieving Freshcare Environmental Certification
- Design and build a customized EnviroVeg Member web portal

Launching the revised EnviroVeg Program

Key achievements involved in the launch in 2020 of the revised EnviroVeg Program:

- Delivery of a self-assessment data capture process hosted within Hort360
- Supported pathway for achieving Freshcare Environmental Certification
- Delivery of a customized EnviroVeg Member web portal
- Recognized partnerships and linkages between EnviroVeg and VegNET RDOs to support broader regional adoption of best practice.

Key project management outputs developed to guide the EnviroVeg Project delivery include:

- Engagement and Communication Plan
- Recognition Strategy
- Sustainability Strategy

Results and discussion

Engagement and Communication Plan

The Engagement and Communication Plan for the project resulted in the following outputs:

- EnviroVeg Steering Committee Meetings were held twice each year
- Four EnviroVeg factsheets
- Project updates through the Vegetable Communication Program
- Extension and engagement activities in all six states

Recognition Strategy

The Recognition Strategy priority identified by the EnviroVeg Steering Committee was the retail sector. Communication and meeting occurred with supermarkets across the project, with the latest meeting occurring in October 2021.

Corteva approached AUSVEG and the EnviroVeg program to identify participants for an international awards program called the 'Climate Leaders Program.' Nominees were drawn from EnviroVeg participants. The result was recognition for two Australian vegetable producing businesses on the world stage (Appendix 10):

- Jake Ryan - wins Corteva international award.
- Sharni and Shane Radford – together achieved a runner-up position.

Sustainability Strategy

The EnviroVeg Sustainability Strategy, finalized in 2021, is an important document outlining the opportunities for the EnviroVeg program beyond the current project (Appendix 11d).

Achievements against the final EnviroVeg Sustainability Strategy are outlined below:

- Partnerships for EnviroVeg
 1. "Digital remote monitoring to improve horticultures environmental performance," is a Smart Farm Partnership project. The partnership is being led by Hort Innovation and includes EnviroVeg as the vegetable industry environmental best management program. One of the long-term aims of the partnership project was to investigate the potential for a more efficient, and potentially automated audit phase for BMP programs, such as EnviroVeg. This is a proof-of-concept project.
 2. New South Wales VegNET: Increasing the adoption of best practice sustainable water and nutrient management on vegetable farms. Funded through Smart Farm Small Grants Round 4.
- Gippsland VegNET: Growing Gippsland's Drought Resilience with Technology and Better Soil. Funded through the Future Drought Fund
- Vegetable Levy funding to maintain core functionality

An approval from the vegetable SIAP to maintain the core functionality of the EnviroVeg Self-assessment has been achieved.

EnviroVeg Membership

A significant element of the EnviroVeg Program 2017 – 2022 results relate to the progress of vegetable businesses through the three steps of the EnviroVeg Program:

1. EnviroVeg Self-assessment Step online and hosted by Growcom Hort-360
2. EnviroVeg Training in line with Freshcare Environmental 3.0
3. Certification against Freshcare Environmental 3.0

During the project, over 300 vegetable producing properties have registered for the revised EnviroVeg program, of which 140 vegetable properties – encompassing approximately 19,500 hectares from across the six states – commenced the EnviroVeg self-assessment.

Of these, 47% have completed the first step, training of key staff from 28 vegetable properties has occurred and there have been 5 audits, with ongoing demand for the final two steps remaining.

A report illustrating the can be found in Appendix 14: EnviroVeg Data Report February 2022

Outputs

Include in Table 1 are details outlining the key outputs for the EnviroVeg Program 2017 – 2022.

Table 1. Output summary

Output	Description	Detail
EnviroVeg Technical Manual	An updated technical manual drawing upon up-to-date information. Developed by the Technical Advisory Committee in 2018	The EnviroVeg Technical Manual has been included as attachment to this report (Appendix 1). The EnviroVeg Technical Manual is linked to the EnviroVeg self-assessment. For each practice question in the self-assessment, there are several links to the relevant section of the EnviroVeg Technical Manual. These links are also included in the EnviroVeg Business Report, an example of which is included in Appendix 3.
EnviroVeg Factsheets	Four factsheets were developed for the EnviroVeg Program during the project	What is EnviroVeg? (Appendix 7a) EnviroVeg Pathway 2019 (Appendix 7b) EnviroVeg Program Summary 2020 (Appendix 7c) EnviroVeg Postcard (Appendix 7d)
EnviroVeg Pathway	A three-stage pathway for environmental assurance with logical flow and housing of key elements on appropriate platforms	The EnviroVeg Pathway is outlined in three steps: ➤ EnviroVeg Self-assessment, hosted by Growcom Hort-360 ➤ EnviroVeg Training, aligned with Freshcare ENV3 ➤ Certification, utilizing Freshcare ENV3 Detail in Appendix 7b – EnviroVeg Pathway 2019
EnviroVeg Self-assessment	The first step in the revised EnviroVeg Pathway	The EnviroVeg Self-assessment was developed with the expertise held in Growcom to house it on the Growcom Hort-360 platform. Alignment with the Freshcare Environmental standard also required significant input. The Technical Advisory Committee was also instrumental in achieving this output.
EnviroVeg Communication Plan	The EnviroVeg Communication Plan is a project management document.	The Engagement and Communication Plan developed at the commencement of the project, aimed to ensure: • Key stakeholders and the vegetable industry were aware of the project, understood how it operates and the benefit it will deliver • Broader stakeholders are aware and supportive if the project as a means of developing the environmental performance of vegetable producers • There is support for the project within appropriate key stakeholder groups, especially grower and project members Australian vegetable growers can be recognized for best practice techniques.
New EnviroVeg Website	New EnviroVeg Website	In 2019 a new EnviroVeg website was developed to improve the experience and usability for vegetable growers. https://enviroveg.com.au/

		An illustration of the landing page at the time of launch is included in Appendix 2, a screenshot of the new EnviroVeg website 2020.
Communication Articles	Vegetable Australia magazine which had an average distribution of around 5,200 per edition, with a readership likely higher given the tendency for businesses to share the publication among employees.	Nine Vegetables Australia articles relating to EnviroVeg (Appendix 8-10): • Summer 2019/2020 - EnviroVeg Program: What's next? • Autumn 2020 – Introducing the new EnviroVeg website • Spring 2020 – Developing evidence of good environmental stewardship. Shane and Sharni Radford Case Study. • Summer 2020/2021 – Practicing good environmental stewardship. Paul Gazzola Case Study. • Winter 2021 – Piloting digital remote monitoring to improve environmental performance. EnviroVeg partnership project funded through the Australian Government's Landcare Smart Farming Partnerships program, the <i>Digital remote monitoring to improve horticulture's environmental performance</i> (ST19024). • Spring 2021 – Collaboration key to kicking environmental goals. Mulgowie Farming Company Case Study. • Summer 2020/2021 – Vegetable Crop Nutrition Masterclass reaps online reward. EnviroVeg R&D Linkage • Summer 2021/2022 – Championing sustainable environmental practices. Graeme Pitchford Case Study. • Summer 2021/2022 – Climate positive practices: Aussie veg producers acknowledged on the world stage. Jake Ryan, an EnviroVeg grower wins Corteva international award. Sharni and Shane Radford, EnviroVeg certified growers achieve runner-up position. Nominations drawn from EnviroVeg members.
Extension and Engagement		EnviroVeg extension activities included: • Queensland: Toowoomba (5-6 March 2018) • Tasmania: North-west coast and Hobart (16-19 April 2018) • Victoria: Clyde and Cranbourne (4 April 2018) • New South Wales: Woolgoolga and surrounds (31 July-2 August 2018) • Western Australia: • Northern Territory: • Victoria: Traralgon (26-27 November 2019)

Outcomes

Below, Table 4 provides details of the progress made to achieve the stated outcomes for the EnviroVeg Program.

Table 2. Outcome summary

Outcome	Alignment to fund outcome and strategy	Description	Evidence
Industry led development of accepted and holistic BMPs for vegetable production in Australia	Increased levels of post-farm gate integration	The EnviroVeg Steering Committee played an invaluable role in leading the program. A strength of the EnviroVeg program within the vegetable industry has always been its legacy as an industry-led program, aimed at both supporting and promoting environmental best management techniques.	Appendix 7b. EnviroVeg Pathway 2019
A clearly defined pathway for achieving environmental certification for vegetable production in Australia	Increased levels of post-farm gate integration	AUSVEG led the development, pilot, and wider launch of a revised EnviroVeg pathway during the project period to ensure the program is aligned and integrated with the Freshcare Environmental 3 (ENV3) standard that enables a certification option for EnviroVeg participants.	Appendix 7b. EnviroVeg Pathway 2019
A clear pathway for levy funded R&D outputs to be incorporated into BMPs thus driving continuous improvement in the vegetable industry	Improved farm productivity	As a result of the integration with the Growcom Hort-360 platform, the EnviroVeg program now has the capability to capture valuable data that enables industry benchmarking and can support the directing of research and development investments.	Appendix 1: EnviroVeg Technical Manual
EnviroVeg members can use their track record of good environmental management practices to seek opportunities with consumers and retailers	Growth in the domestic market	EnviroVeg members able to gain benefit from the financial sector has presented as an opportunity. Ongoing discussions with key retailers have been important and will continue to be so.	Appendix 11c. Recognition Strategy Appendix 8c: Developing evidence of good environmental stewardship

Increased numbers of EnviroVeg certified vegetable growers	Increased levels of post-farm gate integration	Over 300 vegetable producing properties have registered for the revised EnviroVeg program. Certification of 5 properties has occurred. As travel restrictions have eased, there has been renewed interest in scheduling the appropriate audit.	Appendix 14: EnviroVeg Data Report February 2022
Increased understanding of vegetable industry uptake of sustainable production practices	Improved industry capabilities for adoption and innovation	As a result of the integration with the Growcom Hort-360 platform, the EnviroVeg program now has the capability to capture valuable data that enables industry benchmarking and can support the directing of research and development investments.	Appendix 14: EnviroVeg Data Report February 2022
Direction for future vegetable industry (and horticulture) R&D through the delivery of quality data	Improved industry capabilities for adoption and innovation	The EnviroVeg program has the capability to capture valuable data that enables a nationally consistent approach to understanding current practice on farm.	Appendix 14: EnviroVeg Data Report February 2022
Greater sustainability of Australian vegetable production regions, through on-farm implementation of recognized and scientifically robust BMPs	Improved farm productivity Improved industry capabilities for adoption and innovation	EnviroVeg promotes best management techniques by providing resources, support, engagement, and a pathway to environmental certification for those businesses looking to take that next step.	Appendix 1: EnviroVeg Technical Manual Appendix 14: EnviroVeg Data Report February 2022

Monitoring and evaluation

The Monitoring and Evaluation (M&E) Plan developed for the project includes intermediate outcomes and longer term, or end of program outcomes. The M&E Plan includes key evaluation questions addressed in the table below.

Table 5. Key Evaluation Questions

Key Evaluation Question	Project performance	Continuous improvement opportunities
Effectiveness: To what extent have the industry funds achieved their objectives in delivering benefits to growers?	The project has recorded achievements against all three project objectives. Support and improve environmental management on-farm has commenced. Track industry progress regarding sustainable practices has commenced, at the regional level. Facilitating recognition for improved environmental management has been recorded, in a limited way.	The two regional partnership projects that include the EnviroVeg Program both aim to support regionally relevant environmental management and track industry progress for key practices within their specific region. There are ongoing opportunities to pursue similar regional partnerships. Competitive advantage in the marketplace or market access requirements are not yet present. Several areas where these opportunities may occur in future are outlined in the EnviroVeg Sustainability Strategy.
Relevance: How relevant is the Project to the needs of intended beneficiaries including targeted growers, advisors, and industry stakeholders?	There are several new opportunities posed to vegetable producers. EnviroVeg as an industry led environmental BMP is a strong basis from which the emerging areas of natural capital, carbon neutral and biodiversity certification may be addressed.	There are opportunities to increase the relevance by linking with the VegNET team. Increasing the regional relevance of the program, while maintaining the national consistency is an option included in the Recommendations section.
Process appropriateness: To what extent were engagement processes appropriate to the target audience/s of R&D including targeted growers, advisors and industry stakeholders?	The engagement process commenced with in-person extension events. This changed in 2020 to include a regional focus with key VegNET RDOs beginning to promote and support local vegetable producers.	Several opportunities to progress the use of the EnviroVeg Program through the VegNET team are included in the Recommendations section.
Efficiency: What is the benefit-cost ratio of the Project?	The EnviroVeg Sustainability Strategy addresses several opportunities to improve the benefit-cost ratio for the EnviroVeg Program. The pilot phase costs were higher than those towards the end of the project, where new partnerships and VegNET regional contributed in-kind and recently cash contributions to support the EnviroVeg Program.	Further opportunities and improvements are included in both the EnviroVeg Sustainability Strategy and in the Recommendations of this report.

Recommendations

The achievements and momentum generated through the EnviroVeg Program 2017-2022 provide a solid foundation for future iterations of the program to engage and support vegetable growers as they seek to promote the strong environmental stewardship occurring within their production systems and look to meet environmental best management practice requirements.

The EnviroVeg Sustainability Strategy (Appendix 11d) proposes several recommendations for the future of the EnviroVeg program.

Recommendation 1. Seek Vegetable Levy funds to maintain the first stage of the EnviroVeg program.

The issue of environmental sustainability, and the need for industry to prove its credentials in the space, will become more important as the broader public increases its focus on the industry's environmental practices. Growers have demonstrated a strong desire for the program to continue and for the levy to continue supporting the program, as it has a positive legacy in the industry and has momentum to continue engaging with vegetable growers on the journey to environmentally sustainable vegetable production.

There is also the added benefit for the program to capture practice data in line with Hort Innovation's recently released Sustainability Framework.

Recommendation 2. Continue to support VegNET RDOs to pursue regionally relevant RD&E projects that incorporate EnviroVeg self-assessment data to tailor extension activities and track practice change on-farm.

Two regional partnership projects have already been achieved during the project. These projects led by VegNET Regional Development Officers, incorporate regional and de-identified practice data captured as a part of the EnviroVeg self-assessment, demonstrating the ongoing benefits that the program delivers to the wider industry.

Recommendation 3. Provide VegNET RDOs with training and facilitator access to the EnviroVeg platform, allowing them to support their local vegetable producers more efficiently.

Recommendation 4. Investigate the option to segment the EnviroVeg self-assessment into its ten module components. This would support VegNET RDOs when setting priorities for tracking practice change relevant to a vegetable growing region.

Recommendation 5. Maintain the linkage with the Freshcare environmental standard and make necessary modifications to the EnviroVeg Program in the case of any release of an updated Freshcare environmental standard.

The integration with Freshcare Environmental in the EnviroVeg pathway enables vegetable producers to access a network of Freshcare auditors and trainers to complete the pathway when needed. By maintaining the currency of the linkage, this option is to utilise the Freshcare network and to achieve Freshcare Environmental certification when the need occurs.

Recommendation 6. Investigate the option for single component module certification through Freshcare. This could exist as an add-on to the Freshcare Food Safety process and provide more targeting options to environmental best practice goals aligned with a single audit to achieve certification.

Recommendation 7. Investigate the ability to broaden the current scope of the EnviroVeg program. Include details specific to the practice needs of protected cropping systems. Investigate options to explicitly assess organic vegetable production systems.

Intellectual property

Background IP and Project IP is included in the IP Register (Appendix 15).

Acknowledgements

AUSVEG and the EnviroVeg project team would like to acknowledge the significant contribution of the Technical Advisory Committee. The technical expertise held by this group was instrumental to the design and development of a scientifically rigorous EnviroVeg Technical Manual. The contribution to the process of reviewing and revising the EnviroVeg program to integrate the Freshcare Environmental Standard and the Growcom Hort-360 platform is also recognized.

EnviroVeg Technical Advisory Committee members:

Doris Blaesing, RMCG	Jessica Lye, AUSVEG
Alison Kelly, Alison Kelly Consulting	Andy Shaw, AUSVEG
Andy Chambers, Seed Consulting Services	Jane Muller, Growcom
Mardi Longbottom, AWRI	Angela Steain, Freshcare

AUSVEG and the EnviroVeg project team would also like to acknowledge the significant contribution of the EnviroVeg Steering Committee in guiding and championing the EnviroVeg Program over many years.

EnviroVeg Steering Committee members:

David Anderson, Western Australia (chair)	Heidi Radcliff, Tasmania
Belinda Adams, Queensland	Sean Croft, Victoria
Graeme Pitchford, South Australia	Jane Muller, Growcom
Daryl Lohrey, Tasmania	Scott Wallace, Growcom
Nathan Free, Victoria	Claire Hamilton-Bates, Freshcare
Paul Shoker, New South Wales	Angela Steain, Freshcare
Ikebal Patel, New South Wales	Brenda Kranz, Hort Innovation
Zarmeen Hassan, AUSVEG	Byron De Kock, Hort Innovation
Doris Blaesing, RMCG Tasmania (Technical Advisory Committee Representative)	Ashley Zamek, Hort Innovation

The composition of the EnviroVeg Steering Committee saw several changes across the 5-year project. We would like to acknowledge the contributions made by all committee members, past and present and thank them for their valuable insight and guidance of the project.

Acknowledgement is especially paid to the outgoing chair of the EnviroVeg Steering Committee, David Anderson.

With well over a decade of service to the EnviroVeg Steering Committee, David has adeptly guided the EnviroVeg Program through this current phase of the program.

Appendices

- 1 EnviroVeg Technical Manual
- 2 Screenshot of New EnviroVeg Website 2020
- 3 EnviroVeg Self-Assessment Business Report (example only including benchmark)
- 4 EnviroVeg Training Forms for Freshcare ENV trainers (example only)
- 5 EnviroVeg Logo files
- 6 EnviroVeg Program Rules
- 7 EnviroVeg Factsheets
 - a. What is EnviroVeg
 - b. EnviroVeg Pathway 2019
 - c. EnviroVeg Program Summary 2020
 - d. EnviroVeg Postcard Side A & Side B
- 8 EnviroVeg Articles (Vegetables Australia)
 - a. EnviroVeg Program: What's Next?
 - b. Introducing the new EnviroVeg Website
 - c. Developing evidence of good environmental stewardship
 - d. Practicing good environmental stewardship
 - e. Championing sustainable environmental practices
 - f. Collaboration key to kicking environmental goals
 - g. Catching up with David Anderson
 - h. EnviroVeg & Vegetable Crop Nutrition Masterclass
- 9 Smart Farm Partnership Article (Vegetables Australia)
- 10 Corteva Article (Vegetables Australia)
- 11 Project Management:
 - a. Engagement and Communication Plan
 - b. Monitoring and Evaluation Plan
 - c. Recognition Strategy
 - d. Sustainability Strategy
 - e. Milestone Reports: 102-111
- 12 Mid-term Evaluation Report
- 13 EnviroVeg data included in Horticulture Sustainability Framework – Water Example Feb 2021
- 14 EnviroVeg Data Report February 2022
- 15 IP Register

ENVIROVEG MANUAL

The Australian vegetable industries environmental production resource



EnviroVeg
Sustainable Vegetable Production

INTRODUCTION



AN INTRODUCTION TO ENVIROVEG

EnviroVeg is an industry-led environmental best-practice management program for vegetable production businesses. It provides resources for sustainable growing techniques and represents vegetable businesses as responsible stewards of land, water and biodiversity.

CONTENTS

Introduction	2
Business	11
Land and Soil	25
Crop Nutrition, Fertilisers and Soil Additives	40
Water	54
Pests, Weeds and Diseases	70
Biosecurity	87
Chemicals	101
Energy and Greenhouse Gasses	124
Waste	137
Air	151
Biodiversity	160

FOOD & AGRICULTURE

Food security (having access to nutritious food that enables a healthy life) is a major concern in a world with an exploding population. In **2050, 9.8 billion people will demand 70% more food than is consumed today.**¹

Food production inputs (e.g. nutrients, water and energy) face increasing competition for use, heightened by the need to adapt to and reduce the effects of climate change.

Agriculture is a major contributor to negative impacts on our environment and increased global warming through greenhouse gas emissions. Commonly sighted unsustainable agricultural issues include;

Methane produced primarily by commercial cereal and animal husbandry practices.

Destroying carbon-sinks, releasing carbon from tropical forests that are removed to make way for large-scale agriculture.

Nitrous oxide released through the improper application of fertilisers.

Water supply damage from chemical run-off and wasteful irrigation practices.

Food loss and waste, approximately one-third of all food grown is lost or wasted.

As well as a changing climate, our ability to provide food security is exacerbated by a growing population, evolving dietary preferences, water scarcity and economic pressure on farmers.

Fewer people are choosing farming as an occupation. In developed countries, **less than 2% of people grow crops or breed animals for food.** At the same time, food prices are rising, arable land continues to be lost to sprawl and soil is being degraded by over-farming.¹

In order to be sustainable, we have to **meet present requirements without compromising the ability of future generations to meet their own needs.**⁴ In a sustainable production system, natural resources are replenished faster than they are used up and high levels of biodiversity are maintained in the surrounding environment.

Australia has global strengths and capabilities to increase food security. We are able to advance technology for developing countries in our region,

lead climate change research (on impacts, adaptation and mitigation) and leverage expertise in human health and nutrition research. To address global issues, our capabilities should be combined with human capacity, R&D investment and increased awareness of food's nutritional value.³

Agricultural producers are tasked with delivering our sustainable food future. The responsibility was not requested, nonetheless farmers are fronting this challenge.

"Food security is the issue of our time"
- Hillary Clinton

PRODUCTION

Food production in Australia requires operating in unforgiving conditions with generally ancient and low fertility soils, variable and harsh climates and significant degradation such as soil erosion, acidification and salinisation. Despite this, Australia remains a world leader in agriculture.

Our competitiveness can be attributed to well **above average productivity growth in the sector and a strong research and development (R&D) base.** Australian agricultural R&D capability is ranked among the best in the world and an evaluation of return on investment has indicated that \$1.00 invested in rural R&D returned \$10.51 over the course of 25 years.

The **ability of Australian agriculture to do well depends on maintaining and stimulating productivity growth**, especially given the opportunity presented by growing global food demand.⁴ However, productivity growth has recently been in decline and now sits lower than earlier levels.⁵

Given that production area sizes have growth limitations, it will **be important to increase productivity per unit area** in order to turn around this decline. In the long term, this may be achieved through technological progress and adoption on existing farms, as well as lower performing farmers leaving the industry for opportunities elsewhere in the economy.⁶



Farm size and access to capital limit the scope and extent of on-farm adaptation.⁷ As financial security drives Australian farms to become fewer and larger, their stronger capital base will increase ability to adapt to change and uptake research.

Our current research, development and extension (RD&E) priorities are; managing natural resources, advanced technology, biosecurity, soil, water and adoption of R&D.⁸

*Improving productivity requires increased understanding of current resources, identification of emerging technologies and well-designed monitoring and decision criteria to inform future priorities that combine industry and region-specific resource management.*⁶

“Science is not the complete answer. Science does not tell us which decisions to make, but it does tell us the possible consequences of some of those decisions.”
- Penny Sackett

CONSUMPTION

Today many people enjoy the cheapest food in human history. In **rich countries it is one third of the price our grandparents used to pay for it.**⁹

The global middle class is projected to increase to 4.9 billion by 2030,¹⁰ a population growth largely driven by developing countries. These consumers are increasing their consumption of total calories and animal products, and are able to pay more for trusted premium products.¹¹

In Chinese diets, meat demand (including demand for beef, eggs and more dairy products) or calorie consumption grew from less than 100 kcal/capita/day to more than 600 kcal/capita/day between 1961 and 2003.¹²

However, **significant environmental costs are associated with higher meat production.** High water use, methane production, animal effluent pollution

and land degradation⁹ are commonly sighted issues. With global food production doubling in one generation, these environmental costs have risen dramatically. In Australia 312,000 tonnes of food is wasted annually and agricultural water use is projected to increase by 20% globally by 2050.⁹

This will need to change as **to be viable, the environmental footprint of increased production must reduce by half.**⁹

Sustainably conscious markets are seeking alternative protein sources (including plant-based)⁹ as a method for dealing with the resource constraints on meat production. Plant based proteins are one of the growth opportunities for Australian agribusiness as identified by the **CSIRO in July 2017**, as well as products for health and wellbeing.

In a 2015 Nielsen survey of 30,000 people in 60 countries, **66% of respondents were willing to pay more for sustainable brands; up from 50% in 2013.**⁹ Australia ranks 16th out of 80 countries regarding global perception of a green economy, but only 55th for performance. If this disparity continues, Australia will not be able to leverage consumer demand for sustainability as well as other countries.

“Eat well but eat less. Eat more vegetables and less energy-intensive foods. Choose foods that spare our soil and water.”
- Julian Cribb⁴

CHOICE

Poor eating choices is resulting in an increase in obesity, diabetes, cancer and cardiovascular diseases in Australia. These chronic **non-communicable diseases** are now the number one global killer, claiming more than 36 million lives annually.

Unbalanced diets and poor nutrition consumption lead to chronic disorders. However, a **diet high in fresh produce and whole foods, particularly vegetables, can significantly reduce the risk of heart disease, diabetes and cancer.**⁹



Increasingly, consumers are looking for food that is not only **fresh, healthy and minimally-processed but, convenient and of reputable provenance.**

Sustainably sourced horticultural produce meets our changing habits and the need to choose food that addresses degrading health. However, **vegetables are poorly regarded in popular culture, often labelled as a boring, bland and unenticing choice.**

Continued education targeting the impacts of our food choices is required to reverse this trend and incentivise the sustainable growth of horticulture production.

Additionally, **productive, sustainable management practices help to reduce farmer costs** and improve crop and soil health. Whereas intense farming operations, exploitative of natural resources fail to achieve impressive production results.¹³

Successful adoption of sustainable systems by farmers requires appropriate equipment to be developed¹⁴ as defined by informed, reliably sourced data.

“To make agriculture sustainable, the grower has got to be able to make a profit.”
- Sam Farr

FUTURE

Farmers are not just growing food. Our 1.8 billion farmers also manage half the world's land, three quarters of its fresh water and a third of its atmosphere. **To do so sustainably requires increased consumer understanding and fair prices** for their produce.¹⁵

Future needs dictate we produce more nutritious food from less land with a lower environmental impact. Achieving this requires stimulation of farm productivity growth per unit area through research based on **well informed monitoring.**

As markets for healthy, plant based, socially responsible, local and sustainable products change

consumption habits, horticulture will play an increasing role in our future food.

We can positively impact the development of food production; sustainable agriculture grows when there is reduced demand for foods that depend on crops produced by unsustainable practices (erode major ecosystems).

ENVIROVEG'S ROLE

Capturing and benchmarking the production habits of vegetable producers gives quality direction for the investment of future R&D, a proven, cost-efficient method to increase farm productivity and profitability.

Research is not complete without adoption on-farm. Producers need a clear concise reference point and method to apply practical solutions. Such a system should encourage and adapt to feedback, incorporate existing programs, and connect like-minded people to drive collaboration.

The major drivers for sustainable horticulture production (providence, health, environmental footprint, lower cost of production, increased natural resource health, population growth and international markets) are long-term trends. Leveraging these drivers requires a reputable, respected pathway for our producers to tell their story as well as targeted education methods.

As production and consumption habits change, so too will the perception and compliance requirements of the horticulture industry. Having industry ownership over this change keeps farmers interests at the core of decision making.

EnviroVeg is a vehicle for these goals as outlined in the following text. It is only useful when producers and industry believe in it and own what it works to achieve.

Program development

EnviroVeg was established in Victoria in 2000 to help local growers showcase their management credentials with regards to the environment, specifically water use. A voluntary self-assessment and environmental-management practice guidelines (the EnviroVeg manual) became the fundamental resources for sustainable vegetable production in Australia.

A national scheme followed, and expansion of the program to include an environmental certification



option (EnviroVeg Platinum) as a part of a tiered membership structure. At the end of 2016, EnviroVeg had over 480 members across the country, whose businesses encompassed a majority of the vegetable producing land in the country.

However, there were improvements to be made under this version of the EnviroVeg program;

Practice change had not been achieved or documented. Members were inactive (did not complete annual benchmarking requirements), so the program could not showcase real improvement nor inform new areas of R&D levy funding.

Reference material was outdated, the manual needed to contain updated content to be of relevance to producers and members, and to help achieve its goals.

The program duplicated industry resources, a robust third-party verified program (Freshcare Environmental) had established itself as the recognised pathway for environmental certification in Australian horticulture. The Hort360 platform had developed a superior benchmarking platform, which was established and used in a variety of horticultural systems.

Member recognition and benefits were ill-defined and unclear. Program members could access certificates, gate signs and some retailer understanding, but EnviroVeg did not clearly present a vision nor transparently underpin its clean-green credentials.

EnviroVeg had stagnated and not become self-sufficient. As a levy funded project, EnviroVeg should have represented a good-value for levy payers. Yet, after 16 years, EnviroVeg had yet to become self-sufficient and remained focused on outputs (number of members, communications etc.) and not outcomes (uptake of, and recognition for sustainable production practices).

Logically, EnviroVeg needed to address these improvements and adapt to a changing environment.

As an industry managed and led program, EnviroVeg is directed by the needs of vegetable growers. From consultation, the program was asked to continue and evolve to improve and service the needs of growers.

In late March 2017, a new EnviroVeg project was approved, involving Freshcare, Growcom and

AUSVEG. Freshcare Environmental now provides the underpinning third-party assurance program and Hort360 the benchmarking platform. The harmonised program had a mandate to update its processes, resources and procedures to offer improved value to the Australian horticulture industry.

With oversight from the EnviroVeg Steering Committee, a Technical Advisory Group of environmental practice experts was established, and in 2018 the EnviroVeg program released updated resources.

Going forward, EnviroVeg will adapt and learn from mistakes of the past. It is intended that program resources will be maintained, with continual advancements enabling objectives to be met.

“Finding mechanisms for putting carbon back into landscapes enhances biodiversity. More biodiverse ecosystems store more carbon, more securely and are more resilient to the impacts of climate change.”
- Professor Will Steffen

THE MANUAL

About

The EnviroVeg program is underpinned by the environmental management guidelines within the EnviroVeg Manual. This resource includes current, quality information on achieving sustainable vegetable production. To ensure it remains useful, technical experts have recently overseen a review of its content to produce an updated, online-friendly resource.

The updated manual has additional value through the embedded links, which direct users to useful resources and interesting research.

Importantly, relevant research and development (R&D) outcomes (focusing on levy funded R&D) are integrated into the manual. This enables easy adoption of effective practices for sustainable vegetable production.



Whether you are a producer, program member, researcher, member of industry or interested stakeholder - all feedback is welcome.

Purpose

The EnviroVeg Manual is a compilation of information, resources and recommendations on good, environmentally responsible practices to enable the implementation of sustainable production techniques on Australian vegetable farms.

The Manual is designed to:

- Provide an overview of management priorities for sustainable vegetable production

- Address key environmental risks through practice recommendations

- Enable the monitoring and recording of environmental management outcomes

- Establish clear pathway to achieving recognised environmental certification

- Identify quality, up-to-date resources and research for environmental production techniques

- Function as a conduit between other EnviroVeg resources

Composition

The EnviroVeg Manual (2018) incorporates updated content from prior versions of the manual (the last update was released in February 2014) to present information in an accessible, useful format. It is broken into management chapters;

- Business
- Land and Soil
- Crop nutrition, fertilisers and soil additives
- Pests, weeds and diseases
- Water
- Biosecurity
- Chemicals
- Energy and greenhouse gasses
- Waste
- Air
- Biodiversity

Each management chapter contains three main sections;

1. **Management guidelines;**
 - Context, business benefits, scope and management objectives that define the rationale for the section

- Achieving environmental assurance certification
- Key hazards and risks, recommended practices, expected outcomes (short and long term)
- Simple ways to stay informed and the knowledge and innovation pipeline (emerging/recent research)

2. **Putting it into practice;**
 - Collect baseline information and data
 - Assess your risks
 - Prepare an action plan
 - Monitor performance indicators
 - Keep records
 - Review, evaluate and communicate
3. **References and resources:**
 - Continually updated with links and resources to achieve uptake and drive continuous improvement.

How to use

Assessment first: The manual is designed to integrate with and navigate between other EnviroVeg resources. The report produced after completing the self-assessment highlights the specific components of the manual of relevance to your business. This method is the most efficient way to access the resources within the manual.

In-depth read: The manual has a lot of content and resources, all of which are useful in some capacity. To get the most out of the manual go through the whole document and revise the components that you recognise as applying to you.

Embedded links: Optimised for online functionality, the green highlighted links within the manual take you directly to a resource or relevant research for in-depth direction. The links ensure that you maintain your train of thought and dive deeper into learning.

“The greatest challenge humanity has to face is to make decisions on what is ethical as well as profitable.”
- Lyn White



THE PROGRAM

Objectives

There are three main objectives to EnviroVeg:

- To support and improve environmental management on farm
- To facilitate program recognition of and competitive advantage from EnviroVeg membership and branding
- Track industry progress regarding sustainable farming practices

Values

Members of the EnviroVeg program value the environment and their production resources. Members act as stewards of land, water and biodiversity by enacting the EnviroVeg Values;

- Minimise the impact of vegetable production on the environment
- Prioritise vegetable production techniques that use a minimum, sustainable amount of resources
- Production practices strive to align with farm resource management objectives
- Increase the uptake of quality research on farm
- Continuous improvement of vegetable production systems in these areas

Values are also underpinned by EnviroVeg management objectives (see program rules) and are complementary and additional to other health, agricultural, environmental, food and production related regulatory requirements at federal, state, territory and other relevant levels.

Rules and membership

EnviroVeg membership requires annual completion of an internal self-assessment (this is the minimum requirement). Continuous improvement is the cornerstone of this program, and it is important that members understand the serious commitment to environmental management.

For full details see EnviroVeg program rules. Also see certification and logo use rules to understand the requirements and benefits for independent verification of environmental practices.

Additional components

The self-assessment encourages uptake of environmental-best practice production techniques and relevant industry research as well as highlighting member requirements to progress to

certification. It is hosted on the Hort360 platform, which is maintained by Growcom. A feedback report (the EnviroVeg feedback report) is produced through the self-assessment containing benchmarking and improvement information linked to the EnviroVeg Manual.

For more in-depth analysis of your report, there is optional EnviroVeg training.

For independent verification of your practices, as well as access to EnviroVeg branding, EnviroVeg offers a pathway to achieve certification to Freshcare Environmental.

For more detail on these and other additional resources, see EnviroVeg program rules and the EnviroVeg website.

Recognition

A founding remit of EnviroVeg is to seek benefits for its members that commit to continuous improvement. The program's recognition strategy aims to deliver this and encourages feedback on methodology, it is refined over time given experience and input.

This includes initiating and investigating;

- Acknowledgement through the domestic supply chain
- Underpinning Australia's 'clean and green' image in export markets
- Quality extension materials
- Collaboration with related projects
- Managing regional environmental issues
- Branding and consumer understanding

Recognition options available to members (dependent on their progress through EnviroVeg) include:

- Referencing EnviroVeg on promotional materials
- Inclusion in EnviroVeg business registry
- Certificate of membership
- Use of EnviroVeg logo
- Letter of acknowledgement from EnviroVeg to supply-chain and community

To offer feedback visit; enviroveg.com.au.

More information on membership recognition can be found at EnviroVeg program rules.



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The EnviroVeg Steering Committee (members past and present)

Project Partners (Freshcare, Growcom, AUSVEG)

Past EnviroVeg projects, namely the original manual author; Helena Whitman and designer; Helen Bull.

Andrew Shaw (AUSVEG, coordinator/editor)

FOOTNOTES

¹World Economic Forum, agenda: food security and why it matters (2016)

²Food Security and the 2015-2030 Sustainable Development Goals: From Human to Planetary Health: Perspectives and Opinions (2017)

³Report of the PMSEIC expert working group: Australia and Food Security in a changing world (2010)

⁴Australian agricultural productivity growth: ABARES research report (2014)

⁵Why has Australian agriculture productivity growth stalled?: Australian farm institute (2015)

⁶Promoting productivity in the agriculture and food sector value chain: issues for R&D investment: ABARE and BRS report for the rural R&D council (2009)

⁷FAO water report 36: Climate change, water and food security (2008)

⁸Rural Research, Development and Extension Priorities: Department of Agriculture and Water resources (2015)

⁹The coming famine: risks and solutions for global food security, Julian Cribb (University of California and CSIRO) (2010)

¹⁰Shaping the Future of Global Food Systems: A Scenarios Analysis: World Economic Forum (2017)

¹¹The Future of Food: CSIRO Agriculture and Food essay (M.Cole and M. Noakes, 2017)

¹²Global water crisis and future food security in an era of climate change: Charles Sturt University, CSIRO and ANU (M.Hanjra and M. Qureshi, 2010)

¹³Economic Efficiency of Sustainable Agriculture; Institute of Agricultural and Food Economics (W.Wrzaszcz and K. Prandecki, 2015)

¹⁴The role of conservation agriculture in sustainable agriculture: Cornell University (P.Hobbs, K.Sayre and R.Gupta, 2007)

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BUSINESS



PART ONE: MANAGEMENT GUIDELINES

Context

Sustainable production techniques are implemented in combination with good business management decisions. All vegetable production businesses are responsible for protecting and improving their environment and contextualising the big environmental issues helps businesses to make continuous environmental management improvements. Environmental management decisions can be affected by a variety of business factors, from relationships with experts, advisors and the local community to regional environmental priorities and management plans both within the supply chain and on-farm.

Quality data underpins decision making and is obtained through good record keeping. Therefore to influence good future business management decisions, it's important to identify and track current business procedures.

Scope

This section details procedures and key topics for making environmentally responsible, sustainable management decisions in vegetable production systems including; community relationships, catchment

priorities, local objectives, access to expertise and support, supply chain management, farm layout and farm plans. Business management underpins all the other sections within the scope of EnviroVeg and can affect how practices are implemented on-farm.

Management decisions are affected by external forces such as the political climate, the ability to access funding and to show return on investment.

Management objectives

Ensure that business management decisions are environmentally responsible, meet the needs of the community and promote the longevity and sustainability of Australian vegetable production regions.

Support environmental improvement; on-farm, within local land-management regions and the supply chain.

Accurately capture and record business management decisions so as to identify and improve sustainable production outcomes.

Protect and improve the environment.

"It is only by understanding the cultural complexity and largeness of the concept of agriculture that we can see the threatening diminishments implied by the term 'agribusiness.'"
- Wendell Berry

FIGURE 1: CALCULATING THE COST OF PRODUCTION

The cost of production is calculated by adding up all of the costs and dividing by the unit of production. It is useful to calculate a number of parts of the cost of production. Doing this helps understand where the biggest costs are, how much of the costs are input or growing costs and how much are the capital costs. The table assumes area of 5ha yielding 100t/ha and 100 cartons/t.

The following table gives an example of a cost of production analysis for capsicums.

CROP INPUT COSTS	Total farm	Crop cost	per tonne	per carton	% of COP
Fertiliser	\$50,000	\$5,600	\$11.20	\$0.11	
Seedlings	\$40,000	\$5,000	\$10.00	\$0.10	
Labour	\$70,000	\$10,000	\$20.00	\$0.20	
Chemicals	\$5,000	\$3,000	\$6.00	\$0.06	
Fuel	\$25,000	\$5,000	\$10.00	\$0.10	
Other input costs	\$5,000	\$2,000	\$4.00	\$0.04	
Total crop input costs	\$195,000	\$30,600	\$61.20	\$0.61	28%
POST GROWING COSTS	Total farm	Crop cost	per tonne	per carton	% of COP
Harvesting - labour	\$70,000	\$6,000	\$12.00	\$0.12	
Harvesting - other Packing	\$40,000	\$3,000	\$6.00	\$0.06	
Packing	\$20,000	\$2,000	\$4.00	\$0.04	
Transport	\$10,000	\$5,000	\$10.00	\$0.10	
Total post growing costs	\$140,000	\$16,000	\$32.00	\$0.32	15%
Overhead costs	\$50,000	\$5,000	\$10.00	\$0.10	5%
Total operating costs	\$385,000	\$51,600	\$103.20	\$1.03	47%
CAPITAL COSTS	Total farm	Crop cost	per tonne	per carton	% of COP
Machinery depreciation	\$35,000	\$5,500	\$11.00	\$0.11	
Opportunity cost of machinery ownership					
value of machinery	\$200,000				
% apportioned to crop	25%				
opportunity cost of capital	8%	\$16,000	\$4,000	\$8.00	\$0.08
Land rent	\$4,000	\$4,000	\$8.00	\$0.08	
Financing total operating costs					
total farm operating costs	\$385,000				
total crop operating costs	\$51,600				
cost of finance (e.g. overdraft)	10%	\$38,500	\$5,160	\$10.32	\$0.10
Total capital costs	\$93,500	\$18,660	\$37.32	\$0.37	17%
RETURN FOR LABOUR, MANAGEMENT AND OWNERSHIP	Total farm	Crop cost	per tonne	per carton	% of COP
Owner's labour	\$80,000	\$20,000	\$40.00	\$0.40	
Profit	\$100,000	\$20,000	\$40.00	\$0.40	
Total return for labour, management and ownership	\$180,000	\$40,000	\$80.00	\$0.80	36%
TOTAL COST OF PRODUCTION	\$658,500	\$110,260	\$220.52	\$2.21	100%

The analysis in the table shows that:

- The total cost of production for our example capsicum grower is \$220.52 per tonne or \$2.21 per carton.
- The operating costs make up less than half (47%) of the total cost of production.
- The largest component of the total cost of production is the return for labour, management and ownership (owner's labour and profit) at 36% or \$0.80 per carton.

This table is available as a simple calculator. This helps you to use your own figures when calculating cost of production.

Source: ausveg.com.au/app/data/technical-insights/docs/case-study-using-cost-of-production-for-decision-making.pdf page 4

ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard sections M1 – M5 and E1.1. To achieve certification to this standard, growers must demonstrate their compliance with the requirements outlined here. Note that these compliance criteria have some crossover with the management requirements of Freshcare Food Safety and Quality.

M1.1 Define the business scope and the scope of Freshcare certification.

1. The scope of Freshcare certification is defined by the owner or appropriate senior manager.
2. All business enterprises and activities undertaken are recorded.
3. Flowcharts are completed to document the crops and activities for which Freshcare certification is required.

M1.2 Identify property areas, infrastructure and surrounds on a property map.

1. A property map is documented and maintained. The map identifies:
Property boundaries, roads and surrounds (farming, school, sports fields, residential, etc.)

Sensitive areas adjacent to the property boundary such as National Parks, World Heritage-listed areas, Ramsar-listed wetland areas, wildlife sanctuaries/corridors or other specified conservation areas

Production areas and growing sites
farm houses, buildings, sheds, on-farm roads and access points

Toilet facilities, septic tanks and seepage pads

Worker accommodation and facilities

Bulk fuel storage, including underground tanks

Chemical storage areas, mixing areas, equipment clean-down areas, dip sites (postharvest, livestock) and disposal trenches/evaporation ponds

Storage sites for waste, including controlled wastes (empty chemical containers awaiting collection, tyres)

Fertiliser and soil additive storage areas, composting/ageing and mixing/loading areas

Water sources, extraction points and delivery infrastructure

Drainage lines and discharge points

Natural waterways, wetlands, riparian areas and lakes

Areas that are, or are at risk of being, highly degraded, eroded or contaminated

Significant stands of remnant native vegetation

Threatened species

Other sensitive areas with high conservation value.

M1.3 Define the business organisational structure.

1. The organisational structure of the business is documented and must include:
Workers responsible for the management of environmental compliance.
Reporting relationships of all workers whose roles may affect environmental compliance.

M1.4 Document the business commitment to the Freshcare Code of Practice.

1. The owner or appropriate senior manager signs a commitment statement to support and comply with the Freshcare Code of Practice Environmental, Freshcare Rules, Environmental Action Plan (E1) and all legislative requirements.
2. The commitment statement is communicated to all workers.
3. The commitment statement is reviewed annually in conjunction with the Environmental Action Plan (E1).

M2.1 Verify compliance with the Freshcare Code of Practice through relevant documents and records.

1. The current editions of the Freshcare Code of Practice Environmental and the Freshcare Rules are kept.
2. All records and documents required to verify compliance to this Code of Practice are legible and must include:
Title and date of issue or version number
Business name
Name of the person completing the record, and date of completion
3. As documents and records change, out-of-date versions are replaced.

4. All records are kept for a minimum of two years (or longer if required by legislation, customers or this Code of Practice).

M3.1 Complete Freshcare training.

1. A management representative completes approved Freshcare Environmental training. Evidence is kept. (See *Appendix A-M3*)

M3.2 Train all workers who complete tasks relevant to this Code of Practice to ensure a base level of environmental awareness.

1. Training is provided for workers who complete tasks relevant to this Code of Practice.
2. Training is provided in the relevant language for workers, or pictorially.
3. A record of internal and external training is kept and must include:
 - Name and signature of trainee
 - Name of trainer or training provider
 - Title or topic of the training
 - Date of training and expiry date (when applicable).
4. A review of training is conducted at least annually or when tasks and/or workers change.

M4.1 Conduct internal audits to verify ongoing compliance with this Code of Practice.

1. An internal audit of all activities and records relevant to the Freshcare Code of Practice Environmental is conducted at least annually. A record is kept.
2. Workers responsible for completing sections of the internal audit are identified and, where possible, are independent of the practices being assessed.

M4.2 Complete corrective actions for any non-compliance.

1. A Corrective Action Record (CAR) must be completed when the requirements of the Freshcare Code of Practice Environmental, Freshcare Rules or legislation are not being met, as identified by:
 - routine activities
 - annual internal and external audits
 - a valid complaint received from a neighbour, customer or regulatory authority
 - environmental harm has occurred/may occur as a result of property activity, neighbouring activity or a natural event.
2. A Corrective Action Record must include:
 - Description of the problem
 - Cause of the problem

Whether or not the problem has occurred before
Short term fix (action taken to fix the problem)
Long term fix (action taken to prevent the problem recurring)
Date action completed and the name of the person responsible

Review and verify that short term and long term actions are complete and effective
Name of the person completing the review and date of review.

3. Reoccurrences of non-compliance are reviewed by the owner or appropriate senior manager.
4. Corrective Action Records are retained for a minimum period of five years (or longer if required by legislation or customers).

M5.1 Comply with customer requirements.

1. Where a customer requires compliance with specific environmental, sustainable agriculture or greenhouse gas emission practices not covered in this Code, a written copy of these practices is kept.
2. These practices are complied with and included in M4 Internal audits.

E1.1 Establish an Environmental Action Plan to identify planned future actions to manage environmental issues and improve the property's environmental values.

1. Conduct an assessment of the property and business operations to identify any environmental issues and assess environmental values.
2. Establish an Environmental Action Plan (EAP) that documents the actions planned to address the environmental issues and improve the environmental values of the property. The EAP must include:

Date of plan development
Environmental issue/value being addressed
location on the property of environmental issue/value
Actions planned to address the issue and/or improve the value and worker/s responsible
Target date of completion for each action
Evaluation of action/s undertaken
Date, name and signature of the person verifying action has been completed.

3. Evidence of progress towards and/or changes to planned actions is kept.
4. The Environmental Action Plan is reviewed and updated at least annually. The name of the person completing the review and the date of the review are documented.

KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

┌ Sustainable management not incorporated in business strategy/future planning	┌ Depleted or polluted natural resources are passed on to future generations └ Business is unviable, money is lost and product cannot be produced
┌ Unaware of all potential on-farm environmental impacts	┌ Environmental resources impacted └ Damage to reputation, ability to manage resources
┌ Poor management and development of staff	┌ Knowledge and skills relating to the environment are lost/not prioritised └ High turnover, loss of knowledge, inefficient functionality of business
┌ Environmental management practices are not documented or readily proven	┌ Resources are mismanaged, either being overlooked and neglected or over managed therefore wasting resources └ Business is negatively perceived by local communities and supply chain, relationships deteriorate
┌ Management decisions are made with a short-term view	┌ Resources are damaged or depleted irreparably └ Business cannot function in the long term
┌ Unaware of legal requirements relating to the environment and farm	┌ Damage to the environment and its resources └ Legal implications, loss of ability to do business
┌ Staff and contractors are unqualified	┌ The environment is damaged └ Damage to reputation, ability to do business and cost to business
┌ Business is ill-prepared for dealing with environmental emergencies	┌ Flood, fire, other emergencies damage/destroy the environment and its resources └ Unable to produce crops or function as a business
┌ Products and services are not environmentally responsible	┌ Damage to the environment and its resources └ Inability to do business, reputational damage, loss of resources

RECOMMENDED PRACTICES

The following practices are recommended to manage risks. Consider incorporating these practices in your business management program and/or environmental action plan.

Define the scope of your business operations

Cost of production and gross margin budgets for your crops.

Business enterprises and activities;

- organisational structure of the business, especially staff responsibilities with regards to environmental issues.

Identify all farm property areas, key infrastructure and surrounds focusing on the identifiers listed under section M1.2 - compliance criteria of achieving environmental assurance certification (above).

Identify areas for improved return on investment, where are your resources being spent and how can you improve these returns. For example, auditing your energy use can find the potential for energy savings and increase efficient use of this resource.

Make a business case for future large-scale expenditures, showing the investment returns.

Understand the environment and your region of production/operation

Identify your business actions that could impact the environment, and understand what that impact may be.

Understand the impacts of climate change on your business (also see Section 8).

Identify activities you plan to complete that may cause concern to neighbours, maintain healthy communication with your local community. Contact your neighbours well in advance of carrying out any activities that may impact them.

Research and investigate your local environmental priorities (NRM/CMA priorities) and include within business management decisions.

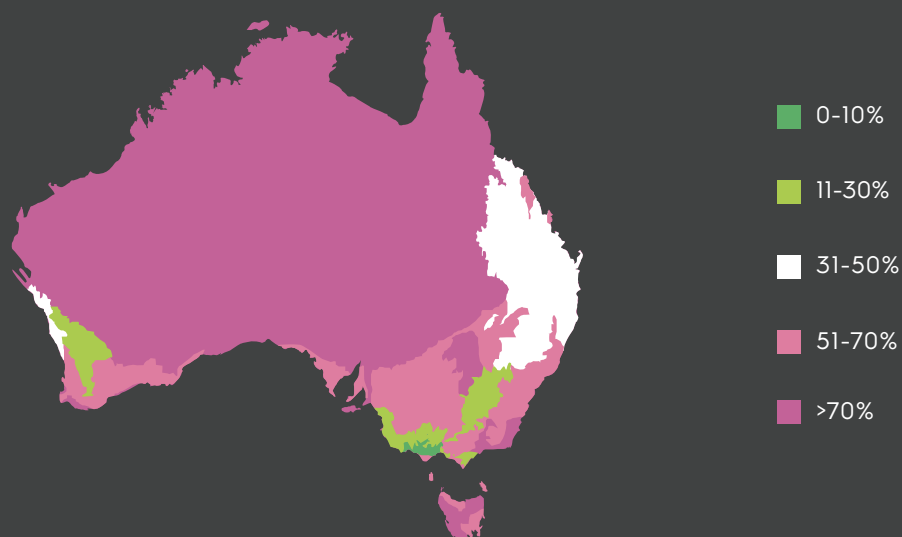
Identify nearby sensitive regions, such as specified conservation areas.

Identify the risks to your business, both environmental and otherwise, and implement mitigation plans for them.

Plan for property management

Develop a property map and implement an Environmental Action plan, see essential records (below) for templates and examples of information to include. Update these resources regularly.

FIGURE 2: EXTIMATED REMAINING NATIVE VEGETATION



Percentage of estimated pre-1750 native vegetation remaining uncleared across Australia by bioregion. Note that vegetation may be changed by grazing or altered fire regimes even if it remains uncleared. Source: publish.csiro.au/ebook/download/pdf/6967.

Plan for property management (continued)

Identify key environmental areas and associated issues with regards to EnviroVeg management elements, develop plans to manage these issues and incorporate value into future decisions.

Maintain appropriate records

Keep up-to-date documents and records, replace out-of-date versions as required.

Record what products are used to produce your crops and where the crops came from.

Encourage environmental practices through your supply chain through record management.

Accurately record information to meet local environmental requirements.

Train and treat staff members appropriately

Ensure staff have training appropriate to the activities they are undertaking.

Engage staff so that they remain satisfied with their working environment, incorporate **personal development opportunities** and monitor satisfaction levels.

Ensure staff and **contractors are appropriately qualified.**

Consider the **cost-benefit ratio of business expenditures**

Cost-expenditure decisions can deliver long-term benefits to the bottom line and the environment when implemented appropriately, options to consider include purchasing;

- **Quality assurance software**
- **Farm management software**
- **Staff training and development**
- **Energy auditing/benchmarking**
- **A plan for management transition, especially within a family business**
- **Changing soil management techniques**
- **Robotics and remote sensing equipment**
- **The materials and practices used in hydroponic systems**
- **New irrigation equipment**
- **Using IPM techniques on-farm**
- **Power sources; wind power, hydro power**
- **Using biofuels**
- **Lighting selection, LEDs and localised lighting**
- **Insulating windows with window coverings**
- **The location of your cool room**

External factors and internal management decisions that can influence your business, these include;

- **Key economic variables** in vegetable production
- **Employing carbon sequestering techniques**
- **What farming operations will look like in the future**
- **Relocating property** – what is the right decision?
- **Vertical integration** within your business
- **Developing new blocks of land**

For more expenditure evaluations review part 3; references and resources.

Prepare for **environmental emergencies**

- **Fires**
- **Floods**
- **Biosecurity emergencies**
- **Cyclones and power outages**
- **Food safety recalls** and associated issues
- **Preparedness planning** and **other possible hazards**

Use **environmentally responsible products and services.**

FIGURE 3: THREATENED SPECIES TABLE

The number of threatened species formally documented by scientists versus the number of species thought to exist in Australia.

Group	Number of species described	Number of species estimated to exist	Percentage described
Mammals, birds, reptiles and frogs	2358	2470	95
Fishes	5000	5750	87
Insects	62 000	205 000	30
Other terrestrial invertebrates	52 000	115 000	45
Fungi	11 846	50 000	24
Flowering plants	18 706	21 000	89
Micro-organisms	4186	160 000	2.6

Source: publish.csiro.au/ebook/download/pdf/6967

EXPECTED OUTCOMES

Improved business management practices outcomes expected to be achieved through implementing these practices include:

Within 1-5 years

Business operations across all management areas are well understood by relevant staff.

Identified areas for improved on returns from investments.

Staff are happier, turnover is reduced.

The business has a clear direction.

Longer term outcomes, which may take 5-10 years or more

Improved return on investment, business operations are more profitable.

Natural resources are healthier, used more efficiently and can be passed on to future generations.

Information on all business operations are readily accessible and available for easy decision making.

Simple ways to stay informed

Industry updates

[VegNET](#) – extension officers for industry R&D
[Agribusiness Australia](#)

Horticulture wide updates

[Hortlink](#) – contains updates on levy funded projects
[Hort Innovation communications](#) and [membership](#)
[AUSVEG communications](#)
[Growcom email subscription](#)

Government department updates

[National environmental law – reviewing support for farmers](#)

[Local councils](#)

[Your natural resource management groups](#)

[State business structures and departments](#)

- [New South Wales](#)
- [Victoria](#)
- [Tasmania](#)
- [South Australia](#)
- [Western Australia](#)
- [Northern Territory](#)
- [Queensland](#)

FIGURE 4: AUSTRALIA'S BIODIVERSITY STATUS AND TRENDS

Australia's biodiversity has been modified since human settlement by land clearing, habitat fragmentation, biological invasions, burning, harvesting of species from land and sea, and climate change.

There are surprisingly few scientific data sets on how Australian biodiversity is faring; however, direct measures, such as numbers of extinct and endangered species, and indirect measures, such as extent of vegetation cover, show that biodiversity in both terrestrial and aquatic environments is declining. Our marine environments are in good condition, except near cities.

Ecosystems near large population centres and on prime agricultural land have experienced the greatest declines; hence, most endangered species occur along the eastern coastline and in south-eastern and south-western Australia.

Evidence from monitoring suggests that pressures on Australian biodiversity are increasing, despite the investments in management.

Better monitoring of biodiversity is needed to boost the efficiency and effectiveness of management.

Source: publish.csiro.au/ebook/download/pdf/6967

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Staff development

Hort Innovation
Leadership fund projects

A number of vegetable levy funded projects are operating to develop the skills and knowledge of industry members. These include;

- Masterclass in Horticultural Business (UTAS)
- Growing leaders, (Affectus, leadership development)
- Nuffield and Churchill scholarships (research fellowships)

Vegetable industry export program

Hort Innovation VG16061

The principle objective of the program is to construct a holistic market access and development program aimed at fulfilling the export growth targets identified in the VIES 2020 of increasing the value of vegetables exports by 40% to \$315 million by 2020 and to over \$400 million by 2025, as well as creating a strong export culture in the vegetable industry and assisting the industry to develop a sustainable vegetable export sector.

Creating value from edible vegetable waste

Hort Innovation VG15076

Addressing the issue of vegetable wastage on-farm and post-farm-gate, this project is developing new knowledge and processes to improve recovery of edible material. Avenues of exploration include the extraction of 'nutraceuticals' from vegetable waste; the processing of edible waste into new fibre-rich, healthy raw ingredients and food products; and the use of fermentation to develop next-generation fermented vegetables. The project has a focus on brassica vegetables and carrots.

Digital agriculture

CSIRO blog

Digital agriculture is causing excited chatter, especially about its potential benefits to farmers, industry, agribusiness, researchers and government. But why the fuss?

Water management through data modeling

CSIRO project, WaterWise

Digiscape's WaterWise initiative focuses on providing Australian irrigators with digital strategies to confidently apply irrigation water at the right time to optimise yield, quality and water use for high-value crops.

The system uses proximal (single location in the field) continuous canopy temperature measurement and offers growers a simple means of identifying crop stress.

Retailers of the future

Retail Tomorrow, Today
Retailer trends report from
oracle cloud

In this report, leading retailers and influencers share their thoughts on what 2018 holds in store for one of the world's most exciting and challenging industries. Through their insights, we explore the trends that are reshaping retail and outline how brands should respond.

Consumer trends and
technology
Consumer goods forum;
AI - the future of business
Data sharing and robotics

The linear models of many consumer goods supply chains are now shifting towards consumer-led, data-driven, highly complex supply networks. For organisations willing to embrace this inevitable evolution, AI and Robotics automation will enable innovation, ensure optimum service levels and deliver growth at low cost. It will become a major source of competitive advantage.

PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Business operation information

- Resources and cost expended across the whole business, and
- all EnviroVeg management areas

The cost of production for your produce

Audit how you manage your resources

- Identify areas where resources are wasted
- Identify the skills and attributes your staff have and what skills are lacking
- Develop a plan for staff to develop skills required

Step 2: Assess your practices and risks

Complete the on-line EnviroVeg self-assessment.

The report will identify critical risks and recommendations for actions/practices to implement.

Step 3: Prepare an action and implementation plan that addresses key risks

Use the EnviroVeg action planning template
Incorporate into the business management program relevant recommended practices outlined in Part one, in particular;

- ensure all environmental legal requirements are compiled
- Prepare a budget of annual operating costs
- Optimise resource use efficiency and environmental resource re-use where possible
- Manage quality natural resource inputs and discharges

Step 4: Monitor performance measures / indicators

In vegetable production systems, key indicators include;

- Up-to-date records, including a current property map
- Cost of production/return on Investment (ROI)
- Long term goals vs short term outcomes
- Satisfaction levels of employees
- Changes in training requirements

Step 5: Keep records

Essential records

- Property map identifying property boundaries, major infrastructure and areas of Environmental concern as per M1.2
- Environmental Action plan
- Staff training records and plans for workers
- Records of crop inputs and products used in crop production
- Organisational structure of the business
- Internal audit (updated annually)

PART THREE: RESOURCES AND FURTHER INFORMATION

Legislation

[Your Council](#)

[Conservation priorities](#)

[Commonwealth](#)

[Australasian Legal Institute](#)

[Australian Law Portal \(National Library of Australia\)](#)

[About the environmental protection and biodiversity conservation act](#)

[National Environmental law factsheets](#)

[EPBC act](#)

[Australia's biodiversity conservation strategy](#)

International

[Australasian Legal Institute](#)

[Australian Law Portal \(National Library of Australia\)](#)

[Environmental Defenders Offices \(independent community environmental law centres\)](#)

State farm planning guidelines

[NSW DPI - best practice guidelines for vegetable growing](#)

[Agriculture Victoria - environmental farm planning](#)

[Rural planning guidelines - WA state planning policy](#)

[QLD DNRM](#)

[PIRSA - farm gross margin guide](#)

[TAS DPIPWE - farm business planning tools](#)

[NT EPA - environmental waste guidelines](#)

Freshcare Environmental record forms

Form - M1 Scope

Form - M1 Flowchart

Property map

Organisational chart

Form - M1 Commitment statement

Freshcare Code of Practice Environmental

Freshcare Rules

Training certificate

Form - M3 Training record - internal ENV

Form - M3 Training record - other

Form - M4 Internal audit report

Form - M4 Corrective action record (CAR)

Customer contract, agreement or specifications.

Form - M4 Internal audit report

Form - E1 EAP assessment

Form - E1 Environmental Action Plan

Freshcare Environmental Resources

Factsheet - M1 Scope and commitment

Freshcare Crop List (available via FreshcareOnline)

Factsheet - M2 Documentation

Appendix - A-M3 Approved Freshcare training

Factsheet - M3 Training

Factsheet - M4 Internal audit and corrective action

Factsheet – M5 Customer requirements

Factsheet – Environmental action planning

General references and resources

Business plan template and guide

Fact sheet; business management, think through the numbers

Business decision making

Hort for tomorrow guidelines for Environmental assurance: Guidelines for Environmental Assurance

Develop a sustainability business case

Evaluation of quality assurance software for the vegetable industry – report

Include the tables from page 83 – 110 of this document in the 'tools' section of references and resources.

Final Report: Evaluation of commercially available farm management software programs for the vegetable industry:

Training in the Vegetable industry report

Economic evaluation of farm energy audits and benchmarking of energy use on vegetable farms

Continuing on-farm improvements through good practice demonstration and extension in WA, includes case studies

Transitioning management

Return on investment workbook – making a business case study

Future and technical insights:

Future farms – the best practice farm of 2050

Carbon and sustainability

What drives the economy? Key economic variables

Talking business

Add table below: Using cost of production for decision making

Robotics and remote sensing

Greenhouse and hydroponic systems – improvements in systems and practices
ausveg.com.au/app/data/technical-insights/docs/VG303.pdf

ausveg.com.au/app/data/technical-insights/docs/

[VG97028.pdf](#)

ausveg.com.au/app/data/technical-insights/docs/VG02051_complete.pdf

Case studies:

ausveg.com.au/app/data/technical-insights/docs/CasestudyBuildingasoundvegetablegrowingbusiness.pdf

Using cost of production for decision making

How is our business going?

Search infoveg database for 'vegenotes case studies' – source of many additional case studies.

Business cases:

Business case, new irrigator

Business case, IPM in lettuce

Property relocation part a and b

[BusinesscasePropertyrelocationPartA.pdf](#)

ausveg.com.au/app/data/technical-insights/docs/BusinesscasePropertyrelocationPartB.pdf

Expansion through vertical integration

Develop a block of land for vegetable production

Capsicum grader

Buy a truck or use a contractor

Calculators and tools

Quantifying the return on investment

Calculator: Business case tractor replacement

Business case, property relocation

Lettuce planter?

Developing land for vegetable production

Gross margin comparison tool

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

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Innovation
Research and Development
VEGETABLE
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A practical checklist – QA tools

In consideration of the above, a practical checklist has been developed that provides a range of checks to assist vegetable growers in their decision-making process when considering the purchase of a 'complex' rated QA tool. For the purchase of an 'easy' rated QA tool, vegetable growers can use the practical checklist, but as a minimum take into account the allowable budget and cost of the QA tool (refer to Business Needs / Pricing and Availability), downloading and trying the product before purchase (refer to Evaluation), ease of use (refer to Ease of Use) and how much training is required (refer to Training). A practical checklist to use when purchasing 'complex' QA tools is detailed below:

Business Needs (Pre-planning)

- Identify the internal and external people who need to be on the decision making and implementation project team.
- Determine what you need and why you need it.
- Which elements are essential today ("must haves"), will be important in the next two to three years ("nice to have") and which are not likely to be needed in the near future, if ever ("don't need")?
- Determine your budget.

Technology Specifics

What are the minimum hardware requirements for installing and running the tool(s)?

- How many people will need to use and/or access the tool(s)?
- Can they access the tool(s) at the same time?
- Does my current infrastructure meet those minimum requirements?
- Will the tool(s) reside on a desktop computer, a server, or is a cloud option provided?
- Is the tool(s) database designed for use on a platform, such as Microsoft SQL Server, that remains fast and reliable as the data grows larger?
- Where is the data stored, internally on the computer hardware, or online?
- What backup data features and disaster recovery systems are available?
- What safety/security features does the vendor provide?

Functionality (sometimes called "add-on applications" or "modules")

- Can a desired third party application be integrated within the system?
- Who at the organisation or vendor level will coordinate the integration of third party tools and systems?
- If integration is not possible, what are the alternatives?
- Can I use the tool(s) whenever I need it, at any location?

Ease of Use

- Who will be using the system daily?
- What is the sophistication level of the average user?
- Does the tool(s) have a Windows based interface?
- How much time can be allocated for training and engagement with the new tool(s)?

Integration

- What business information will be needed to be processed?
- Can it be integrated with other data systems within the business (such as Access, MYOB)?
- If you outsource some of the processes, how will information get transferred back and forth with your tool(s)?
- How long will it take to implement the tool(s) within the business?

Vendor Information

- How long have they been in business, and how many customers use the tool(s)?
- What industries does the vendor serve?
- What size businesses does the vendor serve?
- What is their niche?
- Does the vendor offer a complete end-to-end solution or does it only provide certain capabilities?
- What do their customers say?
- Does the vendor allow you to purchase the functionality you need today, but also offer additional functionality that you can buy later or when your company grows and changes?

Pricing and Availability (Total Cost of Ownership)

When calculating the total cost, take a broad view and remember to add in the following:

- Are there any licenses, fees and ongoing costs for the products purchased?
- Are any add-on applications planned for purchase during the first three years?
- Is any new hardware needed?
- Cost of implementation (outside consultants or internal IT resources).
- Customisation of the system or creation by outside professionals of custom reports.
- The annual cost of technical and/or maintenance support (if required).
- Up-front training for staff to learn the system.
- Recurring or additional training as new workers come into the business or new functionality is added to the system.

Technical and ongoing Support

- How will updates to the tool(s) be delivered – and how often?
- Will all of the changes be delivered in one annual update? Or will the vendor make more frequent updates if important changes are taking place?
- How long and how frequently must the tool(s) be down for maintenance?
- Can I talk to a real person when I have a question?
- Do I have several options for contacting customer support (phone, email, live on-line chat)?
- Is the support base local?
- What other support benefits are provided?

Training

- Do you have a budget and resources to manage training internally?
- Will your chosen vendor be available to provide the level of training required?
- How, when and where is user training provided?
- What are the costs associated with training provided?

Evaluation

- Align features with real business activities. Are the tool(s) designed for what you do?
- Try before you buy – download or request a demonstration/trial version of the tool(s).
- If you have staff, have the staff try the tool(s). What do they think of the tool(s)?
- Compare your list of necessities with the features the tool(s) offer.
- Will the tool(s) help you capture the information you need and faster?
- Is the price of the tool(s) within your budget? If not, revise the scope of the project if required.
- Do the tool(s) add value and fit into your future goals?
- Is a change management process required?

LAND AND SOIL



PART ONE: MANAGEMENT GUIDELINES

Context

The maintenance of healthy, productive and stable soils is essential to support vegetable production and contributes, in multiple ways, to the health of environmental systems.

Business benefits

Effective management of soil health and structure underpins farm productivity and resilience. Good soil health also helps to optimise resource use efficiency, particularly for water and nutrients.

Scope

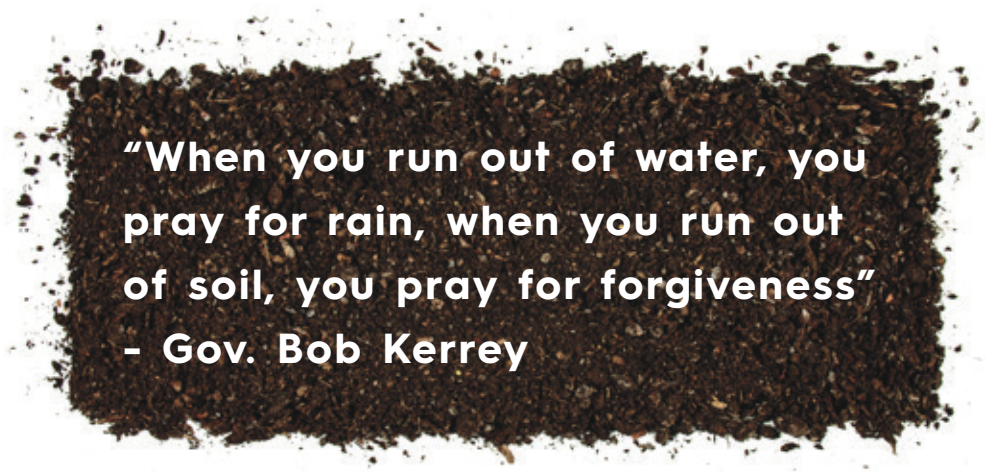
This section addresses risks to soil health and structure, soil stability, and soil degradation. Management of crop nutrition is addressed in section three.

Management objectives

Manage vegetable production to maintain and improve soil health and stability, and to avoid degradation or contamination of soils.

Avoid the export of sediments and nutrients from vegetable production sites to the local environment.

Repair degraded or contaminated soils to the extent that is economically and technically feasible.



"When you run out of water, you pray for rain, when you run out of soil, you pray for forgiveness"
- Gov. Bob Kerrey



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E2. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

FRESHCARE ENVIRONMENTAL CODE ELEMENT

Compliance Criteria

E2.1 Manage land and soil, and minimise degradation, erosion compaction and contamination.

- 1. Soil conservation and crop production practices are chosen to: minimise soil degradation, such as erosion, compaction, loss of organic carbon and

contamination
optimise soil organic matter and fertility relevant to the specific business enterprise (soil, climate and production system)

- 2. For identified areas, applicable records of practices are kept

E2.2 Manage areas with highly degraded, eroded or contaminated soil.

- 1. Areas identified as being highly degraded, i.e. eroded, compacted or contaminated are: managed to minimise further degradation contaminated soil is contained to minimise movement within and off-site and contamination of vegetable crops
- 2. Remediation activities for areas identified in E2.2.1 are documented in the Environmental Action Plan

KEY HAZARDS AND RISKS

Hazards

Risks Environmental Business

CULTIVATION AND FARMING PRACTICES CAUSE:

	Decline in soil biodiversity Increased use and reliance upon agricultural chemicals, fertilisers and crop protection products
	Productivity decline Increased costs, especially of inputs Reduced vegetable quality, yields and shelf life
Decline in organic matter and soil organic carbon (OC):	Increased greenhouse gas emissions Reduced nutrient holding capacity, nutrient cycling and nutrient content of soil
Decline or imbalance in soil biology/life	Loss of organic matter and/or chemical imbalances Reduced, nutrient cycling Loss of pest and disease suppression
Soil borne disease, pest and weed pressure	Off-site movement of chemicals Spread of environmental weeds Resistance to; fungicides, insecticides, herbicides, nematicides or miticides



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

SOIL STRUCTURE:	Water run-off	Nutrient loss
	Productivity decline	
	Higher costs, especially of tillage and inputs	
	Reduced vegetable quality, yields and shelf life	
Hard setting soil (typically high in magnesium and sodium, low in organic matter)	Soil erosion	NOx emissions
	Reduction of organic carbon and soil biodiversity	
	Increased pest, weed and disease risks	
	Reduced nutrient use efficiency	
Poorly drained soil / water logging	Cation imbalances in soil and crop	
	Fertilisers or crop protection products leach or move off-site.	
	Inefficient use of production inputs	
CULTIVATION AND FARMING PRACTICES AFFECT SOIL STRUCTURE, CAUSING:	Water run-off and logging	
	nutrient loss	Soil erosion
	Productivity decline	
	Increased pest, weed and disease prevalence	
Compaction	Higher costs, especially of tillage and inputs such as water	
	Poor nutrient use efficacy	
	Reduced organic carbon and soil biodiversity	
	NOx emissions	
Poor; drainage, infiltration or water holding capacity	Reduction of soil life/soil biodiversity	
	N emissions	
	Higher irrigation water and running costs	
	Poor water use efficiency	
Rootzone / root growth restriction	Nutrient imbalances – excess, leaching or run off	
	Higher disease risk	



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

SOIL IS LOST THROUGH:

Biodiversity decline, Fertility decline

Nutrient imbalances and loss

Productivity decline

Higher input costs and disease risks

Wind erosion, water erosion or flooding

Loss soil/carbon into waterways

Turbidity, low oxygen levels

*Also refer to section on loss of organic matter

Acidification, Salinity or Sodicity

*Also refer to section under hard setting soil

Contamination

Loss of contaminants into waterways

Contaminated produce

FARMING PRACTICES LEAD TO SOIL FERTILITY ISSUES:

Overuse of certain fertilisers or nutrients

Leaching/run-off of fertilisers or nutrients into waterways

Higher input costs

Reduced crop quality, shelf life

Productivity decline

Low soil fertility

Over use of nitrogen

Nutrient imbalances, including excess use

Increased pest and disease pressures

Poor nutrient use efficiency

Nutrient remain in the soil with an Increased risk of leaching or run off

*Also refer to sections under soil structure decline and loss of organic matter

Nutrient losses such as leaching and runoff

Turbidity, low oxygen levels

Poor biodiversity

*Also refer to sections on soil fertility



RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices in your soil management program and/or environmental action plan.

Get to know the soil

Use soil tests/analyses to assess soil types, structure, chemistry/pH, nutrient levels, organic matter (OM) and organic carbon (OC) levels, slope/contours and erodibility across all cropped areas of the property.

Protect the soil surface

Avoid bare fallowing, particularly during known periods of high rainfall, on sloping ground or ground that is prone to erosion. Limit fallow periods to the minimum time required to prepare the ground for seeding/planting, including time needed for pest, disease and weed control, if applicable.

Maintain soil cover: use crops, crop residues, cover crops, mulches, organic amendments, grasses and/or native vegetation to maximise the amount of time soils on the farm are covered.

Establish wind breaks and other vegetated areas in strategic locations to reduce wind speeds and/or to capture or slow run-off water down water across production areas.

Use the universal soil loss equation to assess risk of water erosion

Manage the flow of water over production sites

Utilise the natural contour lines of the site, where possible.

Establish cut-off drains or diversion banks to direct water flow away from exposed sites and/or to prevent water from other areas coming onto the site.

Establish contour drains or bunds to slow and/or collect run-off from the site. Contour drains may be filled with straw or similar material to slow the flow of water.

Establish v-drains in inter-row areas to divert water to grassed water ways and away from exposed areas.

Use grassed irrigator runs for travelling gun irrigators if possible.

Ensure water delivery of the irrigation system matches infiltration rates

Maintain organic matter, fertility and biodiversity

Aim for optimum soil fertility and a good nutrient balance within the constraints of your soil type.

Use soil testing, nutrient budgeting, crop nutrient uptake monitoring and water quality testing to guide management of soil fertility and crop nutrition.



**There is no universal target
for organic matter - the
optimum level depends on
soil type/texture and climate**



Where there is low **nutrient use efficiency**, check soil and crop/root health and root zone restrictions. Seek professional advice to address identified problems.

Avoid excess use of highly soluble fertilisers or large single applications, and implement irrigation scheduling and monitoring to avoid loss of nutrients through leaching or run-off.

Use **organic mulch and compost** as much as possible, guided by **compost standards** and **best management practice recommendations**.

Avoid the use of broad spectrum pesticides and fumigants and fertilisers with high salt index or acidification potential (and especially in high volumes).

Grow deep-rooted green manure crops, such as brassicas, sorghum and legumes, to introduce nitrogen into the soil, benefit the soil structure, improve nutrient cycling and water holding capacity, and provide habitat for beneficial organisms.

Incorporate healthy green manure or **biofumigants** and cash crop residues into the soil.

Encourage biodiversity on-farm and provide a range of habitats **for beneficial organisms in the soil** and crop. This can be achieved through windbreaks, sowing mixed green crops in field margins, maintaining some native vegetation on-farm, or using mixed cover crops.

Rotate crops regularly if possible. Alternatively use mixed cover crops or change cover crop types regularly.

Manage cultivation

Avoid cultivation of degraded soils or on steep slopes (above 10-15%).

Implement **permanent beds** where feasible.

Where cultivation is required:

- Before cultivating, assess the risk of soil compaction and erosion.
- Avoid over-cultivation by implementing **semi-permanent beds and/or minimum tillage techniques**.
- Ensure appropriate implements are selected and they are properly maintained (for example, sharp and correctly adjusted); reduce the use of power implements as much as possible.

- Where possible, cultivate across the slope.
- Combine as many passes as possible (such as simultaneous tillage and bed formation).
- Do not till soil that is too wet or too dry.

Manage irrigation

See practices outlined in Section 4 (water management)

Manage traffic

Restrict traffic to all-weather tracks or other specified areas.

Design permanent tracks with adequate surface drainage and ensure water is not diverted to production areas.

Maintain tracks to reduce dust movement onto crops or neighbouring properties.

Plan farming activities carefully **to minimise the movement of vehicles** and machinery.

Consider the use of **GPS-guided machinery and narrow tyres** to minimise areas of compaction.

Reduce loads.

Avoid contamination of soils and crops

Do not plant vegetables in contaminated areas.

Maintain a program of regular soil, water and plant testing to monitor for contaminants.

Use low cadmium phosphorus.

Avoid spillage of contaminants outside designated, bunded areas (refer to Section 7 Chemicals and also Section 8 Energy and Fuels).

Test organic amendments for contaminants.

Avoid run-off and leaching from contaminated sites and storage areas onto paddocks and sources of irrigation water.

REPAIR DAMAGED SOILS

To repair compacted soils

Deep ripping using appropriate implements / tines at the correct soil moisture may shatter a compacted soil layer and improve drainage.



Rip lines or paddocks should be stabilised immediately with mulch, planting of a green crop, application of lime or gypsum, or other methods.

To repair eroded soils

Review available information regarding **soil erosion** and seek professional advice.

Seek professional advice to design contour drains or other structures or drainage methods to control water and soil movement and divert potential run-off from roads/farm tracks and paddocks up the slope.

Establish trees and shrubs to achieve long-term erosion control, such as areas of tunnel or gully erosion or landslips.

Add organic matter to eroded areas.

Do not till and produce on eroded areas, sow down until recovered; cropping eroded areas will reduce the overall gross margin.

To manage **sodic (dispersive) soils**

Maintain a program of regular soil testing.

Seek professional advice.

Maintain a protective, non-sodic, topsoil where possible.

Minimise cultivation and disturbance of the top soil and follow practices that improve surface drainage and soil structure.

Apply chemical treatments based on advice from a qualified agronomist. These may include gypsum and lime, or increased calcium inputs to counter-balance high magnesium and or sodium. Other treatments may include irrigation with slightly saline water and the addition of organic matter (either introduced or through growing cover crops).

Stabilise areas with dispersive subsoils with permanent, deep rooted vegetation cover.

Raised beds may not be appropriate on sodic soils.

To manage **saline soils**

Maintain a program of regular soil and water testing, and monitor water table level.

Seek professional advice to identify the **cause of soil salinity** and determine appropriate

management actions, which may include;

- Reconsider irrigation water sources, irrigation systems or cropping strategies.
- Reduce salinity of irrigation water by diluting it with non-saline water. Avoid raising the level of the ground water table.
- Adjust irrigation or cropping practices to address rising water table levels.
- Lower the water table through establishing deep-rooted vegetation in strategic locations.
- Improve drainage, especially of easily waterlogged soils, ensure drainage water can move off farm and does not cause off-site damage. Also note that drainage of saline soil may lead to sodicity.
- Use raised, permanent or semi-permanent beds.
- Apply fertilisers or soil amendments high in calcium and potassium, guided by recommendations from soil/plant tests.
- Monitor the crop to ensure nutrient uptake is adequate. Crops grown in saline soils may have low cation (calcium, potassium, magnesium), phosphorus or boron uptake.

To manage **acidic or alkaline soils**

Maintain a program of regular soil testing and seek professional advice regarding the management of soil pH.

Avoid establishing new cropping areas on acidic soils. In particular, seek advice to identify **acid sulphate soils** on the site. These areas should not be used for vegetable production.

Follow practices that improve surface drainage and soil structure.

Select appropriate fertilisers that do not acidify the soil and manage irrigation to avoid leaching fertilisers deep into the soil.

Apply organic matter or other soil treatments based on advice from a qualified agronomist. These may include lime, magnesite or dolomite for acidic soils, and sulphur or acidifying fertilisers for alkaline soils.

To manage **poorly drained or waterlogged soils**

Identify wet lying areas on the property

Avoid cropping water-logged soils

Prepare a management/ drainage plan and implement it if economically feasible.



EXPECTED OUTCOMES

Improved water management practice outcomes expected to be achieved through implementing these practices include;

Within 1- 5 years

Vegetable production systems are well matched to the site's land capability, soil types and soil condition trends.

Cultivation, rotation, soil cover, irrigation, drainage, crop nutrition and traffic are managed to maintain soil health and stability.

Production decision-making is guided by the results of testing and monitoring programs (weather, soil tests, leaf/plants, irrigation) and, where required, the specialist advice of qualified agronomists.

The effects of climate change are incorporated into soil management decisions.

Longer term outcomes, which may take 5-10 years or more

Soil is friable and stable, and erosion losses or water logging do not occur under normal production conditions.

A high level of organic matter, typical for the given soil type and climate, is maintained in the soil which supports a high number and diversity of beneficial organisms.

The condition of eroded or otherwise degraded soil is improved over time.

Soil structure and organic carbon is maintained or improved over time.

A good level of above-and below-ground biodiversity is achieved and maintained.

Groundcover and biomass production (crop yield / crop residue retention, cover crop biomass) are maintained or increased.

Off-site impacts on environmental assets associated with soil and nutrient movement from farms are controlled.

Crop disease, pest and weed pressure is reduced, leading to a reduced need for crop protection products.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- [Soil Wealth email updates](#)
- [VegNET - extension officers](#)
- [AHR resources](#)

Horticulture wide updates

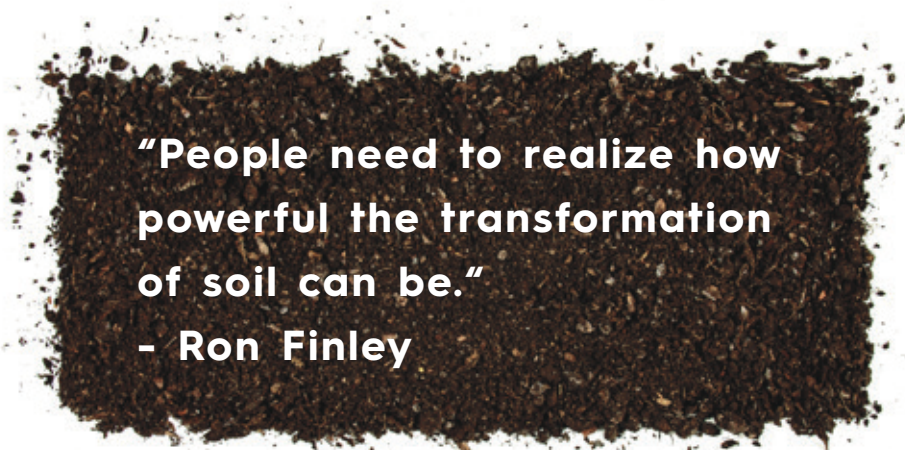
- [AUSVEG mailing list, including weekly updates and Vegetables Australia Magazine](#)
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)

Soil industry updates:

- [Soil journal - research updates](#)
- [Soils for life - contacts](#)
- [Soils for life - resources](#)
- [Australian Controlled Traffic Farming Association - resources](#)
- [Healthysoils.com.au](#)
- [Soil Science Australia](#)

Government updates

- [Soilquality.org.au](#)
- [Australian soils resource information Centre](#)



"People need to realize how powerful the transformation of soil can be."
- Ron Finley



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Precision agriculture project

Hort Innovation (VG16009)

Case-study farms in each state for research and extension – including training events and field days – and will develop video and fact-sheet resources to showcase potential applications of relevant precision technologies

Soil borne disease management (VG15010)

A project to provide Australian vegetable growers with the tools and solutions they need to manage the risk of crop losses due to soil-borne diseases in the major vegetable growing regions of Australia.

Cover crops (VG16068)

Optimising cover crops for the Australian Vegetable industry. Bringing together a consortium of research partners, it is building on existing cover crop trial sites and establishing new ones to explore the how, why and when to best use cover crops across Australia's main vegetable growing regions. It is exploring cover crop species, cropping sequences, sowing windows and transition practices under a range of soil types, climates and crops, and ultimately deliver clear grower guidelines for using cover cropping that are specific to growing regions.

Strategic weed management (VG15070)

This project will deliver weed management tools and approaches. The four-year project will identify and improve integrated management strategies for high-priority weeds and develop guidelines and a host of resources for growers. It will ultimately help reduce the dependence on herbicides and tillage for weed control, which can become ineffective when used repeatedly.

Robotics and intelligent systems (VG15003, VG15059)

Located at the University of Sydney, HICRIS is initially hosting a \$10 million commitment to projects in robotics and autonomous technology that aim to increase farm efficiencies. Work at the centre includes, but is not limited to, developing technology that can detect foreign matter; robots that can map tree-crop architecture; and ground-breaking autonomous weed identification and eradication capabilities. We are also investigating capabilities such as automated crop forecasting to predict the best time to harvest and ground penetrating radar sensors to measure factors such as soil water content and root systems.

Biosecurity (VG15020, VG15023)

This program aims to provide strengthened biosecurity for the vegetable industry by ensuring the interests of the industry are represented in the biosecurity decision making process as well as in areas requiring technical expertise. The appointed Biosecurity Advisor, Dr Kevin Clayton-Greene, represents the vegetable industry in biosecurity matters and provides technical advice on various working groups.

Irrigation (VG14048)

Review of developing irrigation technologies and techniques to identify practises/technologies that will benefit Australian Vegetable growers.

Soil-borne disease diagnostic capacity improvement (VG15009)

This project considered a range of vegetable commodities for most impact and value, with a focus on three key areas of investigation;

- Pre-planting soil tests for disease risk & soil health indicators
- Risk thresholds, management options & validation of tools
- Soil sampling strategies

This approach is directed towards reducing risk associated with soil-borne disease at the pre-planting through to crop production stages.



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Establish baseline information about soils on the property from soil tests and/or soil/terrain maps

- soil type
- soil structure
- soil chemistry/pH
- nutrient levels
- Organic matter and organic carbon
- slope/contours and erodibility
- drainage and surface water flow

Also consider accessing more recent mapping and imaging technologies as additional sources of information, such as EM38 maps, NDVI, soil condition maps

Where salinity is an issue, groundwater flow maps may be useful if available

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment

The report will identify critical risks and recommendations for actions/practices to implement

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a water management plan/program and review and revise it annually

Use the EnviroVeg action planning template

Incorporate into the water management program relevant recommended practices outlined in Part 1, in particular

- ensure all water accessed complies with all legal requirements
- Prepare water budget
- Optimise water use efficiency and water re-use
- Manage quality of water inputs and discharges

Step 4: Monitor performance measures / indicators

Performance indicators for land and soil management in vegetable production systems may include:

Soil structure

Cloddiness, slaking and dispersion determined through visual assessment

Aggregate stability and water infiltration

Rooting depth and root health



Excess sodium or magnesium and chloride in soil test results – these may indicate soil structural problems

Penetration resistance, measured with a **penetrometer**

Ease of tillage (horsepower needed)
Organic matter and organic carbon

Percentage of organic matter and organic carbon recorded in soil tests, aiming for an increase in levels over time.

Carbon levels in the natural environment/bush close to the farm are an indicator of typical organic carbon levels in local soils. Use the same soil testing methodology to see trends. A change of 0.5% is probably within the range of testing error

Soil biology

Monitor **total microbial activity and major microbe groups** recorded in soil tests, aiming for an increase in soil life/biology over time

Also, check for

- A pleasant, earthy smell – this is a sign of healthy soil biology.
- Evidence of soil macro fauna (worms, critters). These are a positive sign of soil biology, however, note that these will fluctuate over seasons and with changing weather conditions.
- Soil particles that stick to roots when they are pulled from the soil (this soil mantle is called rhizosphere); roots are light brown with white growing tips that are covered in root hairs and or have white emerging roots; they are never black or distorted.

Soil fertility

Biomass production in yield (tonnes/ha) and cover crop biomass

Available nitrogen (measured through soil tests such as N-check or Deep Soil N)

If soil phosphorus (P) levels are high, conduct a P leaching risk assessment using the P buffer index (PBI) or P sorption ratio (PSR) from the soil test and risk factors such as slope and distance to ground or surface water

Nutrient use efficiency (NUE%) especially for nitrogen as N applied vs N removed with harvest

Monitor for nutrient imbalance through soil and plant (sap or dry leaf tissue) tests

Monitor pH and electric conductivity (EC) and manage for optimum crop growth

Ground cover

Length of time per year that soil used for vegetable production is covered by a crop, cover crop or other ground cover (farm diary records of planting and harvest times)

Soil loss

Monitor top soil layer height on top of slope

Estimate soil losses from wind or water erosion events

Pest, disease and weed pressure

Monitor changes/trends in pest, disease and weed incidence and severity, aiming for a reduction in pest, disease and weed pressure over time

Soil degradation (acidification, salinity, sodicity or contamination)

Use soil tests to monitor pH, electric conductivity (EC), percentage Sodium (= Sodium Adsorption Ratio – SAR) as part of cation exchange capacity = exchangeable sodium percentage, magnesium, heavy metals.

Pesticide residues and other contaminants such as heavy metal need to be tested specifically if required as they are not part of an agronomic soil test

Use plant sap tests to monitor ppm Chloride and Sodium uptake and uptake & balances of other nutrients

Step 5: Keep records

Records that should be kept by vegetable producers include:

- Property map – Keep an up to date property map to record
- Areas of degraded / at risk soils
- Areas of contamination



- Areas of poor drainage / water logging
- Drainage plans / design
- Areas of high biodiversity value
- Any environmental plantings for example, to address salinity
- Areas important to support Integrated Pest Management (IPM) strategies
- Soil test reports
- Organic carbon and/or organic matter levels
- Electric Conductivity (EC)
- pH
- Salinity (via EC and especially Chloride (Cl) levels)
- Sodidity (via exchangeable sodium percentage = SAR)
- Nutrient levels, including available N and P and deep soil N

Major microbe groups and microbial activity in soils

Visual soil assessment (VSA) records

- Cloddiness
- Penetration resistance
- Evidence of soil life (worms, critters)
- Earthy smell
- Dispersion
- Slaking
- Rooting depth and root health

Plant/leaf tests

- Nutrient levels (sap or tissue tests)
- Sap pH

Spray diary

- Soil borne pests and diseases: species, incidence and severity
- Above ground pests and diseases: species, incidence and severity
- Weed pressure: species, incidence and severity

Farm diary

- Photographs/images/maps/notes on date/sites of significant wind/water erosion events, water logging

- Photographs/images/maps/notes regarding date/sites of significant flooding events
- Irrigation scheduling and monitoring information (refer to Section 4, Water)

Freshcare forms; Form E1 Environmental Action Plan

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed;

- Soil test results?
- Microbial activity?
- Plant/sap leaf tests?
- Legal requirements?

Connect with like-minded producers, network and discuss your ideas

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is @EnviroVeg

Come to EnviroVeg events, ask questions of other growers about their practices



PART THREE: RESOURCES AND FURTHER INFORMATION

Advisors and service providers

[Australian Society of Soil Science Inc](#)

Maintains a directory of accredited soil scientists

[Fertiliser Australia](#)

Maintains a directory of accredited nutrition advisors, and contractors

General information

For information on soil management, requirements, targets and monitoring, contact:

- council
- Regional NRM organisation
- Relevant government agriculture and environment jurisdictions (below)

Government agriculture departments:

Federal
Queensland
New South Wales
Victoria
South Australia
Western Australia
Northern Territory
Tasmania

Government Environment Departments:

Federal
Queensland
New South Wales
Victoria
South Australia
Western Australia
Northern Territory
Tasmania

Training

[EnviroVeg](#)
[VegPRO](#) - Vegetable Industry Training Initiative
Catchment Management Authority or regional NRM organisation
State or federal Departments of Agriculture

FertCare

provides training to assist industry participants understand the food safety and environmental risks involved in handling, transporting, storing and spreading fertilizers

Testing

[National Association of Testing Authorities](#)

Maintains a list of NATA-registered testing laboratories

[Accu-Spread](#)

- Independent testing and accreditation of fertiliser spreading equipment for accuracy and evenness of spreading
- Independent laboratories for agronomic, environmental and biological soil tests

Soil health and management

[Healthy Soils for Sustainable Vegetable Farms - Ute guide](#)

[Soil Wealth - Nurturing Crops](#)

[Australian Organic Standard \(ACOS\)](#)

[National Association for Sustainable Agriculture Ltd \(NASAA\)](#)

[Australian Soil and Plant Analysis Council](#)

An independent international organisation consisting of individuals, laboratories, research and commercial organisations involved in soil and plant tissue analysis

Not-for-profit organisations

[The Soil and Landscape Grid of Australia](#)

[Australian Soil Resource Information System](#)

[Healthy Soils Australia](#)

[Soil foodweb institute](#) - soil rehabilitation

[Soil Quality - agricultural regions](#)

[Australian Soil Club](#)

[Soil Systems Australia](#)

[Soil Carbon Coalition](#)

[Soils for life](#) - Regenerative landscape management practices



Soil Science Australia
CSIRO – soils

University research

University of Queensland
University of Melbourne
University of Adelaide
University of Sydney
University of Western Australia
University of Newcastle
University of Tasmania

Commercial sites providing information

Soil Management Systems (SMS)
Bio platforms – soil biodiversity projects
Seed company websites
Agchem industry websites
Fertiliser industry websites

Apps

SoilMapp: Soil information at your fingertips
(CSIRO decision support tool)

International soil sites

University of Hawai'i – soil nutrient management
Seafriends NZ – Soil ecology
Cornell University – Soil Health Assessment
Smithsonian Environmental Research Centre –
Dig-it the secrets of the soil
National Association of Conservation Districts
(USA) – Soil resources
Holistic soil management – healthy soils

Specific soil health aspects

Biodiversity

- Australian Worm Growers Association
Vermiculture Inc
Provides information on earthworm behaviour,
and species found in horticultural areas
- NSW Department of Primary Industries –
soil biology videos
- Meat and Livestock Australia
Physical fertility – soil structure. Also Provides tips
and tools for increasing earthworms in pastures

Compost

Australian Organics Recycling Organisation Find
compost producers and fact sheets
Soil Wealth – Nurturing Crops – Compost
factsheets
State peak industry bodies for composting

Mapping and data

CSIRO, the Australian Soil Resource
Information System

- Provides online information on soil features
including soil types, landforms, soil depth,
water storage, permeability, fertility, carbon
and erodibility

Monitoring tools

Reid and Cox (2005). Soil biology testing.
Department of Primary Industries (NSW) –
Fact sheets and information

Fertiliser Australia. Cracking the nutrient code

- Provides information on benefits and risks of
fertiliser use, responsible management practices,
monitoring tools and accreditation programs

Nutrition

Growcom's Water for Profit program –
• Fact sheets include information on fertigation

Department of Primary Industries (NSW) – dpi.nsw.gov.au (search 'crop nutrient replacement in tropical horticulture')

Organic soil health

Australian Organic Standard (ACOS) 2017 –
austorganic.com

Legislation

Commonwealth, State and Territory legislation:
Commonwealth – comlaw.gov.au
Australasian Legal Institute – austlii.edu.au
Australian Law Portal (National Library of Australia)
– nla.gov.au/oz/law.html

Environmental legislation:

- Environmental Defenders Offices – edo.org.au

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

CROP NUTRITION, FERTILISERS AND SOIL ADDITIVES



PART ONE: MANAGEMENT GUIDELINES

Context

Effective crop nutrition underpins yield and quality outcomes, and contributes to the maintenance of healthy and productive soils and substrates. Poor nutrient management practices, however, pose risks to productivity, productive resources and the natural environment.

Business benefits

An efficient nutrition program supports healthy, productive crops with a good shelf life and high nutritional value; it therefore has a positive effect on the bottom line.

Scope

This section addresses nutrient management in vegetable crops and the responsible storage and application of fertilisers and soil amendments.

Management objectives

Maintain a crop nutrition program that is based on a detailed understanding of the needs of the crop and the specific considerations of the site, its soils and climate, and that delivers the required nutrients as efficiently as possible.

Ensure the crop nutrition program supports soil health and avoids nutrient imbalances or any decline in soil fertility over time.

Manage the storage and application of fertilisers and soil amendments to control the risk of leaching, run-off, other types of off-site movement, contamination, or nitrous oxide emissions.

Ensure the fertilisers and soil amendments applied do not introduce food safety hazards to soils or crops via microbial, toxic, physical or allergenic contaminants.

“Two out of every five people on Earth today owe their lives to the higher crop outputs that fertilizer has made possible.”
- Bill Gates



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E5. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

E5.1 Select fertilisers and soil additives to minimise risk to the environment.

1. The decision to use fertilisers and soil additives is based on one or more of the following:
 - results of soil/plant tissue/sap testing
 - crop monitoring with monitoring records kept
 - a recognised nutrition program.
2. Fertilisers and soil additives used comply with heavy metal limits specified in AS4454-2012 Composts, soil conditioners and mulches. (See Appendix A-E5).

3. Workers responsible for crop nutrition are competent to make recommendations relevant to the crops under their management.

E5.2 Store and manage fertilisers and soil additives to minimise risk to the environment.

1. Storage sites for fertilisers and soil additives are located, constructed and maintained to minimise harm to off-target and sensitive areas from nutrient runoff or leaching.
2. A current Safety Data Sheet (SDS) (where available) is kept for fertilisers and soil additives stored on the property.
3. Workers are trained in practices that minimise the risk of environmental contamination from fertilisers and soil additives.

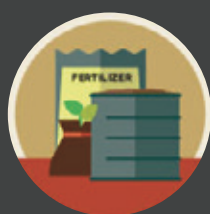
E5.3 Maintain and calibrate fertiliser and soil additive application equipment.

1. Equipment used to apply fertilisers and soil additives is calibrated at least annually or as per manufacturer's instructions. A record of calibration is kept and must include:
 - description of method and calibration results
 - date of calibration
 - name of the person calibrating the equipment.
2. Equipment used to apply fertilisers and soil additives is maintained and checked for effective operation before and during each use.

E5.4 Record all fertiliser and soil additive applications.

1. Records of all fertiliser and soil additive applications are kept and must include:
 - application date
 - location and crop
 - product used
 - rate of application
 - wind speed and direction
 - method of application/incorporation
 - name and signature of the person applying the fertilisers and soil additives.

FIGURE 1: THE FOUR Rs OF NUTRIENT MANAGEMENT



RIGHT SOURCE

Matches fertiliser type to crop needs



RIGHT RATE

Matches amount of fertiliser type to crop



RIGHT TIME

Makes nutrients available when crops need them



RIGHT PLACE

Keeps nutrients where crops can use them

4R Nutrient Stewardship provides a framework to achieve cropping system goals, such as increased production, increased farmer profitability, enhanced environmental protection and improved sustainability.

Source: nutrientstewardship.com/4rs

KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Leaching or run off of nutrients from the storage of fertilisers or soil amendments, or their application to soils/crops	- Excessive nutrients applied to soils, transported to ground water, local waterways or sensitive environments such as native habitats - Financial loss, fines - Nutrient imbalance in crop, reduced crop quality, pest and disease resistance, pack-out % and shelf life
Application of fertilisers/soil amendments generates nitrous oxide emissions	- Contribution to greenhouse gas emissions - Financial loss - Nutrient imbalance in crop, reduced crop quality, pest and disease resistance, pack-out % and shelf life
Poorly managed nutrient program	- Decline in soil fertility or excessive levels of some nutrients in soils that may be lost to the environment - Nutrient imbalance in crops or soils - Productivity decline, lower quality vegetables, reduced crop quality, pest and disease resistance, pack-out % and shelf life, lower nutritional value
Fertiliser use releases heavy metals into soils or waterways	- Heavy metal contamination of soils, reducing soil health - Biodiversity decline in terrestrial or aquatic environments - Heavy metals accumulated in crops - Productivity decline - Heavy metal contamination of produce
Soil amendments host/release human pathogens	- Contamination of soils or waterways - Contamination of crops - Endanger consumer health - Reputational damage that may also affect other producers - Potential legal consequences
Legal requirements around the use of fertilisers or soil amendments are not met	- Contamination of soils, crops or waterways - Fines, prosecution or other enforcement actions - Reputational damage
Regulated inputs (such as waste water or biosolids) are used improperly (without the required approval or without adherence to a government approved management plan)	- Contamination of soils or waterways - Potential contamination of crops - Fines, prosecution or other enforcement actions - Reputational damage



RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices in your soil management program and/or environmental action plan.

Follow an evidence-based approach to nutrient management and a customised crop nutrition program

Prepare a **nutrient budget** and **crop nutrition** program that meets the specific requirements of the site (climate and soil) and the crop, taking into consideration

- Soil test results, including soil type/texture and, for deep rooted vegetables (such as brassica crops), subsoil testing
- Soil conditions, such as top soil depth, compaction, variability of paddock
- Crop/rooting depth
- Expected yield (crop removal)
- Nutrient content in incorporated crop residues or cover crops
- Risks and constraints, including the proximity of water ways, slopes or rootzone restrictions
- Application equipment available to broadcast, spray or fertigate
- Availability of fertilisers for purchase and how they may be best used
- The preferences of the crop manager and customer/market requirements
- Requirements of the desired certification standards

Maintain a regular program of **soil and leaf/petiole testing**. This should include:

- At least one plant sap or dry ash test per crop, best conducted in the first half of the production cycle to be able to adjust the nutrition program, if required, during the season
- Annual soil testing
- Irrigation water testing every 2-3 years or when major changes occur to the water source used

Ensure that the nutrient content of soil amendments is known (from labels or through testing) and included in the nutrient budget

Calculate **nitrogen use efficiency** to **identify risks of high nitrogen residues** after harvest and potential losses to leaching, run-off or nitrous oxide emissions

Check the **phosphorus loss potential** to **identify risks of phosphorous movement** in soils. Take into

account distances between production areas and waterways, groundwater tables and slopes.

Record details of all applications of fertilisers and soil additives

Details required for certification are noted steps 4 and 5 of part two, putting it into practice

Ensure application equipment for fertilisers/soil amendments is maintained and regularly calibrated

Maintain a regular schedule to service application equipment

Check the application equipment is operating correctly before and during each use

Follow the manufacturer's recommended schedule for calibration, and ensure equipment is calibrated at least annually

Manage the risk of applied or stored nutrients (from fertilisers, soil amendments) leaching through soils, moving off-site via run-off, or generating greenhouse gas emissions

Use **precision tools/systems** to apply fertilisers/ amendments at appropriate rates and to match varying conditions in the field/crop

Coordinate application of fertilisers/soil amendments with soil moisture and weather conditions. Avoid applying fertilisers prior to heavy rain events

Measure available/leachable nitrogen before planting, in crop and post-harvest to monitor the efficiency of the nutrition program

Use cover crops to stabilise soils and minimise the potential for nutrient run-off or leaching, and to capture nutrients that have moved past the crops rootzone (use deep rooted cover crops for this)

Use fertilisers with **nitrification or urease inhibitors**, where possible

Do not apply nitrogen to crops that have limitations to growth such as disease or root zone restrictions, and will therefore not use the applied nutrients

Do not apply nitrogen to wet or waterlogged soils

Never apply more nitrogen than a crop takes



up in the interval between two applications or application and harvest

Use split applications and match the **crop's growth curve** with appropriate amounts (more during rapid growth phases, less early and late in the crop)

Avoid tillage in wet conditions

Maintain a regular program of soil and crop (plant) monitoring

Avoid using fertilisers or soil amendments that contain heavy metals that are not plant nutrients or have an excess of trace metals (Zn, Cu, Mn, Fe)

Follow any applicable regulatory guidelines for heavy metals and other contaminants in soil amendments

Ensure that irrigation is managed to avoid water logging in the rootzone and drainage below the rootzone

To avoid nitrous oxide emissions

- do not apply nitrate fertiliser to wet soils or prior to heavy rain
- place urea and ammonium based fertilisers below the soil surface, work them in
- irrigate urea in, use coated product, especially on alkaline soils

Work or irrigate in urea or ammonium based nitrogen fertilisers

Ensure relevant personnel have been properly trained or hold appropriate qualifications

Ensure that staff and/or external advisors responsible for decisions regarding crop nutrition are competent to make site specific recommendations relevant to the crops under their management. In the longer term, this would be best demonstrated by certification through **FertCare** when this becomes available for the vegetable industry.

Ensure that staff who are responsible for applying or managing fertilisers and soil amendments are trained in practices that minimise the risk of environmental contamination from their use and storage.

Ensure fertilisers/soil amendments are stored appropriately

Ensure that **storage sites** for fertilisers and **soil amendments** are located, constructed and maintained to avoid runoff or leaching of nutrients, heavy metals or pathogens to waterways and other off-target or sensitive areas.

Keep current Safety Data Sheets (SDS) for fertilisers and soil additives stored on the property (where available) and ensure these are accessible to relevant staff. If an SDS is not available, information on the composition of the product (from the manufacturer or an accredited laboratory) and any recommendations about its storage and use must be kept.

Manage the risk of **human pathogens in soil amendments**

Follow **food safety guidelines for fresh produce**

Test regularly for **pathogen regrowth in organic wastes**

Do not use biosolids as a soil amendment for **production of lettuce or leafy greens**

Follow the Australian standard for **composts, soil conditioners and mulches**

Ensure recycled organic products are **safe for use with fresh produce**

Human effluent/biosolids must **not be used in vegetable production**

Meet all legal requirements

Adhere to all environmental protection, food safety and workplace health and safety regulatory requirements related to fertilisers/soil amendments

Meet all legal requirements and **approvals processes** for regulated inputs such as **waste water, sludges or biosolids**, and prepare and implement management plans as required.



EXPECTED OUTCOMES

Improved water management practice outcomes expected to be achieved through implementing these practices include;

Within 1-5 years

Nutrient management plans are developed based on soil/plant/water testing, nutrient budgets, removal rates, growth curves and/or yield targets and used to determine the application of fertilisers/soil amendments

Fertiliser application equipment/systems are appropriately selected, calibrated and maintained

All applications of fertilisers/soil amendments are recorded and monitored and withholding periods are observed

Relevant personnel are trained in responsible management of fertilisers and soil amendments

Use of fertilisers and soil amendments meets legal requirements

Mineral, organic and liquid fertilisers are appropriately selected, stored, used and disposed of

Management and response plans are prepared for the event of a spill or emergency involving fertilisers and soil amendments that could cause harm to the environment.

Longer term outcomes, which may take 5-10 years or more

Nutrient inputs and removal by vegetable crops are balanced

Fertilisers/soil amendments are used appropriately to control any off-site releases
Soil condition, organic matter and fertility are maintained or improved

Pollution of soil, water and air by fertilisers or soil amendments is avoided and evidenced by monitoring data.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

Soil Wealth email updates
VegNET – extension officers
AHR resources

Horticulture wide updates

AUSVEG mailing list, including weekly updates
Hort Innovation newsletter
Growcom email subscription

Industry updates:

Nutrient Stewardship
International Plant Nutrition Institute
Society of Precision Agriculture Australia

Government updates

The Australian Pesticides and Veterinary Medicines Authority
Australian Centre for International Agriculture Research
FSANZ – food safety standards

“If women had equal access to fertilizer and modern farm machinery, developing countries would produce between 2.5-percent and 4-percent more food.”
- Sri Mulyani Indrawati

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Precision agriculture project

Hort Innovation (VG16009)

Case-study farms in each state for research and extension – including training events and field days – and will develop video and fact-sheet resources to showcase potential applications of relevant precision technologies.

Minimum tillage combined with cover cropping

Soil Wealth and Integrated Crop Protection project – phase two

A project to integrate sustainable soil health practices into commercial vegetable farming operations which looked at ‘softer’ soil management practices such as reduced tillage, cover crops, compost and controlled traffic. This project has provided commercial scale validation that ‘softer’ soil management practices can be integrated into large-scale vegetable production.

Precision agriculture technologies

VG15003 - Application of intelligent sensing systems, robotics & precision agriculture automation in vegetable production

A number of research projects and groups are investigating the future of precision agriculture on Australian farms, these include:

- The precision agriculture research group at UNE
- PIRSA in south Australia
- Precision in Queensland vegetable systems
- CSIRO
- The University of Sydney
- Australian farm institute
- GRDC and the grains industry

Improving soilborne disease diagnostic capacity for the Australian vegetable industry and A multi-faceted approach to soilborne disease management

VG15009 & VG15010

Using world-leading DNA testing technology to provide growers with a way to assess the risk of soilborne diseases caused by select pathogens prior to planting. This knowledge, when applied with sound disease and soil health management strategies, will contribute to a reduction in the losses from soil-borne diseases.

This project considered a range of vegetable commodities for most impact and value, with a focus on three key areas of investigation; pre-planting soil tests for disease risk & soil health indicators, risk thresholds, management options & validation of tools and soil sampling strategies.

Adoption of precision systems technology in vegetable production

VG16009

This project is responsible for developing case-study farms in each state for research and extension – including training events and field days – and will develop video and fact-sheet resources to showcase potential applications of relevant precision technologies.

Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry

VG13004

This project is to build knowledge of endemic and exotic sweetpotato viruses, and improve sweetpotato virus diagnostic capacity in Australia. It has a number of key goals and activities, including reviewing current information on viruses and diagnostic techniques; conducting annual virus surveys and planting-bed monitoring in major growing regions; developing and implanting virus diagnostics; and communicating project-specific information via field walks, workshops, fact sheets and guides.

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Area wide management of vegetable diseases: viruses and bacteria

VG16086

This project will be responsible for developing an 'area wide management' (AWM) strategy to address high-priority viral and bacterial diseases affecting vegetable crops. This strategy will include viral diseases transmitted by thrips, aphid and whitefly pests, and phytoplasmas transmitted by leafhoppers, and will involve pest management approaches.

Optimising cover cropping for the Australian vegetable industry

VG16068

Supporting Australian vegetable growers in effectively using cover crops to boost soil health and reap productivity benefits. This project is building on existing cover crop trial sites and establishing new ones to explore the how, why and when to best use cover crops across Australia's main vegetable growing regions.

Pathogen persistence from paddock to plate

VG16042

The Fresh Produce Safety Centre

This project will determine look at pre-harvest water and untreated animal manure withholding periods in relation to minimising or eliminating the risk of microbial contamination of high-risk vegetable crops. It will help growers use untreated manures and pre-harvest water confidently, with proven exclusion periods, without compromising the safety of their products.

Nitrogen use efficiency tools for farmers

Research paper

Nitrogen use efficiency (NUE%) calculator was developed to engage with cropping farmers and advisors on reducing nitrogen (N) losses from crop production.

The calculator utilises the 'partial nitrogen balance' (or 'output-input ratio') method to calculate NUE% for an individual crop, a rotation or a whole farm. It also enables estimating the monetary value of potentially unused mineral and organic nitrogen fertiliser.

Sustainable Phosphorous futures

RIRDC report - Adapting to future phosphorus scarcity

Without adaptation to the way phosphorus is used and managed, global phosphorus scarcity could constrain Australian food production and global food security. As an essential nutrient in fertilisers for food production, phosphorus has no substitute. Australia and the world are currently dependent on phosphorus from finite phosphate rock reserves, which are becoming more expensive, scarce, difficult to access and geopolitically concentrated in only a few countries. Limited research exists to help understand and explore the regional implications of phosphorus scarcity and inform adaptation in Australia and other countries.

Optimising benefits of vermiculture in commercial-scale vegetable farms - VG15037

Investigating the use of commercial-scale vermiculture in the Australian vegetable industry to improve productivity (with vermiculture the cultivation of earthworms to convert organic waste into compost and/or for direct soil integration and management). Its end-goal is to develop guidelines for the use of vermiculture as part of soil and nutrient management, and provide a cost/benefit analysis to help growers decide whether to adopt the approach.



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Gather information regarding site conditions, crops, and results from soil, sap, leaf and water tests to inform nutrient budgets and a crop nutrition program

Step 2: Assess your practices and risks

Complete the on-line EnviroVeg self-assessment. The report will identify critical risks and recommendations for actions/practices to implement.

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a crop nutrition management plan/program and review and revise it regularly. Use the EnviroVeg action planning template. Incorporate into the crop nutrition management

program relevant recommended practices outlined in Part one

Step 4: Monitor performance measures/indicators

The effectiveness of the crop nutrition program and fertiliser/soil amendment management practices can be monitored through:

- Fertiliser and soil amendment applications (kg nutrients applied/ha)
- Soil nutrient levels (mg/kg and or kg/ha) in top and subsoil
- Yields (t/ha)
- Nitrogen use efficiency (NUE %)
- Rainfall (date and mm)
- Irrigation (date and mm)

To monitor for heavy metals including trace elements, other contaminants or human pathogens in soils or water ways:

- Monitor / test for heavy metals and/or trace elements in amendments / soils / water supplies / waterways (mg/kg or ppb)
- Ensure human pathogen levels in water used to irrigate or wash vegetables are within food safety guidelines
- Test soil and/or water for other contaminants including pesticides, if there has been an event that has most likely caused contamination e.g. floods. Use the Australia/New Zealand Guidelines for Fresh and Marine Water Quality (2000) to compare results with target levels, which may vary depending on how the water will be used e.g. ecosystems, human consumption, recreation, agriculture (irrigation and stock water)

Monitor surface water quality/test the nutrient levels in waterways (mg/l or ppb): these should comply with current Australia/New Zealand Guidelines for Fresh and Marine Water Quality (2000) – aquatic ecosystems.



Monitor vegetation condition and changes (as per local score card, if available)

Monitor threatened species and changes (as per local score card, if available)

To monitor regulated inputs

Follow monitoring programs required under licence/approvals and food safety guidelines

To monitor for potential off-site movement of nutrients, record:

- Erosion events (date and intensity of soil loss)
- Rainfall (date and mm)
- Irrigation (date and mm)

Step 5: Keep records

Records that should be kept by vegetable producers include:

Staff training records around handling and management of fertilisers and soil amendments.

Storage

- Farm plan identifying sensitive areas and storage sites for fertilisers/soil amendments
- Records of annual assessment of maintenance and security of storage sites
- Safety Data Sheets, or appropriate safety information if SDS not available for the product, for all fertilisers and soil amendments stored on site

Application

- Nutrient management plan, including nutrient budget and nutrient use efficiency information
- Results of soil/leaf/petiole/water tests
- Material Safety Data sheets or appropriate safety information if MSDS not available for the product

Records of all applications of fertilisers/soil amendments (Freshcare form E5), noting;

- application date,
- location (block names and crops),
- product used
- rate of application per hectare
- wind speed and direction
- method of application/incorporation/placement
- name and signature of the person applying the fertilisers and soil additives.

Fertiliser/soil amendment application equipment calibration records

- Description of method and calibration results

- Date of calibration
 - Name of person calibrating the equipment.
- Hydroponic nutrient solution monitoring record, if applicable (Freshcare form E5)

Soil amendment test results/certificates detailing presence of heavy metals and other potential contaminants (e.g. pesticide residues).

Results of monitoring programs, including water quality testing, biodiversity, native vegetation condition, status of threatened species.

Farm diary records if a risk of soil contamination due to erosion has been identified.

Certifications/licence/approvals from EPA/ other government agencies regarding regulated fertilisers, soil amendments, wastewater or biosolids - and associated management plans if required.

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed;

- Fertiliser and soil amendment applications?
- Soil nutrient levels?
- Water availability?

Connect with like-minded producers, network and discuss your ideas;

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is @EnviroVeg

Come to EnviroVeg events, ask questions of other growers about their practices



PART THREE: RESOURCES AND FURTHER INFORMATION

Advisors and service providers

[Fertiliser Australia](#) - Maintains a directory of accredited nutrition advisors and contractors

General information

[SoilWealth website](#)

[FertCare](#)

For information on crop nutrition management, also contact your state government department of agriculture

[Healthy Soils for Sustainable Vegetable Farms](#)

[Australian Organic Standard \(ACOS\) 2017](#)

[National Association for Sustainable Agriculture](#)

Testing

[National Association of Testing Authorities](#)

Soil, plant and water testing services can be found on the [ASPAC website: Australian Soil and Plant Analysis Council](#)

[Accu-Spread](#) - Independent testing and accreditation of fertiliser spreading equipment for accuracy and evenness of spreading.

[Australian Soil and Plant Analysis Council](#) - An independent international organisation consisting of individuals, laboratories, research and commercial organisations involved in soil and plant tissue analysis

[Soil Testing and Interpretation for Vegetable Crops: A guide](#)

Biodiversity

[Australian Worm Growers Association Vermiculture Inc.](#) Provides information on earthworm behaviour, and species found in horticultural areas

Compost

DPI NSW - [dpi.nsw.gov.au](#)
(search 'compost factsheets')

Mapping and data

[CSIRO, the Australian Soil Resource Information System](#) - Provides online information on soil features including soil types, landforms, soil depth, water storage, permeability, fertility, carbon and erodibility

Monitoring tools

[Reid and Cox \(2005\). Soil biology testing.](#)
Department of Primary Industries (NSW)

[Fertiliser Australia. Cracking the nutrient code](#)
Provides information on benefits and risks of fertiliser use, responsible management practices, monitoring tools and accreditation programs

Nutrition

[Growcom's Water for Profit program](#)
Fact sheets include information on fertigation

Legislation

Commonwealth, State and Territory legislation:

- Commonwealth - [comlaw.gov.au](#)
- Australasian Legal Institute - [austlii.edu.au](#)
- Australian Law Portal (National Library of Australia) - [nla.gov.au/oz/law.html](#)

Environmental legislation:

- Environmental Defenders Offices - [edo.org.au](#)

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

FIGURE 2: WHAT ARE SOIL AMENDMENTS?

“Soil amendments” are any chemical, biological, or physical materials intentionally added to the soil to improve the chemical, physical or biological condition of the soil in relation to plant growth or to improve the capacity of the soil to hold water. “Biological soil amendments of animal origin” are biological soil amendments, which consist, in whole or in part, of materials of animal origin, such as manure or non-faecal animal by-products, or table waste, alone or in combination. The following table lists the main soil amendments used on farms as soil conditioners or fertilisers.

Organic material/term	Description
Soil amendment	Organic (biological) inputs to soils used to supply nutrients (as fertiliser) and or improve the biological, chemical or physical condition of the soil (soil conditioner). The inputs can be in solid, sludge/slurry or liquid form.
Soil conditioner	Composted or pasteurised organic material including vermicast, manure and mushroom substrate that is suitable for adding to soils. This term also includes “soil amendment”, “soil additive”, “soil improver” and similar terms, but excludes polymers that do not biodegrade such as plastics, rubbers and coatings. Soil conditioners may be either “composted soil conditioners” or “pasteurised soil conditioners”. Soil conditioner has not more than 20% by mass of particles with a maximum size above 16mm and results in beneficial effects. This term also includes “soil amendment”, “soil additive”, “soil improver” and similar terms, but excludes polymers which do not biodegrade such as plastics, rubbers and coatings.
Fertiliser	Any material of natural or synthetic origin (other than liming materials) that is applied to soils or to plants (usually the canopy) to supply one or more plant nutrients essential to their growth.
Compost	All types of recycled, organic materials, which are completely decomposed (biodegraded, rotted, humified) so that they are amorphous i.e. without a cellular structure characteristic of plants or animals. During the correct composting process, organic materials are pasteurised, microbially transformed and stabilised under aerobic and thermophilic conditions for a period of not less than 6 weeks. Composts are destined for use as soil amendment, either as a fertiliser because of their nutrient content, and/or as soil conditioner because of their positive effect on soil structure, biology and chemistry (in addition to the nutrient value). The Australian Standard AS4454 (2012) applies to composts, soils conditioners and mulches; it includes specified levels of maturity (pasteurisation and stabilisation) requirements including their relationship to quality assurance schemes for agricultural produce.
Compost maturity	The degree of decomposition, pasteurisation and stabilisation at which compost is not phytotoxic or exerts negligible phytotoxicity in any plant growing situation when used as directed.
Stable stabilised, stability (of) compost	The degree of decomposition at which the rate of biological activity under conditions favourable for aerobic biodegradation has slowed and microbial respiration will not resurge under altered conditions, such as manipulation of moisture and oxygen levels or temperature.
Pasteurised/sanitised product	An organic product that has undergone pasteurisation but is relatively immature and lacking in stability. (Pasteurisation is a process whereby organic materials are treated to significantly reduce the numbers of plant and animal pathogens and plant propagules.)
Vermicompost	Material that is egested from earthworms as casts then further decomposed and matured in a vermicomposting system.
Mulch	Any pasteurised or composted organic product (excluding polymers which do not biodegrade such as plastics, rubbers and coatings) that is suitable for placing on soil surfaces. Fine mulch has more than 20% but less than 70% by mass of its particles with a maximum size above 16mm. Mulch has at least 70% by mass of its particles with a maximum size of greater than 16mm.
Manures	Animal excrement (urine, dung) which may contain various amounts of bedding such as sawdust, tree bark or straw.
Manure slurry	Animal excrement and water with only small amounts of bedding.

Source: catchmentsolutions.com.au/files/2014/11/IS3-06.pdf



FIGURE 2: WHAT ARE SOIL AMENDMENTS? (Continued)

Organic material/term	Description
Biosolids	Organic solids or sludges produced by municipal sewage treatment processes. Solids become biosolids when they come out of an anaerobic digester or other treatment process and can be beneficially used. Until such solids are suitable for beneficial use they are defined as wastewater solids. The solids content in biosolids should be equal to or greater than 0.5% weight by volume (w/v). The solids component of biosolids is rich in organic matter and essential plant nutrients such as nitrogen and phosphorus. Thus, biosolids can be used as input materials for compost production. The term biosolids does not include untreated wastewater sludges, industrial sludges or the product created via the high temperature incineration of sewage sludge. It should also be noted that many other solid waste materials are not classified as biosolids, e.g. animal manures; food processing or abattoir wastes; solid inorganic wastes; and untreated sewage or untreated wastes from septic systems/sullage wastes.
Recycled organic waste, biowaste	Organic waste (biodegradable waste) is any waste that is capable of undergoing anaerobic or aerobic decomposition (= composting), such as food and organic agricultural waste, paper, cardboard and waste from forestry (sawdust, wood chips) or municipal parks (tree cuttings, branches, grass, leaves - with the exception of street sweepings), and other wood waste not treated with heavy metals, pesticides or organic compounds, textiles made from natural fibres.
Municipal Solid Waste	Solid waste from households that is not necessarily made up entirely of organic materials.
Compost extract	The filtered product of compost mixed with any solvent (usually water), but not fermented. This term has been used in the past to define water extracts prepared using a very wide range of different methods. In the past, the terms "compost extract", "watery fermented compost extract", "amended extract", "compost steepage" and "compost slurry" have all been used to refer to non-aerated fermentations. "Compost extract", "watery fermented compost extract" and "steepages" are approximate synonyms defined as a 1:5 to 1:10 (v:v) ratio of compost to water that is fermented without stirring at room temperature for a defined length of time. "Amended extracts" are compost extracts that have been fermented with the addition of specific nutrients or microorganisms prior to application.
Compost tea	The product of showering recirculated water through a porous bag of compost suspended over an open tank with the intention of maintaining aerobic conditions. The product of this method has also been termed "aerated compost tea" and "organic tea". In the past, the term "compost tea" has not always been associated with an aerated fermentation process. It is important to distinguish between compost teas prepared using aerated and non-aerated processes, therefore the terms aerated compost tea (ACT) and non aerated compost tea (NCT) are used in this review to refer to the two dominant compost fermentation methods. ACT will refer to any method in which the water extract is actively aerated during the fermentation process. NCT will refer to methods where the water extract is not aerated or receives minimal aeration during fermentation apart from during the initial mixing.
Organic biostimulants	The definition is still evolving: any substance or microorganism, in the form in which it is supplied to plants, seeds or the root environment with the intention to stimulate natural processes of plants benefiting nutrient use efficiency and/or tolerance to abiotic stress, regardless of its nutrient content, or any combination of such substances and/or microorganisms intended for this use.
Organic pesticides	Organic pesticides are substances that can be used in organic production under the relevant standard or code. They tend to have natural substances like soaps, lime sulphur, copper or hydrogen peroxide as ingredients. Not all naturally occurring substances that can control pests and disease are allowed in organic agriculture.
Biological crop protectants / Biocides	Types of pesticides derived from natural materials such as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. Main groups are: microbial pesticides, Plant-Incorporated-Protectants (PIPs) and biochemical pesticides.

Source: catchmentsolutions.com.au/files/2014/11/IS3-06.pdf



WATER



PART ONE: MANAGEMENT GUIDELINES

Context

Water is an essential resource for producing high quality vegetables. Careful management of water sources and irrigation in vegetable production systems underpins optimal productivity and product quality.

Water is also essential to every aspect of life. Producers, therefore, have a particular responsibility to ensure their water use and management is efficient and sustainable, and contributes to the conservation of water resources, the maintenance of clean water and the health of natural systems.

The extraction and use of water is closely regulated by most state governments to achieve a balance between consumptive uses and the needs of the environment. Water management is also a key theme in river catchment management frameworks.

Business benefits

Optimising efficiency of water use is integral to achieving profitability in vegetable production businesses. Efforts to protect the health of local waterways and ecosystems usually contribute to production efficiencies as well.

Scope

This section considers each of the key aspects of water management in vegetable production systems, including water sources, water application/irrigation, irrigation water quality, produce washing water, waste water and run-off, and the maintenance of healthy waterways.

It addresses matters of legal compliance, water use efficiency, and the protection of natural environments such as water ways and wetlands. All potential **water sources** that may be used for vegetable production are included, such as watercourses, ground water, rain/surface water, irrigation scheme water and treated, recycled or

desalinated water. The **implications of climate change** for water access and management in vegetable production systems are also considered.

Management objectives

Ensure that run-off and waste water is managed responsibly and its release from the production site does not contribute to pollution or cause other environmental harm.

Ensure that the implications of climate change are considered when planning for the management of water resources within the vegetable production system.

Ensure that water management in vegetable production systems recognises and makes a positive contribution to the diverse values placed on water in the community, for drinking, productive use, recreation, scenic amenity and the maintenance of biodiversity.

Ensure that water used for vegetable production does not contribute to pollution or cause other environmental harm, including soil degradation, loss of biodiversity or impacts on groundwater or aquatic ecosystems.

Ensure that water for vegetable production and washing/packing is stored and used as efficiently as possible.

Ensure that all extractions, storage, use and release of water for vegetable production are environmentally sustainable, comply with legal requirements (including health and safety regulations), and meet reasonable community expectations.



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E6. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

E6.1 Manage water use on the property

1. A Water Management Program is documented and must include:
 - Date developed;
 - Name of the person documenting the Program;
 - Water resources available;
 - Crop water requirements;
 - Water budget;
 - Irrigation method;
 - Irrigation program including justification and schedule contingency plans if water resources are unavailable.
2. Irrigation requirements are determined using soil/ growing medium, crop or weather monitoring methods, or a combination thereof.
3. Irrigation systems are checked and maintained for operational efficiency.
4. Water efficiency must be considered in the selection and design of new irrigation systems and water storages.

5. The Water Management Program is reviewed and updated at least annually. The name of the person completing the review and the date of the review are documented.

E6.2 Water is harvested, extracted, stored, used and discharged in accordance with licences and permits

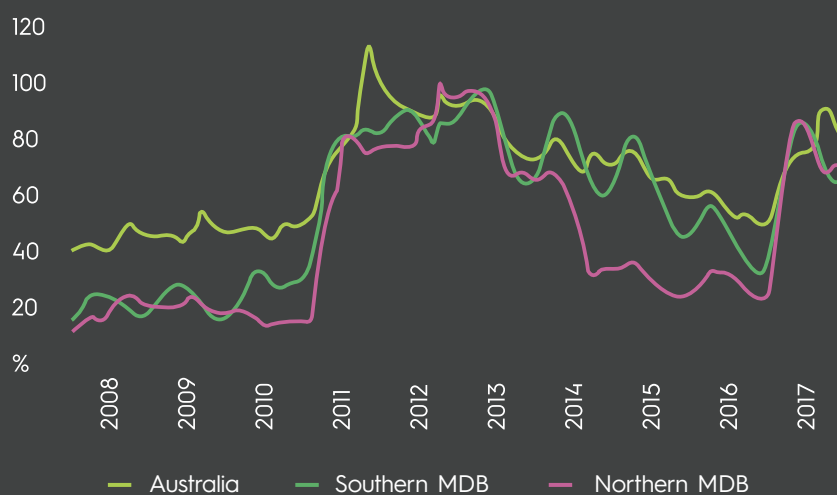
1. Applicable licences and permits for infrastructure and activities in water harvesting, extraction, storage, use and discharge are current.
2. Water licences and permits are adhered to.

E6.3 Manage water to minimise environmental harm

1. Water used for irrigation is assessed for risk of causing soil degradation by increasing soil salinity, soil acidity, soil alkalinity or soil sodicity.
2. Water that may cause soil degradation is, where possible, treated before use or managed to avoid soil degradation.
3. Water runoff or water discharge from property activities is managed or treated to minimise environmental harm on and off-site.
4. Strategies are implemented to prevent contamination and sedimentation of water sources.

FIGURE 1: WATER STORAGE IN AUSTRALIA

Storage levels increased from 50 per cent to 79 per cent at the end of 2016-17, reflecting improved seasonal conditions during that period. This was most evident in the northern Murray-Darling Basin (MDB), where storage levels increased from 24 per cent to 70 per cent. Storage volumes in the southern MDB increased from 38 per cent to 67 per cent. This was the first time since 30 June 2012 that storage levels in the MDB closed higher than the previous year.



Source: ABARES Australian Water Markets Report 2016-17, accessed June 2018.

KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Legal entitlement to take water from regulated sources is not understood or complied with and/or take of water from regulated sources exceeds allocation	- Negative impacts on water quality and aquatic habitats - Reduced river flows or hydraulic balance, also impacting local or downstream water users - Prosecution/fines
Water entitlement is insufficient to meet crop requirements	Change to business practices: crop selection, reduction in volume/scale of production, adjustment to irrigation schedule or investment in other water sources
Seasonal water allocation/availability is insufficient to meet crop requirements	- Reduced yield - Impact on quality
Poor water storage infrastructure leads to high evaporative or leakage losses	- Leakage from water storages may impact ground water systems or change salt balance in soils - Reduced availability of water for production
Water distribution and/or irrigation systems do not operate at optimal levels of efficiency or to design specifications	- Increased water demand from natural systems/water sources - Increased risk of soil degradation and run-off/leaching of nutrients and pesticides to surrounding environment - Reduced productivity - Increased costs of production
Irrigation practices do not take into account the characteristics and water holding capacity of soils	- Increased risk of soil degradation and run-off/leaching of nutrients and pesticides to surrounding environment - Poor irrigation efficiency
Excessive water is applied to crops	- Increased water demand from natural systems/water sources - Increased risk of soil degradation and run-off/leaching of nutrients and pesticides to surrounding environment - Reduced yield - Reduced crop quality
Poor quality water is applied to crops	- May contribute to soil and/or groundwater degradation and vegetation loss - Reduced yield/crop quality - May corrode/block irrigation pipes/nozzles

KEY HAZARDS AND RISKS (CONTINUED)

Hazards	Risks	Environmental	Business
Reclaimed water that is insufficiently treated is applied to crops	Potential for release of contaminated water to the environment	May impact yield/quality or contaminate crops	Fines/penalties
Fertigation systems/equipment are not operated correctly or do not operate efficiently or to design specifications	Increased risk of soil degradation and run-off/leaching of nutrients to surrounding ground and surface water	Increased costs of production	Reduced yield/quality

FIGURE 2: CLIMATE CHANGE IMPLICATIONS

Location	Projection	Management response
Northern Australia	Natural climate variability, including distinct wet and dry seasons, likely to remain the major driver of rainfall over the next few decades. A larger proportion of rainfall is likely to fall during extreme weather events.	Respond to climate variability; e.g. reviews of water plans and allocations evaluated annually and adjusted depending on the seasonal and annual outlooks, and carryover or reserve policies.
Southwest/Southern Australia	The observed drying trend, particularly during the cool season, is expected to continue. This includes; • more rain falling over the ocean rather than the southern part of Australia, • the possibility that the traditional ‘filling season’ for water supply systems will become less reliable, and replenishment of water may be more dependent on spring and summer rainfall events, and • further reductions in rainfall and runoff and increases in drought.	Decisions based on climate change projections; Future water availability revised downward to drive water efficiency measures and explore possible new water sources.
Southeast/ Eastern Australia	Natural climate variability, including the occurrence of extreme droughts, likely to remain the major driver of rainfall changes for the next few decades. Late in the century, cool season rainfall is expected to decline. In Eastern Australia: • projections of rainfall change are the most uncertain of any broad region of Australia, • there is medium agreement from climate models for substantial annual rainfall reductions by 2090 under a high emissions scenario, driven largely by rainfall declines in winter and spring, • there is high confidence in projections of an increase in the intensity of extreme rainfall events, with a larger proportion of rainfall occurring during these extreme events.	Adaptive responses across a wide range of possible climate futures. E.g. include adaptive planning cycles with review provisions, flexible water allocations informed by seasonal and annual outlooks, supporting an active water market and triggers for managing extreme drought. Future water availability may need to be revised downward.

Source: Australian Department of Agriculture and Water Resources, *Considering Climate Change and Extreme Events in Water Planning and Management* (2017). For more detail (including region specific initiatives and projections) see the *Climate Change tools and initiatives* component under; Part three - references and resources



RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices into your water management program and/or environmental action plan.

Access appropriate water sources to meet the water volume and quality requirements for the production system. Ensure compliance with all legal requirements for any water accessed from regulated sources

Consider all potential water sources and the quality and reliability of water from these sources

Review climate projections and seasonal forecasts to check how these may influence anticipated sources and supplies of water

Prepare a contingency plan for the event that there is an undersupply of water

Follow all necessary procedures to attain legal entitlement to access all water sources used on the property. Ensure you understand the regulation of water take in your catchment, which may include waterways, ground water and farm dams

Check if permits are required for construction of farm dams or interference with a waterway/obstruction of flow

Follow all necessary procedures to comply with the conditions of entitlement to water resources and the seasonal allocation of water supply

Consider the reliability of seasonal water access/ allocation and the timing of water delivery/ availability as a key factor in determining the irrigation strategies/systems that can be used

To reduce demand on fresh water supplies, consider accessing alternate water sources, such as recycled/reclaimed/treated waste water if available in your production area:

- Obtain certification of the quality and chemical/biological parameters of the recycled water
- Ensure you understand and comply with the health regulations, safety issues and food safety requirements that apply to the use of the recycled water
- Prepare a risk management plan, if required, to guide the use of recycled water on the property and avoid impacts on human health or the environment.

Assess all opportunities to collect and store rainwater runoff from over-land flows or roof tops and other hard surfaces on the property.

- Ensure the collection and storage of rainwater or runoff water on the property complies with water regulations in place in your catchment and the business applies for and adheres to permits or entitlements for water capture.

Consider establishing a water recycling system to capture, treat and re-use water from the property/ greenhouse production systems and produce washing facilities.

Prepare a detailed water budget

Prepare a water budget that defines the amount of water that is expected to be sourced over the season, matched with the intended irrigated crop area to ensure the planned irrigation needs are within water entitlements and available supply.

Determine and regularly review the total volume of water required for the vegetable production system

Research and calculate the volume of water required to produce the yield and quality of crops planned for production each season. Consider all water needs, including crop water requirements, irrigation for cooling, water use in the harvesting/ packing process as well as other uses of water on the property such as biosecurity wash-down facilities or leaching fraction for flushing soil salinity

Consider ways to save water on site

Ensure efficient storage and distribution of water supply

Reduce evaporation of water from water storages and distribution channels

- Water storages should be lined and capped where feasible
- Implement closed or lined distribution systems rather than open channels where feasible
- Establish native vegetation to shade dams and waterways and reduce evaporative losses, though avoid vegetation in areas that could cause leakage or failure of the storage or delivery system.

Minimise leaks from dams, tanks, channels, pipes and joints. Maintain a program to regularly check for leaks and repair leaks promptly.



Ensure efficient storage and distribution of water supply (continued)

Consider **Aquifer Storage and Recovery (ASR)** to reduce evaporation losses from groundwater

Monitor the physical condition of on-farm water distribution system(s)

Monitor/regularly **test the efficiency of on-farm water distribution system(s)**

Achieve efficient and sustainable use of water

Improve the **water holding capacity of soils** and **reduce evaporative losses** through the use of mulches and/or through other techniques

Seek professional advice for the design and installation of **irrigation/water application systems**

- The chosen system must be designed to accurately match soil types and plant water demand as well as protect the environment
- Pressurised irrigation systems enable more efficient and accurate application of water than flood/furrow systems
- Drip systems achieve more effective minimisation of evaporation than sprinkler systems
- Establish a regular maintenance program to check and service the irrigation system and make repairs as needed
- Regularly inspect the physical condition of your irrigation/application system(s)
- Ensure your irrigation/water application system(s) are operating at the design pressure in the field/greenhouse. Check for variation in flows and pressure
- Check that sprinklers, drippers, filters and pumps are operating effectively and efficiently
- Check and repair cuts, blockages or leaks
- Ensure the irrigation/application system(s) apply water evenly within/across the block.

Ensure the **irrigation/water application system** delivers only the water needed by the crop, when it is needed and at the rate it is needed. **Schedule irrigation** using objective monitoring methods

- Monitor the rate of water applied by your irrigation system (ie mm/hr or L/hr)
- Closely match your irrigation interval and volume applied with crop requirements and soil limitations
- Modify irrigation application in response to weather conditions
- Use **soil moisture monitoring tools** and

calibrate monitoring equipment at least annually (see section 2)

- **Soil moisture monitoring** systems that track and graph soil moisture over time support planning for future irrigation
- Monitor if irrigation practices are causing **surface water run-off or any changes in groundwater levels.**

Coordinate irrigation practices with other farming system operations as far as possible

Measure, record and compare/benchmark crop yield, quality, returns and the volume of water applied

Optimise the efficiency of water use for produce washing/cleaning

- Use air cleaning if appropriate/feasible
- Use water-efficient sprayers
- Use high pressure cleaners for machinery
- Collect and treat wash water for re-use, if appropriate.

Consider soil characteristics as a key factor in farm water planning

Conduct a comprehensive soil survey to determine soil types and their distribution across the property. Analyse the **water holding capacity of the soils** and any structural, physical and chemical considerations that should be taken into account. Key measures to consider in the water planning process include:

- **Readily Available Water (RAW)** – the water component that can be readily used by the crop under ideal growing conditions
- **Soil infiltration rate** – the speed at which water can move through the soil, which is related to soil texture, bulk density, organic matter, soil surface stability and groundcover. This determines the maximum rate at which irrigation should be applied.

Soils with similar characteristics can be grouped into the same irrigation management area, based on the amount and rate at which irrigation water can be applied.

Use the soil survey to select representative sites for soil moisture monitoring.

Manage and monitor the **quality of water** used for crop production

Obtain certification of the quality of water supplied to the property, if available

Monitor the quality of water accessed from all sources used at the property for crop production and washing of produce prior to packing

- Maintain a water quality testing regime/schedule that reflects the level of risk associated with the water supply/source. Annual **water quality testing** is a minimum standard
- Use **professional water quality testing services**. Water quality tests should include microbes, chemicals, heavy metals (see section 2).

Ensure that the water used for vegetable production and washing meets all **relevant standards** for crop health, human health, food safety and the environment

- If required, filter and treat any water to be used for washing produce or irrigation of crops until it meets required water quality standards.

Manage farming activities to minimise risk of contaminating water held in on-farm storages

- Maintain practices that minimise soil erosion on the property
- Maintain practices that minimise off-target movement of pesticides and fertilisers
- Prevent pollution by stock or human waste
- Filter all runoff likely to reach irrigation water storages in sumps, settling ponds or grassed channels to trap sediments and nutrients and help to break down pollutants.

Ensure water use and management avoids **pollution of water storages, waterways or groundwater**

Maintain appropriate soil, nutrient, irrigation and pest management practices to reduce the risk of sediments, nutrients or pesticides being carried offsite to waterways, groundwater or sensitive environments

Coordinate irrigation with chemical application (pesticides and fertilisers) to minimise runoff of chemicals to water supplies, waterways or groundwater

Filter all runoff likely to reach waterways, areas of native vegetation or water storages in sumps, settling ponds or grassed channels to trap sediments, nutrients and break down pollutants

Dispose of waste water responsibly

Check if discharge of waste water from the property requires a permit

Waste water to be released from the property may **require treatment** to meet standards set out in **water quality guidelines**

If disposal of waste water is not permitted in your catchment, find an **alternate means of safe disposal**.

Protect and enhance aquatic habitats and biodiversity

Establish **native vegetation buffers** around water storages to optimise their habitat values and to increase on-farm biodiversity

Retain logs, snags and rocks in and around dams to provide nesting, burrowing and roosting sites

Protect the **stability of waterways**, in particular, river/creek banks to minimize the risk of erosion

Consider options to collect and re-use water

Taking into account legal, technical, fit for purpose and treatment needs, assess opportunities to **capture water from central infrastructure** such as houses, sheds, offices, greenhouses, or from cropping areas or below plant roots

Re-use wash water where possible and where water quality requirements are met

“Water is the driving force of all nature”
– Leonardo da Vinci

EXPECTED OUTCOMES

Improved water management practice outcomes expected to be achieved through implementing these practices include;

Within 1-5 years

- Water use complies with regulatory requirements
- Vegetated buffer strips are established to protect waterways
- Irrigation systems are designed and maintained to meet appropriate standards and optimise water use efficiency
- Water is recycled where possible
- Irrigation scheduling is guided by monitoring of plants, soil, rainfall, temperature and evapotranspiration
- Irrigation systems are monitored to ensure optimal performance through measurement of pressure, flow and distribution uniformity

Longer term outcomes, which may take 5-10 years or more

- Farm water use efficiency is improved, measured by total industry water use (ML)

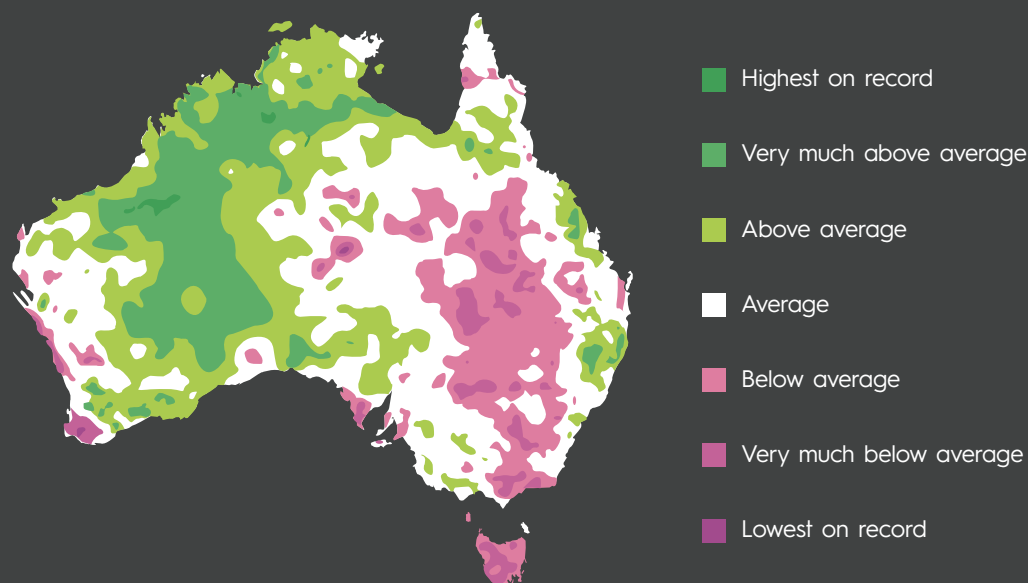
Quality of surface and groundwater leaving farms is improved

Water use in vegetable production systems has minimal off-site impacts on environmental assets

Simple ways to stay informed

- Industry updates
 - [Australian Water Association newsletters](#)
 - [Irrigation Australia eNewsletter](#)
 - [VegNET – extension officers](#)
- Horticulture wide updates
 - [AUSVEG mailing list, including weekly updates](#)
 - [Hort Innovation newsletter](#)
 - [Growcom email subscription](#)
- Government department updates:
 - [Water matters \(Department of Agriculture\)](#)
 - [Environmental Water holder \(Department of Environment\)](#)
 - [Wetlands Australia \(Department of Environment\)](#)
 - [Weekly Australian Climate, Water and Agricultural update \(Department of Agriculture\)](#)
 - [BoM, Enviro news](#)
 - [BoM, Good Practice Guidelines for Water Data Management Policy](#)

FIGURE 3: RAINFALL DECILES JANUARY-JUNE 2017



Source: ABARES Australian Water Markets Report 2016-17, accessed June 2018.

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research	Details
Precision agriculture project Hort Innovation (VG16009)	Case-study farms in each state for research and extension – including training events and field days – and will develop video and fact-sheet resources to showcase potential applications of relevant precision technologies
Robotics and intelligent systems projects Hort Innovation (VG15003 and VG15059)	Using the well-known Ladybird and RIPPA robots in both trial-farm and commercial-farm settings, this project is advancing the application of robotics, intelligent sensing systems, precision agriculture automation and more in Australia's vegetable industry. It is developing, evaluating and supporting the commercialisation and adoption of such technologies, with the end goal of increasing industry productivity, particularly in relation to brassica, lettuce and baby leaf growing.
Irrigation projects Hort Innovation (VG14048, VG15009)	Using world-leading DNA testing technology to provide growers with a way to assess the risk of soilborne diseases caused by select pathogens prior to planting. This knowledge, when applied with sound disease and soil health management strategies, will contribute to a reduction in the losses from soil-borne diseases. The project has close links with <i>A multi-faceted approach to soilborne disease management</i> (VG15010).
Micro-controller glasshouse irrigation controllers Research - USA	Aims at developing an automatic fertilized-irrigation control and management system for the improvement of soil porosity and nutrient by timely application of fertilizer and water level required for the crop's growth and development. This will metabolise the soil texture, give the nutrient to the crops, build plant tissue as well as increase the rate of crop productivity.
Glasshouse humidity and temperature control for greater energy management CSIRO Project	Developing new technologies and systems which intelligently manage the way energy is used, transmitted and generated in order to reduce greenhouse gas emissions, minimise energy consumption and save money. This project may result in lower irrigation demand.
Use of satellite and drone based sensing to provide rapid soil moisture information	Many projects in this area including from; Deakin university, Grains Research Development Corporation, commercial research in USA and many others.
Use of EM deep penetration technology for mapping of groundwater salinity	This may assist more effective access to best water quality, see information from; Department of Agriculture and Commercial research.
Use of regional-scale climate projections and regional climate change adaptation plans	For example, in South Australia, regional climate analogues are being linked with water allocation policy and planning in region, and there is an expectation of reduced water availability and an increased reliance on recycled water.

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research	Details
Increased emphasis on planning for production with insufficient water resources or restricted allocation	Particularly in the context of climate change driving an increase in drought conditions; increased use of deficit irrigation strategies. Allocations will change to take this into account, and there will be further commercial research.
Increased availability of waste water for horticultural production	Case Study: Northern Adelaide Plains – SA Water.
Desalination technology – ground breaking technology is close	Reduce energy inputs by 90% meaning cheap water production on farm. Brine management and disposal continues to be an issue.
Future hyperspectral satellite mapping capability Enmap	Future monitoring and characterising the Earth’s environment on a global scale. EnMAP serves to measure and model key dynamic processes of the Earth’s ecosystems by extracting geochemical, biochemical and biophysical parameters, which provide information on the status and evolution of various terrestrial and aquatic ecosystems.

FIGURE 4: CONSIDER WAYS TO SAVE WATER ON SITE

Consider	Options
Water Use Efficiency	Review the efficiencies of your current irrigation systems and consider the economic benefits of upgrading to a more efficient system. This case study found that converting to a centre pivot from a travelling system (sweetcorn crop in NSW) delivered a net benefit from yield and quality improvements of \$565.00/ha.
Technology used in irrigation systems	The right irrigation technology differs based on the class of water used incorporating; trace elements, salinity, pathogens, suspended solids and the many variables outside of water conditions. Therefore, there is no definitive system of irrigation for vegetable production. A good place to start is this report on irrigation technology in vegetable production.
Irrigation Scheduling	Good irrigation scheduling leads to good irrigation management. The main technologies used in Australia are broadly categorised into ‘intuition’; weather-based and water budget systems; simple tools; and electronic irrigation systems. Review this report on the scheduling techniques broadly used in Australia.
Sustainable water sources	Could you use recycled water or reclaimed water and what would the implications of this be? Some ways this could be achieved include; water recycled from treated sewage, collecting and recycling runoff for irrigation, recycling water for produce washing. Review this factsheet for more details.
Be responsible	Use efficient practices and appliances e.g tap fittings and storage facilities. Turn off the tap when you have finished, consider using methods that don’t require water and work with your team to identify further ideas for saving water.

Source: Australian Department of Agriculture and Water Resources, Considering Climate Change and Extreme Events in Water Planning and Management (2017). For more detail (including region specific initiatives and projections) see the Climate Change tools and initiatives component under; Part three - references and resources



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Soils information

- Soil types and their distribution across the property
- Water holding capacity of each soil type
- Structural, physical and chemical considerations
- Readily Available Water (RAW)
- Soil infiltration rate.

Total volume of water required for the vegetable production system

Total available water

Step 2: Assess your risks

Complete the on-line [EnviroVeg self-assessment](#)

The report will identify critical risks and recommendations for actions/practices to implement

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a water management plan/program and review and revise it annually

Use the [EnviroVeg action planning template](#)

Incorporate into the water management program relevant recommended practices outlined in Part 1, in particular:

- Ensure all water accessed complies with legal requirements
- Prepare a water budget
- Optimise water use efficiency and water re-use
- Manage quality of water inputs and discharges.

Step 4: Monitor performance measures/indicators

Performance indicators for water management in vegetable production systems may include:

Irrigation system performance

- Visual inspection of irrigation system and crop performance
- Discharge of flow rate variation
- Water output and distribution uniformity against manufacturer's specifications
- Pressure variation
- Problem in dripper lines (cuts, blockages, leaks)
- Sprinkler/dripper malfunction
- Filters
- Pumps.

Drainage / runoff water quality monitoring to check for nutrient loss

Rate of water applied by the irrigation system (e.g. mm/hr or kL/hr or mm/ha/shift)



Crop yield/quality/returns against the volume of water applied

- Gross income per megalitre of water applied
- Production water use efficiency (tonnes produce per megalitre of water applied).

Storage efficiency of farm dams (change in water depth measured in periods when there is no inflow, outflow or rainfall).

Try the 'Ready rekenor' tool

Groundwater level monitoring

Step 5: Keep records

Records that should be kept by vegetable producers include:

Property map, identifying soil types, erosion areas or erosion potential

Annual water budget, daily water budgets – record irrigation schedules, amount of water applied, rainfall, soil moisture and crop evapotranspiration

Farm diary

- Soil additives/fertiliser (remedial and fertigation) application amounts recorded.
- Spray diary.

Management strategy for riparian zone

Risk management plan, if required, to guide the use of recycled water on the property

Water management program (Freshcare form E6), noting:

- Date developed
- Name of the person documenting the Program
- Water resources available
- Crop water requirements
- Water budget
- Irrigation method
- Irrigation program including justification and schedule
- Contingency plans if water resources are unavailable.

Soil test reports

Water authority delivery notices

Water licenses and permits

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field.

Compare against previous records, and ask what has changed;

- Water use, quality, availability, delivery systems?
- Soil types?
- Legal requirements?
- Crop yield/volume of water applied?

Connect with like-minded producers, network and discuss your ideas;

EnviroVeg members on Social media;

- Join the [EnviroVeg members group on Facebook](#)
- Tweet to EnviroVeg members on Twitter; the program's handle is [@EnviroVeg](#),
- Come to EnviroVeg events, ask questions of other growers about their practices.

PART THREE: REFERENCES AND RESOURCES

GENERAL INFORMATION

For general information about water and waterway management, requirements and targets, contact:

- State or Territory Government agencies for Natural Resources, Environment, Agriculture, Health
- Water authority
- Regional NRM Body
- Council

For information about water resource plans and water entitlements, see your relevant state jurisdiction

- Queensland
- New South Wales
- Victoria, and (MDB)
- Tasmania
- South Australia
- Western Australia
- Northern Territory

Murray Darling Basin Authority

Provides basin-wide strategy, policies and planning. This website provides links to the Water Quality and Salinity Management Plan, Sustainable Rivers Audit and other publications.

Regional natural resource management plans

The 56 NRM regional organisations cover all of Australia and its estuarine and coastal areas. They have all been recognised as regional NRM organisations by the Federal Government as part of the Natural Heritage Trust and its successor programs including the National Landcare Programme.

National Guidelines for Water Recycling

Managing Health and Environmental Risks
Natural Resource Management Ministerial Council Environment Protection and Heritage Council Australian Health Ministers' Conference.
Australian Government 2006.

National Association for Sustainable Agriculture

ADVISORS AND SERVICE PROVIDERS

Irrigation Australia

Provides directory of certified irrigation designers, installers, equipment providers and resources for landholders.

The Australian Water Association (AWA)

Maintains a directory of providers of irrigation, water testing and treatment services.

Recycled Water in Australia

The national initiative for recycled water in horticulture and wider community. This program was decommissioned, but this website provides access to relevant information on use of recycled water in horticulture.

TESTING

National Association of Testing Authorities

Maintains a list of NATA-registered testing laboratories.

TRAINING

For information on training water and waterway management contact:

- NRM Regional Body
- EnviroVeg
- Your State's Department of Primary Industries.

NUTRITION

Post-harvest care of grapevines: **Irrigation and nutrition.**

CSIRO FullStop

Wetting Front Detector to "see" what is happening in the root zone when irrigating soil.



WATERWAY MANAGEMENT FOR HEALTHY ECOSYSTEMS

Australian River Restoration Centre

Holds a range of free resources including fact sheets and guidelines on water quality, biodiversity and waterway management for multiple benefits.

IRRIGATION AND FARM WATER MANAGEMENT

Growcom's Water for Profit program

Fact sheets on crop water use efficiency benchmarks for a number of vegetable crops.

National Program for Sustainable Irrigation (Land and Water Australia)

NPSI was the national research program for irrigated agriculture. This program was completed June 2012, but website provides access to research publications.

Department of Environment and Heritage Protection (QLD) (search 'land management')

Provides information to help irrigators to plan and review irrigation, improve water use efficiency and manage related natural resource issues.

Queensland Government Business Queensland, Rural Water Use Efficiency Initiative

Department of Primary Industries (NSW). Best practice guidelines for growing vegetables (search 'best irrigation practices')

Bureau of Meteorology

Weather forecasts and evaporation data to help you to schedule irrigation.

Department of Primary Industries (VIC) (2005) Using recycled water in horticulture: A grower's guide

A comprehensive guide for growers on the use and management of recycled water for crop production and produce washing. Includes federal and state contacts for guidelines on recycled water use.

Boland, AM., Ziehrl, A. and Beaumont, J. (2002).

Guide to Best Practice in Water Management - Orchard Crops.

Department of Agriculture (NSW) (2003)

Technology and practice for irrigation
in vegetables
Salinity tolerance in irrigated crops
Irrigation technology videos.

Salinity management practice guidelines

Managing root-zone salinity for irrigated horticultural crops in winter rainfall zones of Australia, National Program for Sustainable Irrigation, Land and Water Australia

Irrigation of amenity horticulture with recycled water - Horticulture Australia Ltd

Grape Production Series - Water management for grapes in a drying environment

WATER QUALITY

Australian Government Department of the Environment - Water Quality Improvement Plan

Provides water quality standards for irrigation use, crop growth and waterway health.

Australian and New Zealand guidelines for fresh and marine water quality

Aquatic ecosystems

Primary industries - see Volume 1, Section 4.2

Provides a list of water quality standards for water use and waterway protection.

Also see Volume 3, Section 9.2 - Water quality for irrigation and general use.

Australian Drinking Water Guidelines

Defines safe, good quality water, how it can be achieved and how it can be assured. Guidelines generally follow World Health Organisation guidelines. The ADWG are not mandatory standards, however, they provide a basis for determining the quality of drinking water in Australia.

Department of Primary Industries (NSW). Water quality and testing

Water Quality Guidelines for the Great Barrier Reef Marine Park - Manual found here

Queensland Government ReefWise Farming initiative

Savewater

Water Efficiency Labelling and Standards (WELS) Scheme

A guide to choosing water-efficient appliances.

Water Services Association of Australia

Provides advice on water efficiency of appliances such as dishwashers, showerheads, washing machines, taps, toilet suites and urinals.

Effect of using reclaimed water on soil

health and crop sustainability (2011, SARDI)

WATERWAY MONITORING TOOLS

Waterwatch Australia safety guidelines
(decommissioned/archived May 2013)

WETLAND MANAGEMENT

Wetland Care

Provides information on general wetland management considerations as well as wildlife habitat.

WASTEWATER

Badgery-Parker, J, (2003). Managing wastewater with a wetland. Department of Primary Industries (NSW)

EPA South Australia (2009). Wastewater irrigation management plan (WIMP) - a drafting guide for wastewater irrigators, EPA, SA

SAI Platform (2010). Water Conservation Technical Brief: TB7 - Wastewater Use in Agriculture, Sustainable Agriculture Initiative Platform

Using Recycled Water in Horticulture: A Growers Guide

LEGISLATION

Commonwealth, State and Territory legislation:

Commonwealth
Australasian Legal Institute
Australian Law Portal (National Library of Australia)
ABLIS legal summary.

Environmental legislation:

Environmental Defenders Offices.

CLIMATE CHANGE TOOLS AND INITIATIVES

Regional

South Eastern Australian Climate Initiative (SEACI) (2005-2012)
Victorian Climate Initiative (VicCI) (2013-2016)
NSW/ACT Regional Climate Modelling Project (NARCLIM) (2011, ongoing)
Indian Ocean Climate Initiative (IOCI) (1997-2012)
Selection of future climate projections for Western Australia (ongoing)
Climate Futures for Tasmania (2010-2012)
Queensland's Consistent Climate Scenarios Project (CCS) (2009-2012)

Agreed Climate Change Projections for South Australia (Goyder Institute) (2010-2015).

NATIONAL

WSAA Climate Change Adaption guidelines (Water Services Association of Australia)

Seasonal Streamflow Forecasts (Bureau of Meteorology)

Australian Climate Futures tool

Allows users to access projections information in a range of formats and to display and download datasets, GIS layers, maps and figures from the climate models.

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

AUSVEG

growcom
growing our future

Freshcare

Hort Innovation
VEGETABLE FUND

PESTS, WEEDS AND DISEASES



PART ONE: MANAGEMENT GUIDELINES

Context

The need to manage pests and diseases is common to almost all vegetable production systems. **Pests, weeds and diseases** are any organisms that can cause damage, infections or loss or pose other risks to vegetable crops. Organisms include pest animals (insects, mites, nematodes, slugs, snails, vertebrates), pest plants (weeds) and disease-causing microorganisms (mainly fungi, bacteria, viruses). The challenge for vegetable producers is to manage all pests and diseases in an integrated, cost-effective way that optimises product quality and yield while avoiding impacts on soils, water, (natural) vegetation or biodiversity.

Business benefits

Integrated pest, disease and weed management can maximise the health of the vegetable production system (and surrounding ecosystem) and minimise the need for use of agricultural chemicals on farm.

Scope

This section addresses the integrated and environmentally sustainable management of pests and diseases in vegetable production systems. Specific issues related to the management of agricultural chemicals are addressed in section 7: Chemical management. Specific issues related to

biosecurity are addressed in section 6: Biosecurity management.

Management objectives

Ensure pests in the vegetable production system are managed in an integrated way to minimise the need for agricultural chemicals and to **encourage natural predators and other beneficial organisms**.

Ensure the condition of soil, growing media, crops, biodiversity and native vegetation is optimised **to reduce the vulnerability of vegetable crops to pests and diseases**.

Ensure the use of agricultural chemicals is **managed to avoid resistance/tolerance of vegetable pests** or enhanced biodegradation of soil applied products.

Ensure pest and disease management practices do not have an impact on biodiversity.

Ensure pest and disease management practices meet all legal requirements and reasonable community expectations.

Ensure pest and disease management practices do not damage **non-target organisms or beneficial organisms** or predators and do not cause pollution of soils or waterways.

“Most of the time pests and disease are just nature’s way of telling the farmer he’s doing something wrong.”
- Michael Pollan



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E4. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

E4.1 Select pest and disease control strategies to minimise risk to the environment

1. Consideration is given to all available methods of pest and disease control (for example biological, chemical, cultural, mechanical and technological) when a control program is chosen. A record of control methods used is kept.
2. When necessary, apply agricultural chemicals, which have the least effect on beneficial organisms and/or the lowest possible environmental impact.
3. When selecting agricultural chemicals, adhere to resistance management strategies and avoid frequent applications of the same soil applied products
4. The decision to use agricultural chemicals is based on one or more of the following:

Crop and/or weather monitoring for pest and disease pressure.

Records must include:

- date
- area/crop and/or weather parameters monitored

- monitoring result and actions recommended
- name of the person who carried out the monitoring activity.

External agency pest and disease alerts. Records must include:

- evidence of subscription alerts
- date of alert pest or disease the alert is issued for
- source/agency that issued the alert.

Documented preventive pest and disease control programs. Records must include:

- date the program was documented
- crop or area to be treated
- target pest/disease/weed
- chemical(s) to be used
- frequency of use (including any limitations on the frequency of chemical use per crop/season) or the stage of crop development
- name of the worker/person/organisation that documented the control program.

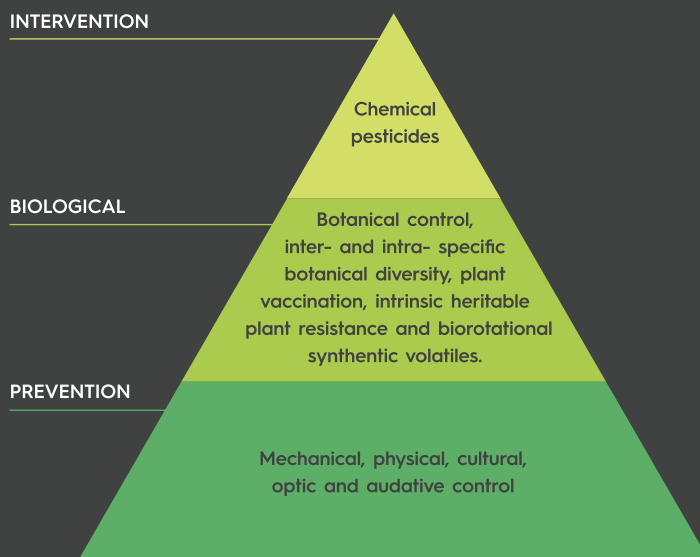
Industry preventive control programs or phytosanitary specifications. Records must include:

- An up-to-date copy of the industry program or phytosanitary specification.

FIGURE 1: THE INTEGRATED PEST MANAGEMENT (IPM) PYRAMID SHOWING THE MOST IMPORTANT PEST MANAGEMENT ELEMENTS

The base tier of the IPM pyramid consists of abiotic actions that can be applied before or immediately after planting and may continue until harvesting. Then follows a circular tier consisting of important elements that can be classified as 'ecological' and form the basis for ecology-based IPM. Finally, the top tier of the pyramid includes chemical pesticides that should only be applied when necessary, if the more basal IPM elements fail to keep pest populations under the economic threshold. Arrows denote particularly important interactions between the ecological elements. These seven interactions are key research areas that require elucidation to integrate the elements and realise the full potential of IPM.

Source: [sciencedirect.com/science/article/pii/S1360138517301334](https://www.sciencedirect.com/science/article/pii/S1360138517301334)



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Pests, diseases and weeds are not managed in vegetable production systems

- Potential impacts on local biodiversity
- Spread of weeds into natural areas
- Reduced yield or quality
- Increased costs of management and/or reduced income

Over reliance on agricultural chemicals

- Loss of beneficial organisms
- Development of pesticide resistance and or enhanced biodegradation
- Increasing costs over time

Overuse of agricultural chemicals/insufficient rotation of products

- Loss of beneficial organisms
- Off-site effects e.g. via run-off/erosion
- Resistance/tolerance of pests to available treatments
- Crop rejections due to residues

Agricultural chemical use affects non-target species or moves off-site

- Potential impacts on local biodiversity
- Potential pollution of water ways or natural areas
- Loss of beneficials that can reduce the need for chemical use

Pest management practices do not meet legal requirements or community expectation

- Various off-site effects depending on the non-compliance
- Fines, Crop rejections / destruction
- Loss of public support for industry

Native pest animals are not managed appropriately

- Potential impact on populations, especially of endangered species
- Crop losses, Food safety issues

“Environmental pollution is an incurable disease. It can only be prevented.”
- Barry Commoner



RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices in your soil management program and/or environmental action plan.

Follow a recognised approach to Integrated Crop Protection and Pest Management

Pest, disease and weed problems occur when three things are present:

1. The pest, disease or weed.
2. There is a host (your crop, exotic weeds, or your native vegetation or waterway).
3. Site conditions are favourable (e.g. weather, soil moisture, temperature).

Integrated crop protection and pest management involves changing one or more of these factors to help to prevent the pest from establishing and spreading. This could include using a range of the following control options:

- **Biological control** – releasing native natural enemies of the pest, disease or weed (e.g. insects, grazing animals or disease)
- **Cultural control** – Manipulating farming practices or enhancing native communities of plants/beneficials
- **Physical control** – removal of host material, weeds themselves or mulching
- **Chemical control** – use of chemicals, such as herbicides.

The following recommended practices involve choosing the combination of options that will have the least impact on the environment.

Record details of all applications of fertilisers and soil additives

Details required for certification are noted steps 4 and 5 of part two, putting it into practice

Manage the production site to discourage the introduction of pests, disease and weeds; to avoid favourable conditions for pests; and to encourage beneficial insects and natural predators

Practice good hygiene and biosecurity measures across the property to avoid the introduction or spread of pests, disease and weeds.

Practice careful crop management

- Ensure seedlings, propagation material, mulches/composts, and other materials or equipment brought onto a production site are pest and disease free.
- Consider using approved pest-resistant varieties where this will not cause other problems (e.g. spread of herbicide-resistant plants into native vegetation).
- Consider risks from alternate hosts. For example, weeds may harbour thrips and other insects which can transmit viral diseases.
- Consider area wide management options for reducing potential incidence of viruses.
- The majority of viruses infecting vegetable crops in Australia are transmitted by insects, with aphids, thrips and whitefly being the main vectors. Examples include the aphid transmitted Papaya ringspot virus, Tomato spotted wilt virus transmitted by several species of thrips and Tomato yellow leaf curl virus which has the whitefly *Bemisia tabaci* as the vector.

Several viruses lack a specific insect vector but are efficiently dispersed by seed and/ or contact. A good example is the cucumber green mottle mosaic virus which is seed borne in several cucurbit species and easily spread by contact and mechanical damage.

- Plan crop spacing and row orientation to provide air flow and allow for space for pest management (e.g. weed cultivation).
- Use organic mulches (e.g. cover crop residues, or mature compost) to help manage weeds, as well as to improve soil structure and reduce water losses. Ensure crop and other plant residues break down quickly.
- Break the reproduction cycles of pests, and encourage natural predators and other beneficial organisms. Where possible, rotate crops regularly and grow cover or biofumigation crops, try mixed cover crops. The use of plastic mulch can also help reduce pest pressure and assist with plant residue management. In some instances, a fallow period may be required to break a pest or disease cycle.
- Consider planting crops outside the time when a pest is most active.
- Manage nutrition and irrigation to maintain healthy soil and crops. Avoid creating conditions which may encourage pests. For example, unbalanced nutrient levels or high soil moisture may encourage weeds and diseases.



Manage areas of native vegetation on the property

- Maintain the health of your **native vegetation** to increase resistance to pests.
- Plant **native vegetation** in any areas not in use, where weeds generally populate. Select species to suit the aspect and position, such as ground cover natives or grasses that do not shade greenhouses or impact line of sight. (Florabank can help identify appropriate natives for your area.)
- Consider using **native vegetation windbreaks** (see Biodiversity section for more on shelterbelts).
- Avoid creating conditions which may encourage pests. For example, high or unbalanced nutrient levels or soil moisture may encourage weeds. Soil-borne diseases (e.g. damping off) may be encouraged by wet or waterlogged soil.
- Protect and restore the vegetation layers (trees, shrubs, grasses, ground covers and leaf litter) you would expect to find in areas of native vegetation. This will help provide habitat for natural predators, and help to discourage weeds.

Manage water storages and waterways on the property

- Maintain the health of waterways to increase resistance to pests.
- Avoid creating conditions which may encourage pests. For example, high nutrient levels in waterways encourage weeds or algae.
- Where appropriate, protect and restore the vegetation and other habitat layers (including logs, snags and rocks) you would expect to find in and around natural waterways.
- Establish native vegetation and habitat layers around farm water storages. This will help support natural predators and other beneficial organisms, and maintain water quality.
- Keep farm animals out of waterways, provide alternative watering points for them; maintain or restore riparian vegetation.
- Do not remove weed vegetation (willows, blackberries) around streams using bulldozers as this will cause bank erosion; cutting and immediately painting stumps with a suitable herbicide is an alternative.

FIGURE 2: NATIVE VEGETATION FOR PEST CONTROL AND ENHANCED BIODIVERSITY

Tips from Glenys Wood – Co-author of the Revegetation by Design guidebook

Start early	Clean up before planting
• Plan at least six months prior to planting • Consider the best time to plant – when conditions allow young plants to become established • Order early from a nursery so the plants can germinate in time for planting	• Good weed management ensures that new natives will establish deep roots without competition, this also reduces the need to spray • Consider native vegetation in the same way crops are considered; prepare the area and nurture
Consider your crops	Choose the right plants
• Consider the crop type and its associated pest and disease issues • Understanding threats to crops allows selection of a habitat for beneficial populations • Consider production methods, plants need to survive traffic and run-off conditions	• Choose a plant that is not a host for vegetable pests or diseases, use a screening system to select appropriate plants • Select perennial species, to provide year-round cover for beneficials • Also consider aesthetics, good looking plants can add value to the property

Source: treesforlife.org.au/sites/default/files/vegetable%20growers.pdf



Encourage beneficial insects, microorganisms and natural predators within the production site/soil

- Improve and extend habitat around crop production areas to encourage a range of native predators including insects (e.g. lacewings, ladybirds), amphibians (e.g. frogs), insect-eating birds (e.g. honeyeaters), predatory birds (e.g. hawks).
- Use communication tools to reduce impact of actions on local beneficial insects. For example, **BeeConnected** is a bee protection initiative where farmers can register and be notified when a beekeeping activity is logged within 10km of their property or crop protection activity.

Manage soil condition, especially structure and organic carbon levels to encourage healthy, diverse soil life, avoid compaction.

Monitor site conditions and embed integrated crop protection into business operations

Train relevant personnel in recognition of the pests and diseases that affect the crops grown on the property, their symptoms of attack and life cycles. Also provide training in natural predators and beneficial species.

Consider physical, mechanical, biological and cultural options in preference to just chemical control options, and select the combination of options that achieves the outcome with the least impact on the environment and the best result for the crop.

Avoid broad spectrum products, especially of S7 classification and those not safe for bees, beneficials and aquatic life.

Instead consider the use of:

- environmentally friendly pesticides, such as proven biological control agents (e.g. based on microorganisms, plant extracts)
- narrow-spectrum rather than broad-spectrum pesticides;
- spot applications of pesticide instead of blanket sprays; strategic application when the pest or disease is most vulnerable; and
- strategies to minimise pesticide resistance and enhanced biodegradation.

Practice good hygiene and biosecurity to limit diseases in particular.

Implement an all-year-round weed management program, both in and around the growing area, to avoid harbouring pests and diseases or providing

a source of re-infestation (also note, though, that weeds can provide a refuge for natural predators).

Maintain good soil health, including an open, well aerated structure, high organic matter levels and a diverse and active soil biology, which in turn promotes healthy crops that are more resistant to diseases and pests.

Encourage natural predators.

Regularly monitor crops for pests, diseases and weeds and identify or get advice on threshold levels that require a management response; use curative pesticides only if pest numbers exceed known threshold levels.

Monitor site conditions (including weather) and use scientific prediction models to help predict likely outbreaks of disease.

Where pest or disease is present, develop an integrated management plan specific to the pests and diseases affecting your crops

Integrated pest/disease management plan should consider:

- Selection of narrow spectrum or 'soft' chemicals where available.
- Stage of pest life cycle where chemicals and predators are to be used.
- Application rates.
- Frequency of use.
- Rotation plan, including use of cover, green or biofumigation crops.
- Use of 'soft' soil management e.g. reducing tillage.
- Site and crop specific irrigation and nutrition management, including good drainage.
- Use of proven biological products as part of the system and encouraging mycorrhiza for crops that rely on it.
- Use of seed dressing and pre-plant drenches for seedlings to avoid broadcast applications to soils, consider banding of products.
- Use of proven quality organic soil amendments (e.g. mature compost that is free of contaminants, humates etc.).
- Use of advanced crop monitoring and precision agriculture tools to prevent, detect and target pests, weeds and diseases.
- Use of well-maintained and calibrated application equipment.

Pest and disease monitoring records should be kept and any actions recorded.



See section 6: Biosecurity for dealing with exotic pests that might be identified through monitoring activities.

Manage weeds on the property

Consider integrated and long-term approaches to management of weeds ([integrated weed management or IWM](#)).

- The most [commonly reported weeds of Australian vegetable production](#) are generally annual or biennial broadleaf species (e.g. fat hen, stinging nettle, mallow, pigweed, and nutgrass).
- No single technique alone will effectively manage weeds in the crop during the entire growing season. IWM options includes a mixture of herbicides, cultivation, hand weeding, plastic mulch (where applicable), and crop rotation.
- Other methods may also be used successfully; Use [organic mulches and mature, clean compost to help manage weeds](#). Use mechanical weed removal methods, where these will not damage soil and crop.
- Other weed control options [can be found here](#).

Consider how conditions can be altered to reduce weed pressure, e.g. wet, compacted or nutritionally unbalanced soils may favour the establishment of certain weeds.

Before managing weeds, consider what you will replace them with as bare soil will most likely support renewed weed growth as well as loss of carbon and erosion. Consider [suitable cover crops](#); including those that can tolerate slashing, allow spraying out of problem weeds or have a [biofumigation effect](#).

Take into account the [vulnerability of sites to erosion](#) and consider slashing weeds, rather than removing them, if they provide useful groundcover to protect the soil and you cannot establish a functional cover crop.

Be aware of any [legal obligations to control 'declared' weeds](#), which may require landowners to take all reasonable steps to control weeds on their property and prevent their spread to other areas. See section 6: Biosecurity for dealing with [Weeds of National Significance](#) that might be identified through monitoring activities.

Also be aware of any [nature conservation and biosecurity legislation](#) which may apply to native pest plants that restricts options to control them.

Where weeds are established over a large area, work with neighbours to achieve more effective weed control strategies.

Ensure ongoing maintenance of weed control actions, to ensure their continued effectiveness over time.

- Monitor the site for reinfestation and treat the weeds as they appear. Photo points, records and maps of work done will help to determine the success or failure of weed control work.

Manage vertebrate pest animals in compliance with legal requirements

[Manage non-native pest animals](#) such as foxes and rabbits and other ['declared' pests](#) to protect crops and increase biodiversity on the property.

- Ensure [legal requirements regarding the control of pest animals](#) are understood and met.
- Use the least cruel methods.
- Remove dens and other harbours.
- Work with neighbours for more effective results over a wider area.

Seek specialist advice regarding appropriate methods for managing native pest animals.

- Ensure all legal requirements regarding the control of native pest animals are understood and met. Native pest animals may be protected under legislation.
- Encourage natural predators, such as hawks.
- Fence cropped areas to exclude browsing animals such as wallabies and possums.
- Establish netting systems over crops to exclude birds, where practical and economically feasible.
- Reduce access to water.
- Consider sound and light or laser systems (e.g. for birds or flying foxes), where there is evidence of their effectiveness.
- Methods which stress or kill native animals should only be considered if all other options have not been effective. Lethal methods such as shooting or baiting usually require permits or licences. Growers must comply with permit conditions.



EXPECTED OUTCOMES

Improved water management practice outcomes expected to be achieved through implementing these practices include;

Within 1–5 years

Pests, disease and weeds in the vegetable production system are managed effectively through a combination of methods, with a high reliance on beneficial organisms, cultural practices and a low use of agricultural chemicals.

Area wide management options are explored with other producers in the district.

Longer term outcomes, which may take 5–10 years or more

Vegetable crops have an increased resilience to pests and disease through improved soil and crop health and effective property management.

Resistance/tolerance amongst vegetable pests to agricultural chemicals is reduced.

Biodiversity and soil and waterway health in vegetable production regions is enhanced.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- [Soil Wealth email updates](#)
- [VegNET – extension officers](#)
- [AHR resources](#)

Horticulture wide updates

- [AUSVEG mailing list, including weekly updates](#)
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)

Industry updates:

- [Goodbugs.org.au](#) – list of beneficial insects
- [Croplife](#) – plant science industry representative
- [Insecticide resistance action committee](#)

Government updates:

- [Invasive weeds list](#) – Department of the Environment
- [Biosecurity](#) – Department of Agriculture
- [Weeds management](#) – Department of Agriculture
- [Pest animal management](#) – Department of Agriculture



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Tomato Potato psyllid (TPP) management

National TPP program coordinator (MT16018)

Surveillance of TPP in the Eastern States and South Australia (MT16016)

Projects to;

- bolster psyllid surveillance for the early detection of tomato potato psyllid (TPP) should it cross from Western Australia into South Australia and the eastern states, including Tasmania. Surveillance involves potato crops as well as other solonaceous vegetables including capsicum, eggplant and chilli – especially those grown in greenhouses.
- coordinate the development and implementation of a national tomato potato psyllid (TPP) management strategy – essentially helping ensure research and development, engagement and other response efforts related to the pest across the various industries and areas it affects are coordinated, prioritised and strategic.

Optimising cover cropping for the Australian vegetable industry (VG16068)

A project to support Australian vegetable growers in effectively using cover crops to boost soil health and reap productivity benefits. Bringing together a consortium of research partners, it is building on existing cover crop trial sites and establishing new ones to explore the how, why and when to best use cover crops across Australia's main vegetable growing regions.

RD&E program for control, eradication and preparedness for vegetable leafminer (MT16004)

A project to bolster preparedness for and protection against the potential spread of vegetable leafminer (*Liriomyza sativae*) through Australian growing regions. The pest is capable of infesting a broad range of crops, and was first detected on the country's mainland in 2015, in a backyard garden in the Cape York Peninsula community of Seisia.

A multi-faceted approach to soilborne disease management (VG15010)

Provides vegetable growers with the skills, tools and solutions needed to manage the risk of crop losses due to soilborne diseases. Its work includes the use of best-practice demonstration sites, field days, workshops, videos, fact sheets and other digital resources, as well as integration with the Soil Wealth and Integrated Crop Protection programs to extend results.

Advanced stable fly management for vegetable producers (VG15002)

Reducing stable flies in crop residues left after vegetable harvest. As well as assessing the ability of the flies to lay eggs on residues, it is looking at the use of new machinery for deep burial of crop residues; the use of biological agents including beneficial fungi and predatory insects; and non-chemical approaches to removing stable flies from carrier animals.

Using autonomous systems to guide vegetable decision making on-farm (VG15003)

Using the well-known Ladybird and RIPPA robots in both trial-farm and commercial-farm settings, this project is advancing the application of robotics, intelligent sensing systems, precision agriculture automation and more in Australia's vegetable industry. It is developing, evaluating and supporting the commercialisation and adoption of such technologies, with the end goal of increasing industry productivity, particularly in relation to brassica, lettuce and baby leaf growing.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Field and landscape management to support beneficial arthropods for IPM on vegetable farms (VG16062)

Designed to support Australian vegetable growers in harnessing the power of beneficial arthropods in integrated pest management (IPM) approaches. Specifically, it brings together a range of researchers and professionals in the field, who will capture information, develop and test strategies, and produce crop-specific and region-specific guidelines for field and landscape management to support beneficials.

Improved management options for cucumber green mottle mosaic virus (VG15013)

Its work includes identifying weed hosts of the virus and the potential role of other factors, including honey bees, in its incidence. It is also developing improved diagnostics for plant and seed material, with a view to developing in-field tests for rapid detection, and producing guidelines and other materials to support improved virus management and help growers strengthen on-farm biosecurity.

Impact of pesticides on beneficial arthropods of importance in Australian vegetable production (VG16067)

As its name suggests, it is developing information on the impact of pesticides on insects and mites that play a beneficial role in the Australian vegetable industry. This information is essential for making decisions about the use of pesticides in vegetable crops that are grown using integrated pest management.

Vegetable agrichemical pest management needs and priorities (VG16060)

This project aims to prioritise agrichemical efforts. With close consultation with growers, it is tasked with identifying pest priorities for vegetable commodities. These outcomes will aid in updating industry Strategic Agrichemical Review Processes (SARPs), inform industry direction at the annual AgChem Collaborative Forum, and lead the progression of minor use permits and chemical registrations.

A strategic approach to weed management for the Australian vegetable industry (VG15070)

Deliver weed management tools and approaches. The four-year project will identify and improve integrated management strategies for high-priority weeds and develop guidelines and a host of resources for growers. It will ultimately help reduce the dependence on herbicides and tillage for weed control, which can become ineffective when used repeatedly.

Innovative solutions for management of tospoviruses of vegetable crops (VG14063)

Aims to address gaps in DNA sequence information for Australian tospoviruses, which infect a broad range of horticulture crops. This information is critical for the development of diagnostics and for management. The project also aims to generate information on host-pathogen interactions that may lead to identification of novel genes for resistance and help deliver broad-spectrum resistance to tospoviruses.

Management and detection of bacterial leaf spot in capsicum and chilli crops (VG14010)

Aims to increase the capacity of the vegetable industry to implement integrated disease management programs for bacterial leaf spot of capsicum and chilli field crops. It is identifying causal agents of the disease, reviewing existing research, filling in knowledge gaps, and investigating control measures.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Viruses of national importance to the vegetable industry

Research report (VG15008)

The purpose of this project was to review viruses of national importance to the Australian vegetable industry with emphasis on providing recommendations for future investments.

The project was largely undertaken as a desktop study with a literature review of viruses of importance to the industry considered in terms of epidemiology, host range, transmission, economic impact and current and potential management methods.

Improving the management of insect contaminants in processed leafy vegetables (VG12108)

Insects are potential contaminants of processed leafy vegetables. Pest and beneficial species, in both the juvenile and adult stages of their life cycles can easily become unwanted contaminants if they make their way from the field into the final product, and to the end consumer. Insect contamination can result in rejections and lost sales for growers, added cost for processors and bad publicity for retailers. Ensuring year round supply of insect free produce is a difficult challenge.

Plant probiotics – UQ

Research into the use of pro-biotics on-farm

Farmers use crop probiotics containing beneficial microbes to boost plant health and growth. However, many crop probiotics are ineffective, and while some help one crop they may inhibit another. Farmers can also be uncertain about whether a product is appropriate for their crop because manufacturers aren't currently required to provide sufficient product information and evidence that the product is helping crops.

Professor Susanne Schmidt, PhD student Shelby Berg and the team at UQ School of Agriculture and Food Sciences are working to reverse this trend. Experimenting with both sugarcane and vegetable crops, they have found that lax regulations around product testing, labelling and marketing in Australia limit the benefits of crop probiotics.

Enhancing Market Attitudes Towards IPM and Sustainable Vegetable Production Practices (VG12084)

Four activities have been conducted; – A desktop study of sustainability labels and 'eco' farming schemes – A series of 8 focus groups, segmented by age and income, in Sydney and Melbourne – A national online survey of over 1,000 main grocery buyers on attitudes to farming, the environment, and insect contamination in food – Production of three videos aimed at consumers, promoted using QR codes linked to a website optimized for mobile phones. Research overseas and in Australia has consistently indicated that consumers care about environmental issues and are willing to pay more for sustainably grown produce. However, intention often fails to translate into action.



FIGURE 3: WEEDS IN AUSTRALIAN VEGETABLE CROPS, SORTED BY NUMBER OF IDENTIFICATIONS DURING INDUSTRY CONSULTATION

Weed (botanic and common name)	Number of identifications	Weed type and perenniality*	State/s present
<i>Chenopodium album</i> (Fat Hen)	32	broadleaf, short	NSW, Qld, SA, Tas, Vic, WA
<i>Urtica urens</i> (Stinging nettle)	23	broadleaf, either	NSW, Qld, SA, Tas, Vic, WA
<i>Malva parviflora</i> (Mallow/ marshmallow)	20	broadleaf, either	NSW, Qld, SA, Tas, Vic, WA
<i>Cyperus rotundus</i> (Nutgrass)	19	sedge, long	NSW, NT, Qld, SA, Vic, WA
<i>Portulaca oleracea</i> (Pigweed/portulaca)	19	broadleaf, short	NSW, NT, Qld, Vic, WA
<i>Amaranthus</i> spp. (<i>Amaranthus</i> / Prince of Wales Feather/Redshank)	17	broadleaf, short	NSW, NT, Qld, Tas, WA
<i>Raphanus raphanistrum</i> (Wild radish)	17	broadleaf, short	NSW, Qld, SA, Tas, Vic, WA
<i>Solanum nigrum</i> (Blackberry nightshade/deadly nightshade)	17	broadleaf, either	NSW, NT, Qld, SA, Tas, Vic, WA
<i>Sonchus oleraceus</i> (Milk thistle/common sowthistle)	16	broadleaf, either	NSW, NT, Qld, SA, Vic, WA
<i>Rapistrum rugosum</i> (Wild turnip)	14	broadleaf, short	NSW, Qld, SA, Tas, Vic, WA
<i>Polygonum aviculare</i> (Wireweed/hogweed)	13	broadleaf, short	NSW, SA, Vic, WA
<i>Senecio vulgaris</i> (Common groundsel)	12	broadleaf, short	SA, Tas, Vic, WA
<i>Stellaria media</i> (Chickweed)	11	broadleaf, short	NSW, Qld, SA, Tas, Vic, WA
<i>Galinsoga parviflora</i> (Potato weed)	10	broadleaf, short	NSW, Qld, WA
<i>Datura stramonium</i> (Common thorn apple/Stramonium)	8	broadleaf, short	NSW, Qld, Vic
<i>Solanum tuberosum</i> (Volunteer potatoes)	8	broadleaf, long	NSW, Qld, SA, Tas, Vic, WA
<i>Digitaria sanguinalis</i> (Summer grass)	7	grass, short	Qld, Vic, WA
Grasses (Grasses misc)	7	grass, either	NSW, Qld, Tas, WA
<i>Artotheca calendula</i> (Capeweed)	6	broadleaf, short	SA, Tas, Vic, WA
<i>Daucus carota</i> (Carrot weed)	6	broadleaf, short	Qld
<i>Fumaria</i> spp. (Fumitory)	6	broadleaf, short	Qld, SA, Tas, Vic, WA
<i>Lolium rigidum</i> (Ryegrass)	6	grass, short	SA, Tas, WA
<i>Oxalis pes-caprae</i> (<i>Oxalis</i> /soursob)	5	broadleaf, long	NSW, SA, Vic
<i>Capsella bursa-pastoris</i> (Shepherd's purse)	4	broadleaf, short	Qld, Tas, Vic
<i>Conyza</i> spp (Fleabane)	4	broadleaf, short	Qld, Tas, WA
<i>Cynodon dactylon</i> (Couch)	4	grass, long	NSW, NT, SA, WA
<i>Poa annua</i> (Winter grass)	4	grass, short	SA, Vic, WA
<i>Tribulus terrestris</i> (Caltrop)	4	broadleaf, either	NT, SA, WA
<i>Trifolium</i> spp. (Clover)	4	broadleaf, either	Qld, Tas, Vic
<i>Eleusine indica</i> (Crab grass/ crowsfoot)	3	grass, either	NT, WA
<i>Physalis minima</i> (Wild gooseberry)	3	broadleaf, short	NT, Qld
<i>Sorghum halapense</i> (Johnson grass)	3	grass, long	NSW, Qld, WA

Source: ausveg.com.au/app/data/technical-insights/docs/VGI3079.pdf



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect **baseline information** and data

E.g. Conduct an audit across the business, including production site/s, packing facilities and the farm office.

Identify existing data and collate records.

Step 2: Assess your practices and risks

Complete the on-line EnviroVeg self-assessment

The report will identify critical risks and recommendations for actions/practices to implement.

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a crop nutrition management plan/program and review and revise it regularly

Use the EnviroVeg action planning template.

Further analysis of priority actions identified within the EnviroVeg self-assessment should be undertaken and steps put in place to assign responsibility/due date of implementing the actions.

Step 4: Monitor performance measures/indicators

Performance indicators for pest, disease and weed management in vegetable production systems may include:

- Reduction in overall pesticide use per hectare over time
- Reduction in use of **broad spectrum**, S6 agricultural chemicals
- No use of S7 agricultural chemicals
- Improved biodiversity on vegetable production sites and regions
- Increased use of **cover/biofumigation crops**, reduced tillage, organic soil amendments, pest and disease forecasting, biological control products and targeted/preventative control e.g. via precision agriculture technologies.

Step 5: Keep records

Key records for pest, disease and weed management in vegetable production systems may include:

- **Pest, disease and weed monitoring record**
- **Preventative pest, disease and weed control program.**



Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed.

- The integrated crop protection program should be reviewed and updated annually.

- The name of the person completing the review and the date of the review should also be documented.
- Ensure actions and procedures have been appropriately embedded into the farm/property management system.
- Identify and prioritise any training that might be required.
- What pests are you now dealing with and may occur in the future.

Connect with like-minded producers, network and discuss your ideas;

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is @EnviroVeg,

Come to EnviroVeg events, ask questions of other growers about their practices.



PART THREE: RESOURCES AND FURTHER INFORMATION

Plant Health Australia

Provides a list of accredited plant health expertise including identification, survey, and pest management

GENERAL INFORMATION

Association of Beneficial Arthropod Producers - expertise in the use of [beneficial insects and IPM](#)

[AUSVEG](#) - search under 'Pest and disease' category of InfoVeg for latest research

[Cooperative Research Centre for Plant Biosecurity](#)
Provides useful information and tools for use on-farm as well as the latest research

[Cucumber Green Mottle Mosaic Virus \(CGMMV\) National Management Plan](#)

Kristiansen, P. (2015) Weed Management for the Vegetable Industry - [Scoping Study](#). University of New England

Kriticos, D (2014) Adaptive pest management for horticulture under climate change - [pilot pest scoping](#). CSIRO Climate Adaption Flagship.

[National Pests and Disease Outbreak](#)
Up-to-date information on pests and diseases outbreaks in Australia

Feral Pests

The website and database contains information on pest animal species in Australia and New Zealand

[Florabank](#) - native seed options

Persley, D (2017) [Viruses of national importance to the vegetable industry](#). Queensland Department of Agriculture and Fisheries.

STATE AND FEDERAL

Australian Department of Environment and Energy.
Invasive species - [pest, diseases and weeds](#)

Department of Agriculture and Fisheries - [protect plants from pests and diseases](#)

Agriculture Victoria - [pest, disease and weeds](#)

ACT government - [weeds and pests portal](#)

NSW government - [NRC review of pest animal management](#)

DAF Queensland - [pest animals](#)

PIRSA - [weeds and pest animals](#)

WA Department of Agriculture - [MyPestGuide](#)

[Biosecurity Tasmania](#)

NT government - [plant pests and diseases](#)

LEVY-FUNDED RESEARCH

The research and factsheets below are found on the [infoveg database](#). Search there for other research that interests you.

Adaptive pest management for horticulture under climate change pilot pest scoping - [VG13029](#)

Managing Biting Fly in Vegetable Crop Residues - [VG12022](#)

New in-field treatment solutions to control fruit fly (I) - [VG13041](#)

Breeding capsicum for tospovirus resistance - [VG10081](#)



Summer Root Rot in Parsley: A Scoping Study - [VG12102](#)

Double knock low dose fenthion treatment of zucchinis as a quarantine treatment against cucumber fly - [VG13066](#)

Identification of potential alternatives to metham sodium - [VG13045](#)

Generation of residue, efficacy and crop safety data for pesticide minor-use permit applications - CPR - [VG11028](#)

Keep it clean handbook - greenhouse control; of pests and diseases - [VG07118](#)

Mechanisms and management of insecticide resistance in Australian diamondback moth - [VG08062](#)

The production of baby-leaf lettuce under floating crop covers - [VG09188](#)

Investigations and developing integrated management strategies for carrot powdery mildew - [VG08044](#)

Development of methods to monitor and control Aphanomyces root rot and black root rot of beans - [VG08043](#)

Revegetation by design, Queensland: natural resource management and IPM - [VG07040](#)

Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildews and white blister - [VG07070](#)

Managing Brassica Stem Canker Phase 2 - [VG09129](#)

Integrated Viral Disease Management in Vegetable Crops - [VG07128](#)

Alternative fungicides for Sclerotinia control - [TL00077](#)

Common diseases of lettuce - [TL00091](#)

Business case: IPM in lettuce

Best practice IPM - Overview - [VG07110](#)

Managing plant needs from the beginning to the end of the crop - [VG09070](#)

Managing pests and diseases - [VG09070](#)

Lettuce crop protection products: A guide to potential impacts on beneficials - [VG07110](#)

Greenhouse Design - Pests and Disease - [VG09070](#)

Mega Pests - Managing Sucking Pests - [VG09144](#)

Control what goes into your clean zone - [VG07118](#)

Check seedlings before planting - [VG07118](#)

Mega Pests - Soilborne Diseases - [VG09144](#)

A Guide to Effective Weed Control in Australian Brassicas

Clean and disinfect the greenhouse - [VG07118](#)

Mega Pests - The Basics of Protecting Your Crop - [VG09144](#)

Viruses in Vegetable Crops in Australia: integrated Virus Disease Management - [VG7128](#)

Managing Pesticide Resistance - [VG09144](#)

Action points for making decisions - [VG07118](#)

Make a clean zone around the greenhouse - [VG07118](#)

Get rid of all weeds - [VG07118](#)

Mega Pests - Managing Chewing and Biting Insects - [VG09144](#)

Do not leave crop debris lying about - [VG07118](#)

Mega Pests - Managing Foliar Diseases - [VG09144](#)

Always check for pests and diseases - [VG07118](#)

FACTSHEETS

Brassica crop protection products: [A guide to potential impacts on beneficials](#)
Managing plant nutrition and general care - [VG09070](#)

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BIOSECURITY



PART ONE: MANAGEMENT GUIDELINES

Context

Biosecurity – measures taken to manage exotic pests – is a critical issue in the vegetable industry. Pests are any organisms (such as insects, mites, weeds, microbes or animals) that can cause damage or loss, or pose a risk to vegetable crops. Exotic pests are those not currently present in Australia.

Australia's biosecurity system operates across many levels: Federal Government border controls; State & Territory Government pest exclusion, eradication and containment strategies; the government-industry agreement within the [Emergency Plant Pest Response Deed](#); and efforts at the industry, regional and farm level. Farm-level biosecurity best practices aim to protect production sites – and the entire industry – from the entry, establishment and impact of exotic pests.

Everyone involved in a vegetable production business has a responsibility for biosecurity – including business owners, managers, staff, contractors, workers and all visitors to the property. Effective biosecurity requires a detailed assessment of the risks and the identification of priority matters for management.

Business benefits

In the event of an exotic pest incursion, growers who can demonstrate their farm biosecurity practices and records tend to re-gain market access more quickly because they can provide the appropriate evidence

to the destination market that they have assessed the biosecurity risk and taken appropriate action. Good biosecurity practices will also enhance the management of existing pests and diseases on farm.

Scope

This section focuses on biosecurity at the property scale – it outlines the hazards and management practices that can guard against the entry, establishment and impact of exotic pests, pathogens or diseases. Management of endemic (established) pests is addressed in section five.

Management objectives

Establish a culture of responsibility for biosecurity management amongst all members of the business team and staff to reduce the likelihood of any exotic plant pest, pathogen or disease entering or establishing on the property.

Maintain adequate surveillance to:

- Enable the rapid identification, containment or eradication of any new pest, pathogen or disease found on the property.
- Collect 'lack of observation' records for high priority exotic pests.

Establish and maintain a collaborative approach to biosecurity risk management amongst the business, its neighbours and the wider industry.

EXOTIC PLANT PEST HOTLINE
1800 084 881



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E3. To achieve certification to this standard, growers must demonstrate their compliance with the requirements outlined here.

E3.1 Manage biosecurity on the property

- 1. A Biosecurity Management Program is documented and must include:
 - Date developed

- Name of the person documenting the program
- Biosecurity threats related to crops grown
- Strategies/practices to minimise risk (including quarantine regulations and requirements)
- Worker/s responsible

- 2. Access to the property and growing sites is restricted to authorised persons.

E3.2 Monitor and report unusual findings

- 1. Any unusual plant pest, disease or weed identified on the property must be reported to the local department of agriculture or Plant Health Australia.

FIGURE 1: HIGH PRIORITY PESTS FOR VEGETABLE INDUSTRY

COMMON NAME	SCIENTIFIC NAME	VEGETABLE R&D LEVIED COMMODITY AFFECTED	OVERALL RISK
Bulb mite	<i>Rhizoglyphus setosus</i>	Leek	High
Red pumpkin beetle	<i>Aulacophora foveicollis</i>	Pumpkin and other cucurbits	High
Allium leafminer	<i>Phtomyza gymnostoma</i>	Leek and other Allium spp.	High
Vegetable leafminer	<i>Liriomyza sativae</i>	Allium spp., bean, pea, eggplant, pumpkin, cucumber, beets, lettuce, celery (and others)	High
American serpentine leafminer	<i>Liriomyza trifolii</i>	Cucurbitaceae, Fabaceae and Solanaceae, Alliaceae (and others)	High
Bean seed fly, bean seed maggot	<i>Delia florilega</i>	Cabbage, cauliflower, bean, corn and leek	High
Carambola fruit fly	<i>Bactrocera carambolae</i>	Capsicum (and others)	High
Carrot rust fly	<i>Psila rosae</i>	Carrot, cauliflower, celery, parsnip, parsley, other Apiaceae	High
Fijian fruit fly	<i>Bactrocera passiflorae</i>	Eggplant	High
Lesser bulb fly	<i>Eumerus strigatus</i>	Allium spp., parsnip and cabbage	High
Melon fruit fly	<i>Bactrocera cucurbitae</i>	Zucchini, pumpkin and cucumber	High
New Guinea fruit fly	<i>Bactrocera trivialis</i>	Chilli	High
Onion fly	<i>Delia antiqua</i>	Shallot and leek	High
Oriental fruit fly	<i>Bactrocera dorsalis</i>	Fabaceae, solanaceae, cucurbitaceae	High
Pea leafminer, Potato leafminer, serpentine leafminer	<i>Liriomyza huidobrensis</i>	Beet, leeks, lettuce (and others)	High
Summer cabbage fly	<i>Delia floralis</i>	Cabbage, radish and leek	High
Tomato leaf miner	<i>Liriomyza bryoniae</i>	Bean, peas, cabbage, lettuce and eggplants (and others)	High
Gastropoda (slugs and snails)			
Giant African land snail	<i>Lissachatina fulica</i> (Syn. <i>Achatina fulica</i>)	Pea (and others)	High
Giant African snail	<i>Achatina achatina</i>	Cabbage and lettuce (and others)	High
Bean aphid	<i>Aphis fabae</i>	Cabbage, cauliflower, radish, celery, capsicum, eggplant, cucumber, beets, broad beans, beans, peas, cucurbits and chilli	High



COMMON NAME	SCIENTIFIC NAME	VEGETABLE R&D LEVIED COMMODITY AFFECTED	OVERALL RISK
Hemiptera (stink bugs, aphids, mealybugs, scale, whiteflies, hoppers)			
Brown marmorated stink bug	<i>Halyomorpha halys</i> (Syn. <i>Halyomorpha mista</i>)	Sweet corn, cucumber, capsicum, carrot, beans, beets, eggplant, lettuce, pea and beans (and others)	High
Silverleaf whitefly	<i>Bemisia tabaci</i> (types Asia 1, China 1, China 2, Asia II (1-8), Italy, Sub-Saharan Africa (1-4), Uganda, New World, Mediterranean, Middle East-Asia Minor 2, Indian Ocean)	More than 600 plant species	Medium-high
Western tarnished plant bug	<i>Lygus hesperus</i>	Sugar beet, bean and carrot (and others)	High
Lepidoptera (Butterflies and moths)			
Cabbage looper	<i>Trichoplusia ni</i>	Beet, broccoli, cabbage, cauliflower, radish, celery, cucumber, lettuce, parsnip, pea, capsicum, navy bean and pumpkin (and others)	High
False codling moth	<i>Thaumotobia leucotreta</i> (Syn. <i>Cryptophlebia leucotreta</i>)	Capsicum and maize (and others)	High
South American tomato moth, tomato leafminer	<i>Tuta absoluta</i>	Eggplant and other solanaceous plants	High
Pathogens and nematodes			
Bacteria (including phytoplasmas)			
Zebra chip	<i>Candidatus Liberibacter solanacearum</i>	Carrot and celery	Extreme
Fungi			
Puccinia agrophila	<i>Puccinia agrophila</i>	Eggplant	Medium-high
Anthraxnose	<i>Colletotrichum higginsianum</i>	Brassicas	High
Banded Leaf and sheath spot/blight	<i>Rhizoctonia solani</i> f. sp. <i>sasakii</i> (AG1) (teleomorph: <i>Corticium sasakii</i> (Syn. <i>Thanatephorus cucumeris</i>))	Corn	High
Late blight (exotic strains)	<i>Phytophthora infestans</i> (A2 mating type)	Solanum spp.	High
Late wilt, slow wilt	<i>Harpophora maydis</i> (Syn. <i>Cephalosporium maydis</i> , <i>Acremonium maydis</i>)	Corn	High
Leaf spot	<i>Alternaria humicola</i>	Pea	High
Lentil anthracnose or soybean anthracnose	<i>Colletotrichum lentis</i> (lentil affecting strain)	Broad bean	High
Lettuce rust	<i>Puccinia opizii</i>	Lettuce	High
Rust - Apiaceae	<i>Uromyces lineolatus</i>	Carrot, parsnip, other Apiaceae spp.	High
Rust - Alliaceae	<i>Puccinia</i> spp. (exotic species)	Allium spp.	High
Nematodes			
Barley root knot nematode	<i>Meloidogyne naasi</i>	Sugar beet	High
Carrot cyst nematode	<i>Heterodera carotae</i>	Carrot	High
Chickpea cyst nematode	<i>Heterodera cicero</i>	Pea	High
Root knot nematode	<i>Meloidogyne enterolobii</i> (Syn. <i>Meloidogyne mayaguensis</i>)	Capsicum, eggplant, cabbage, cucumber, lettuce, carrot and bean	High
Viruses and viroids			
Groundnut bud necrosis virus	<i>Groundnut bud necrosis virus</i> (Tospovirus)	Cucumber, pumpkin, pea and bean	High
Watermelon bud necrosis virus	<i>Watermelon bud necrosis virus</i> (Tospovirus)	Luffa	High



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Introduction of a biosecurity hazard (by any transmission pathway)

Plant pests carried through to the next growing season (plant waste or weeds)

Increased usage of broad spectrum pesticides, due to a lack of other options or on direction from state biosecurity officials (exotic pests).
Increased nutrient inputs to support plant health, intensive tillage, and destruction of surrounding vegetation that may harbour the pest

Off-target species impact

Impact to other native species or ecosystems that have little or no resilience to a new pest or disease (pests or diseases in a new region)

Exotic pests establish at the site

Pest management costs increase

Products do not meet retailer / market specifications due to pest or disease symptoms

The business loses access (temporary or permanent) to intrastate, interstate or international markets

The business is placed under temporary or permanent quarantine by the state plant health authority

The business must abide by strict compliance protocols in order to trade, leading to increased costs

The business is stigmatized by industry

Soils

Plant pests, such as bacteria, fungi, viruses, viroids, nematodes, and insects (and insect eggs), remain stable in soil for long periods

Vehicles and equipment*

Exotic pests introduced to the production site via surfaces where soil and plant debris has collected. In particular, in grilles, in tyre treads and on wheel rims

Viruses remain viable on hard surfaces, such as vehicles or packing materials, without the presence of organic matter

Runoff from vehicle wash down areas carry plant diseases, pests and weeds

Packaging, bins and pallets

Exotic pests introduced to the production site via the re-use of packaging and pallets and their transfer between production sites, properties, production regions and interstate

Staff and farm visitors

Exotic pests introduced to the production site via staff and farm visitors, including contractors, service providers, family members, tourists, news reporters, and school groups

Insects, nematodes, weed seeds, plant viruses and other organisms hitchhike on clothing, hands, footwear and vehicles

*The hazard is higher where there are multiple, unmanaged entry points to the property



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Waste and weeds

Plant waste and weeds incubate plant pests

Cucumber green mottle mosaic virus and Potato spindle tuber viroid are examples of pests that can 'hide' in organic waste or surrounding weeds when primary hosts are not available

Vermin and feral animals

Exotic pests introduced to the production site via animals

Planting materials

Exotic pests introduced to the production site via fertiliser, compost, plastic mulch, seedlings, seed and seed potato, and other planting materials

Plant viruses and some bacterium incubate in seed. Often, this is how plant pests achieve long range transmission between countries

Wind

Exotic pests carried to the production site via wind.

Introduction of previously unknown exotic pests without warning.

Vegetable leafminer, the Current lettuce aphid and the Tomato potato psyllid are examples of pests that have been carried into new regions via wind

Insufficient surveillance, crop monitoring and pest knowledge

High priority exotic pests established

Low chance of early pest detection or proving property freedom

The virus/pest is unmanaged and establishes in growing regions and spread to other properties

"Agricultural science is largely a race between the emergence of new pests and the emergence of new techniques for their control."

- Aldo Leopold



RECOMMENDED PRACTICES

The following practices are recommended to manage biosecurity risks:

Assess biosecurity risks

Follow a rigorous process to comprehensively identify and prioritise biosecurity risks associated with the property and the growing region/district

Biosecurity risk assessment process

Annually re-assess biosecurity risks

Prepare a biosecurity plan/biosecurity management program

Customize to the farm business/production site and ensure it:

- Addresses all risks identified as significant
- Analyses current biosecurity management measures and gaps
 - **checklist/gap analysis process**
- Identifies additional measures necessary to address gaps
- Integrates all biosecurity risk management measures into the farm/property management system and ensures all necessary infrastructure is available to support the implementation of the biosecurity plan
- Sets out the training necessary for all members of the management team and staff to implement biosecurity policies and measures effectively
- Is reviewed and revised annually

Implement **biosecurity signage**

Gate signage is essential to communicate a strong, clear message to staff and visitors that biosecurity procedures are in place at the property and must be followed by all who enter the property. **Gate signage** is particularly important in peri-urban areas where traffic may pass the property more frequently and helps reduce the risk of visitors inadvertently accessing growing areas.

- Provide the phone number for the property manager on the gate sign. Consider requiring phone check-in prior to vehicles entering the site.

Ancillary signage is necessary to reinforce gate signage and to help direct and manage the movement of people and vehicles on-site. Ancillary

signs should provide clear directions to designated parking areas and to direct visitors to the property office where they must sign the visitors register and complete farm induction. Further signage may be required to direct visitors to foot washes, to show the location of vehicle or machinery wash-down facilities, and to indicate restricted areas.

Manage vehicles, machinery and equipment on the production site

Maintain vehicle and equipment **clean-down infrastructure** at dedicated facilities on site and away from growing areas.

- Locate clean-down facilities close to the property entrance on a hard pad or gravel
- Do not locate clean down areas on grass or dirt as pests may incubate in organic matter
- Provide high pressure water and air hoses to optimise removal of plant matter and soil from vehicles, equipment and machinery
- Ensure runoff from clean-down areas leads into a sump away from growing areas
- Ensure any machinery/equipment that will be used on the property is inspected, cleaned and disinfected before entering any growing areas
- Clean machinery or vehicles before moving off the property
- Inspect clean-down facilities and surrounds regularly for potential sources of contamination or infection
- Keep records of the use and inspection of the clean-down facility

Keep dedicated equipment and farm vehicles on the property.

Clean and disinfect vehicles and equipment between use in different growing areas.

Restrict visitor vehicle parking to designated areas.

Ensure on-site vehicles travel on designated pathways between growing areas.

Direct traffic with gate and ancillary signs that inform visitors about property access points, and who to contact for queries.



Farm visitors

Visitors may include contractors, extension staff, tradesmen, sales reps, media personnel, tour groups, study groups, student/school groups or friends/family.

Use gate signs to direct traffic and inform visitors about property access points.

Ensure there is a clearly designated visitor parking area to minimise interaction with growing areas and farm equipment.

Ensure all visitors report to management, [sign the visitors register](#) and report recent movements in other growing regions upon entering the property.

Require all visitors to complete a biosecurity induction session that communicates the risks posed by pests to commercial growers and to ensure visitors are aware of biosecurity expectations and procedures prior to moving around the farm.

Check visitor clothing, footwear and tools for organic matter and soil. If required, clean down before entering the property or provide boot covers to prevent dispersal of foreign soil or plant material.

Maintain cleaning facilities including footbaths and brushes, making sure they are accessible for visitors and staff.

Maintain regular communication with neighbours regarding biosecurity procedures.

Staff training and induction

Induct all staff in on-farm biosecurity practices and refresh their induction regularly. Maintain records of staff inductions.

Train staff in the identification of endemic pests and how to recognise anything unusual that may indicate the presence of an exotic plant pest.

Train staff in high priority exotic pests for the industry and how they may impact the crop.

Display or make available posters, information pages and fact sheets to help staff identify pests or their symptoms.

Train staff in how and where to report suspect pests or suspect plant disease symptoms.

Ensure management understands the [Australian plant biosecurity emergency response system](#) by undertaking [Plant Health Australia Foundation Course online training](#).

Display translated farm hygiene instructional material when needed. Resources translated into Vietnamese and Khmer may be found on [the AUSVEG website](#).

Sourcing of plants/materials

Source planting material from reputable suppliers that will openly disclose seed testing and treatment procedures.

Treat for seed/seedling/other inputs for pests as required.

Establish and follow a seed/seedling testing procedure for common pests.

Ensure testing compliance for imported seed as listed in [BICON \(the Australian Biosecurity Import Conditions Database\)](#).

Maintain records of planting materials and any tests for plant pests, such as seed diagnostics. Source proof of testing from seed supplies where necessary.

Establish zones in growing areas and control access to growing areas

Divide the property into zones to enable the movement of people, machinery and equipment between zones to be managed.

Establish sanitation procedures between zones when there is regular movement of people, machinery and equipment between zones.

Maintain and regularly inspect boundary fences.

Actively manage weeds, vermin and feral animals in the growing areas to prevent pest and disease spread, and communicate regularly with neighbours to achieve consistent pest/weed management strategies between properties.

Regularly inspect and treat water sources for plant insect/pests



Manage plant waste, weeds and animals

Store waste away from growing areas and water sources. Dispose of waste as soon as possible.

Maintain weed-free buffer zones around growing areas.

Control feral animal and weed populations in order to prevent transmission of plant pests, diseases and weeds

Manage packaging, bins and pallets

Do not re-use cardboard packaging materials on farm.

Store unused boxes and bins on clean hard floors in a covered area.

Sanitise plastic bins before reuse in the supply chain.

Clean pallets of organic material and soil before use.

Store dirty pallets away from growing areas.

Maintain an active surveillance and monitoring program and keep detailed records

Conduct routine monitoring of crops for endemic and exotic pests. Symptoms of pests to monitor include:

- Stem or leaf wilt
- Leaf chlorosis or mottling
- Puncture wounds, chew marks or tunnelling tracks in leaf tissue
- Reduced fruit or vegetable size or reduced crops yield
- Under-developed root systems
- Pale, fuzzy or powdery growth on leaves, indicating mildew
- Decayed roots, leaves, stems, fruit or vegetables

Carry out regular pest surveillance around the property including surrounding vegetation, at water sources and around wash down areas.

Use sticky traps to survey for wind borne insects.

Ensure key staff are trained to recognise pests that commonly occur in the region.

Maintain records of all surveillance activities, including the date and all observations, such as pests identified, growing area affected, the level of infestation and proposed treatment plans.

Ensure key staff are familiar with potentially harmful exotic pests for the crop families produced at the site. Refer to the High Priority Pest list in the Vegetable Industry Biosecurity Plan.

Document lack of observation for trade sensitive pests (eg. Tomato potato psyllid). This will aid market access.

Report unusual/unknown pests

Record all unknown pests or pest/disease symptoms and their location and take photographs.

The MyPestGuide application may be used to report pests.

Report the pest (or suspected pest) to the Exotic Plant Pest Hotline on 1800 084 881.

Consult with neighbours about anything suspicious, as the problem may not be restricted to one property.

If an exotic pest is identified or suspected, immediately implement management responses to restrict any further spread

Do not move the affected plant as incorrect handling could further spread the pest.

Wash hands, clothes, boots that have been in contact with affected plant material or soil.

Restrict access of farm workers and equipment to that zone.

Identify equipment and machinery that have recently been used in the affected zone and decontaminate.

Farm Zoning

Develop a farm map that identifies 'clean zones', 'buffer zones', and 'production zones'.

Identify weak points with no controls (areas of risk).

Restrict movement of vehicles, people and equipment between zones as much as possible.

Put in place sanitisation measures if movement between zones is heavy.

If possible, aim to work on pest infested production zones last in the day.



EXPECTED OUTCOMES

Outcomes of effective biosecurity management practices, include:

Within 1-5 years

A clear focus on biosecurity surveillance and management practices leading to a strong biosecurity culture within the business team and staff.

Comprehensive records of risk assessment and implementation of appropriate management practices, and data from monitoring, which may assist the business to maintain or quickly recover market access.

Longer term outcomes, which may take 5-10 years or more to achieve

Production benefits & plant health – higher value produce and reduced input costs.

Maintenance of established contracts and/or markets and improved access to new markets (domestic and international).

Rapid and effective management of exotic pest incursions.

Reduced incidence of exotic pest incursion.

SIMPLE WAYS TO STAY INFORMED

Industry/management area updates:

- AusVeg – [Biosecurity e-newsletter](#)
- AusVeg – [Biosecurity alerts](#)
- AusVeg – [factsheets, templates and guides](#)
- Plant Health Australia – [Tendrils magazine](#)
- Plant Health Australia – [News](#)

Horticulture wide updates:

- [AUSVEG mailing list](#), including weekly updates
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)

Government department updates:

- [Federal agriculture department](#)
- [WA Biosecurity – DPIRD](#)
- [TAS Biosecurity – DPIPWE](#)
- [NT Biosecurity – DPIR](#)
- [VIC Biosecurity – AgVic](#)
- [SA Biosecurity – PIRSA](#)
- [NSW Biosecurity – DPI](#)
- [QLD Biosecurity – DAF](#)

THE VEGETABLE INDUSTRY BIOSECURITY PLAN – WHAT IS IT?

To ensure its future viability and sustainability, it is important that the Australian vegetable industry, represented by AUSVEG as the peak industry body, minimises the risks posed by exotic pests and responds effectively to plant pest threats. [The Plan](#) is a framework to coordinate biosecurity activities and investment for Australia's vegetable industry. It provides a mechanism for industry, governments and stakeholders to better prepare for and respond to, incursions of pests that could have significant impacts on the vegetable industry. It identifies and prioritises exotic plant pests (not currently present in Australia) and established pests of biosecurity concern, and focus on future biosecurity challenges.

Source: ausveg.com.au/app/uploads/2018/06/Industry-Biosecurity-Plan-for-the-Vegetable-Industry.pdf



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Strengthened biosecurity for the Australian vegetable industry
stage 2 VG15020

An ongoing project that supports the activities of the Vegetable Industry Biosecurity Advisor at AUSVEG. The advisor coordinates industry input into a range of biosecurity matters, and helps ensure effective communication of relevant technical information on biosecurity to growers. During the course of 2017 and into 2018, the advisor has had a particular focus on providing advice following detection of tomato potato psyllid (TPP) in Western Australia.

National tomato potato psyllid (TPP) program coordinator
MT16018

Coordinating the development and implementation of a national tomato potato psyllid management strategy – essentially helping to ensure research and development, engagement and other response efforts related to the pest across the various industries and areas it affects are coordinated, prioritised and strategic. Alan Nankivell will now act as a point of contact between the various TPP-affected industries, government and service providers, to help implement TPP management in Western Australia and prepare eastern-state growers.

Review of the National Biosecurity Plan for the Vegetable Industry
(VG15065)

Which began in 2016 and is reviewing the industry's current biosecurity plan. The revised plan will identify the current highest-risk pests to the industry, the risk mitigation activities needed to reduce the biosecurity threat, and the surveillance and diagnostic activities and capabilities available.

Enhanced National Bee Pest Surveillance Program
(MT16005)

A nationally coordinated bee-pest surveillance program to help safeguard honey-bee and pollinator-dependent industries in Australia. It builds upon the previous National Bee Pest Surveillance Program (MT12011), and includes upgrading sentinel hive arrays, strengthening relationships with surveillance operators, the introduction of new elements such as Asian hornet screening and more.

SITplus: Developing and optimising production of a male-only, temperature-sensitive-lethal, strain of Qfly, B. tryoni
(MT13059)

Developing 'temperature-sensitive lethal, male-selecting' strain of Queensland fruit fly (Qfly) – put simply, the research will allow for male-only, sterile fruit flies to be bred in large numbers. It is one of the key projects in the broader strategic co-investment 'SITplus Initiative' that's tackling the issue of Qfly. The male flies are to ultimately be released in growing regions of south-east Australian that are affected by Qfly.

Management and detection of bacterial leaf spot in capsicum and chilli crops
(VG14010)

A project that aims to increase the capacity of the vegetable industry to implement integrated disease management programs for bacterial leaf spot of capsicum and chilli field crops. It is identifying causal agents of the disease, reviewing existing research, filling in knowledge gaps, and investigating control measures.

Innovative solutions for management of tospoviruses of vegetable crops
(VG14063)

A project that aims to address gaps in DNA sequence information for Australian tospoviruses, which infect a broad range of horticulture crops. This information is critical for the development of diagnostics and for management. The project also aims to generate information on host-pathogen interactions that may lead to identification of novel genes for resistance and help deliver broad-spectrum resistance to tospoviruses.

PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Identify existing surveillance data and whether incursions have already been identified, contained and/or eradicated on the property.

Identify and collate existing 'lack of observation' records for high priority exotic pests.

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment.

The report will identify critical risks and recommendations for actions/practices to implement.

Follow a rigorous process to comprehensively identify and prioritise biosecurity risks associated with the property and the growing region/district.

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a biosecurity plan/biosecurity management program that is customized/tailored to the farm business/production site and which:

- Addresses all risks identified as significant
- Analyses current biosecurity management measures and gaps
 - checklist/gap analysis process
- Identifies additional measures necessary to address gaps
- Prioritises actions to be undertaken
- Assigns responsibility/due date of implementing the actions
- Integrates all biosecurity risk management measures into the farm/property management system and ensures all necessary infrastructure is available to support the implementation of the biosecurity plan
- Sets out the training necessary for all members of the management team and staff to implement biosecurity policies and measures effectively
- Is reviewed and revised annually

Step 4: Monitor performance measures/indicators

Performance indicators for biosecurity management in vegetable production systems may include the items listed under the recommended practice;

- Maintain an active surveillance and monitoring program and keep detailed records

Step 5: Keep records

- Biosecurity risk assessment
- Biosecurity management program
- Biosecurity signage
- Visitor register



- Staff induction and training records
- Surveillance and monitoring records, noting both presence and absence of pests
- Biosecurity actions noted in the environmental action plan

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

- Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.
- Ask what could be improved;
 - Review 'Recommended Practices' section in Part 1
 - Review 'References and Resources' section in Part 3
 - Connect with specialists in the appropriate field
- Compare against previous records, and ask what has changed
 - The Biosecurity Management Program is reviewed and updated annually
 - The name of the person completing the review and the date of the review are documented
 - Ensure actions and procedures have been appropriately embedded into the farm/property management system
 - Identify and prioritise any training that might be required
- Connect with like-minded producers, network and discuss your ideas;
- EnviroVeg members on Social media; Join the EnviroVeg members group on Facebook, Tweet to EnviroVeg members on Twitter; the program's handle is @EnviroVeg,
- Come to EnviroVeg events, ask questions to other growers about their practices.

"It is hard to overstate how valuable it is to have all the incredible tools that are used for human disease to study plants."
- Bill Gates

PART THREE: RESOURCES AND FURTHER INFORMATION

Vegetable and Potato Farm Biosecurity Program – the majority of the information presented in this section is drawn from the [Vegetable and Potato Farm Biosecurity Program](#).

Vegetable Industry Biosecurity Plan includes a [list of the exotic pests](#) that may impact vegetable production.

For farm biosecurity planning templates, checklists and step by step guides:

- [AUSVEG biosecurity resources page](#)
- More specifically, see: [DIY Biosecurity \(Vegetable and potato biosecurity planner\)](#)
- [Managing farm biosecurity in the parsley industry](#)

[AUSVEG Farm Biosecurity Planning workbook](#)

[AUSVEG Fact Sheet – Risk Management for your farm: Developing a Farm Biosecurity Plan](#)

[CGMMV National Management Plan](#)

[Priority exotic plant pests – listed in the industry biosecurity plan \(IBP\)](#)

[Plant Health Australia Foundational course online training](#)

[MyPestGuide application](#)

[Australian Biosecurity Import Conditions \(BICON\) database](#)

[FarmBiosecurity.com.au resources](#)

[Plant Health Australia pest fact sheets and vegetable resources](#)

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.



CHEMICALS



PART ONE: MANAGEMENT GUIDELINES

Context

Chemicals are widely used in many vegetable production systems for pest, disease and weed management, cleaning, machinery operations and other purposes. They pose significant risks to the environment and people if not selected, transported, stored, handled, applied and disposed of appropriately. The use of pesticides and other harmful chemicals is strictly controlled by legislation. Pesticides, in particular, are potentially harmful to human health, plants, animals and ecosystems if not managed according to product labels and Material Safety Data Sheet (MSDS) information. The community places a high priority on the responsible management of chemicals. Inappropriate chemical use can cause conflict with neighbours and the wider community, and may damage the reputation of the industry as a whole.

Business benefits

Legal requirements are met and reputational risks managed by minimizing the potential off-farm impacts of chemical use. Maximising the effective use of chemicals on-farm can reduce input costs.

Scope

This section addresses all chemicals potentially used in vegetable production including agricultural crop protection products, growth regulators, cleaning products, sanitisers, water treatment products, and fuels and oils. The section considers how harm to the environment may be minimized through critically reviewing the need for chemical use, and the

appropriate storage, handling, use and disposal of chemicals and chemical containers. Opportunities to reduce use of agricultural chemicals through holistic pest management practices are addressed in section five and the management of fertilisers and soil additives is addressed in section three.

Management objectives

Chemicals are only used in vegetable production systems when necessary and their use can be clearly justified.

Chemical storage, transport, handling, application and disposal are managed according to legal requirements and in accordance with labels, permits and Material Safety Data Sheet (MSDS) information. Soils, waters, natural environments or neighbouring properties are not contaminated or affected. Reasonable community expectations are met.

Agricultural chemicals are used as part of an integrated crop protection program. Preventative products are chosen over curative products. Curative products used are selective and friendly to beneficials.

Appropriate, maintained equipment, precision technologies and timing are used to optimise product placement.

Chemicals of the lowest overall toxicity and risk profile are used.

Operators using chemical are trained and have the required certifications.

“There is also a marked global trend towards sustainable agriculture, building on traditional methods which use fewer chemical inputs, carefully manage soil and water resources, and work hand-in-hand with nature.”

- Helen Clark



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E4. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

E4.2 Obtain, check and record chemicals

1. Chemicals are purchased from approved suppliers. (See Freshcare Environmental Appendix A-E4).
2. Chemical containers are adequately labelled and not damaged or opened when bought or received.
3. Chemicals are not decanted.
4. All chemicals coming on site are recorded in a chemical inventory. A record is kept and must include:
 - Name of chemical
 - Date purchased/received place of purchase
 - Batch number (where available)
 - Expiry date or date of manufacture quantity.
5. Once a chemical container is empty, the last usage date and date of container disposal are noted.

E4.3 Store, manage and dispose of chemicals to minimise the risk of environmental harm.

1. Chemical storage areas must be:
 - located and constructed to minimise the risk of contaminating the site and surrounding environment including via floods or fire
 - structurally sound, adequately lit and constructed to protect chemicals from direct sunlight, weather exposure and floods or fire
 - equipped with an adequate (for the type of products stored) spill kit to contain and manage chemical spills and adequate fire control equipment
 - secure, with access restricted to authorised, trained persons.
2. Chemicals are stored in designated separate areas for each category of chemical, and for chemicals awaiting disposal.
3. A current Material Safety Data Sheet (MSDS) and label is kept in the chemical storage area for all chemicals stored there. If possible, relevant staff

should have access to MSDS and label information on mobile devices.

4. Chemicals are stored in original containers according to directions on the container label and MSDS. If a chemical is transferred to another container for storage purposes, the new container is a clean chemical container and a copy of the product name and chemical label is transferred to the new container. Chemical should not be decanted, if not necessary i.e. only if the original container is damaged. By law, they must never be decanted at the point of purchase.
5. Deteriorating chemical labels are replaced immediately with a legible copy.
6. Stored chemicals are checked at least annually to identify and segregate chemicals for disposal that have:
 - exceeded the label expiry date
 - exceeded the permit expiry date had their registration withdrawn
 - leaking or damaged containers or no/illegible labels.
7. A record of the check is kept and must include:
 - date of the check
 - name and quantity of chemicals awaiting disposal
 - name of the authorised person conducting the check.
8. Unusable chemicals and empty chemical containers are legally disposed of through registered collection agencies, or in approved off-farm disposal areas. A record of approval and each disposal is kept including:
 - Date of disposal
 - Name and quantity of disposed chemicals
 - Disposal method
 - Name of authorised person conducting the disposal.
9. Each person dealing with chemicals should have his/her own personal protective equipment (PPE). It must be cleaned after each use and not be kept in the chemical storage area. Gas mask filters must be the right type for the product(s) used. After use, they must be removed from the mask and stored in a clean zip lock bag. Filters must be replaced regularly as per manufacturer's instructions.



E4.4 Train and authorise workers who transport, store, handle, apply and/or dispose of chemicals.

1. Workers involved in the transport, storage, handling, application and disposal of chemicals must:
be certified via a recognised chemical users course or equivalent (See Appendix A-E4).
be competent in chemical storage, handling, application and disposal as specified by the Freshcare Code of Practice Environmental.
2. Workers authorised to transport, store, handle, apply and/or dispose of chemicals are trained in practices that minimise the risk of environmental contamination from chemicals and in actions to be taken in the event of chemical spills, leakage spray drift, flood, fire or medical emergencies.
3. A register of workers authorised/certified to store, handle, apply and/or dispose of chemicals is maintained and displayed in the chemical storage area.

E4.5 Use chemicals according to regulatory, label and customer requirements.

Chemicals are used and applied:

1. according to label directions and MSDS, or
2. under 'off-label permits' issued by the Australian Pesticides and Veterinary Medicines Authority (APVMA), with a current copy of the permit kept, or
3. according to relevant state legislation for 'off-label use', and
4. according to specific customer and/or destination market requirements (Minimum Residue Limits MRLs).
5. Any incident involving the incorrect use of chemicals is recorded and, if required via regulations, reported to the relevant agency.

E4.6 Avoid potential for spray drift or other off-target risks.

1. Chemicals are not applied when the risk of contaminating off-target areas, e.g. with spray drift, vapours, dust, leakage, run-off or seepage, is high.

Spray drift and other incidents of off-target contamination are identified. A record is kept of each incident.

E4.7 Maintain and calibrate equipment used for pesticide applications and other chemical use purposes (such as sanitising, cleaning, fumigation, machinery operation etc.).

1. Chemical application/handling equipment is maintained and checked for effective operation before and during each use.
2. Equipment is calibrated at least annually or as per manufacturer's instructions.
3. Pesticide application equipment is used with the best nozzle type for the intended purpose. and equipment is calibrated immediately after spray nozzles have been changed or replaced.
4. Equipment is calibrated using a recognised method. A record of calibration is kept and must include:
description of reason, method and calibration results
date of calibration
name of the person calibrating the equipment.

E4.8 Manage mixing and disposal of chemical solutions to minimise risk to the environment.

1. Chemical mixing areas are located, constructed and maintained to minimise the risk of contaminating the site and surrounding environment.
2. Leftover chemical solutions are disposed of according to label directions where specified, or in a manner that minimises environmental harm.

E4.9 Record all chemical uses/applications.

1. Records of all chemical applications/uses are kept and must include:
application/use date
start and finish times
location, purpose and crop or other target or use
chemical used (name, active ingredient, toxicity class and batch number, if available)
rate of application and quantity applied/used
equipment and/or method used to apply the chemical
wind speed and direction (for pesticide applications)
withholding period (WHP) or earliest harvest date (EHD) for applications to crops/product
method of disposal of leftover chemical solutions
name and signature of the person who applied/used the chemical.



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Improper use of agricultural chemicals, pesticides, surfactants and other additives:	- Negative impacts on biodiversity and ecosystem health - Increased costs - Penalties/fines - Crop losses, quality losses
Agricultural chemicals are used that are not registered or permitted for use in the vegetable crop or used outside of label recommendations (rate, timing, crops, withholding period etc)	- Loss of market access due to detection of residues - Reputational damage
Agricultural chemicals are registered for use in vegetable production but are broad spectrum, S7 high to very high toxicity products and have low biodegradability (residual products)	- Increased presence of toxic substances in the environment - High risk of harm to non-target species - Potential risk to human health - Risk of harming beneficial species (pollinators and predators)
Overuse of particular agricultural chemical products and/or of groups of products with the same active ingredient / mode of action	Pests develop resistance to chemical treatments and/or soil organisms break down soil applied products before they can work as expected (enhanced biodegradation)
Incorrect timing of application leads to repeated chemical use because target organisms survived	- Exceedance of residue limits - Pesticide resistance and/or enhanced biodegradation
Spills, leaks or leaching of agricultural chemicals from mixing facilities or disposal areas (even if approved)	- Loss of product - Financial loss
Poor application practices cause over-application or off-target / off-site movement of agricultural chemicals	- Contamination of adjacent properties, waterways, natural areas or marine environments - Contamination of irrigation or drinking water supplies (human or stock use) or waterways used for recreational purposes by communities - Reduced production efficiency - Risk of exceeding maximum residue limits/loss of market access
Personnel who handle or apply chemicals are not adequately trained or certified/licensed	- High risk of inaccurate or inefficient application - Risks to worker safety



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Application equipment is not properly maintained, calibrated, used with incorrect nozzles or settings (e.g. ground speed, pressure)	- Reduced production efficiency - Need for repeat sprays and associated risks/impacts
Improper use of all chemical products	- Negative impacts on ecosystem health and biodiversity - Loss or misuse of product - Risks to worker and/or community safety - Incidents requiring reporting to environmental or health authorities
Chemicals are not stored securely or are accessed by unauthorised persons whom are not certified, trained or supervised as required	Damage to plant and equipment
Regulatory information and MSDSs are not available to users or supervisors	- Contamination of soils or water used for all purposes - Impact on off-target plants/animals
Surplus chemicals are disposed of inappropriately, or they leak and leach	- Contamination of soils or water used for all purposes - Mistaken use, affecting efficacy/contravene MRLs
Obsolete/old chemicals are stored on site for an excessive period	- Workers' health risks when handling or using chemicals - Crop losses, if chemicals are used
Chemicals are stored in unlabelled containers	- Conflict with neighbours - Loss of community support for vegetable business or local industry
Chemicals are stored in defect containers or of materials prone to deterioration	- Chemicals get into soils, water or air - Workers' and community health risks
Chemical use on the property causes legitimate concern amongst neighbours or the local community	Reporting to environmental or health authorities
Spills, leaks or leaching of chemicals, cleaners, oils or fuels from storage sites/facilities	Health/safety risks to staff and communities



RECOMMENDED PRACTICES

The following practices are recommended to manage risks. Consider incorporating these practices in your chemical management program and/or environmental action plan.

Adhere to legal requirements

The below summary of legal requirements is for general information. Important legal details have been omitted to provide a brief overview of this area of the law. If you require legal advice relating to your specific circumstances you should contact the responsible state department(s) or your solicitor. AUSVEG, Growcom, Freshcare and Hort Innovation take no responsibility for any loss or damage resulting from any error in this information.

General

According to law, a person directly or indirectly storing, handling, using or transporting dangerous goods must take all reasonable steps to minimise the risk to people, property and the environment. Failure to exercise reasonable care in the use, storage or transport of dangerous goods is an offence, and is subject to penalties (jail and/or a fine for an individual, or a company). Further information on the rules applying to specific chemicals should be obtained from the responsible state department(s).

A product is considered an agricultural chemical (pesticide) product if it meets the APVMA definition of an agricultural chemical product. It is unlawful to use a pesticide in any manner, place or circumstance which is dangerous or harmful to human health. For the most part, this duty just requires the operator to apply the chemical in accordance with the label. Specific restrictions and regulations apply to aerial spraying. These can be obtained from the responsible state department(s).

Registration

Legally, a person may only use, possess or transport a pesticide (active constituent) if it is approved (or exempted from approval) and registered (subject to certain exceptions) by the APVMA and it is kept in the required kind of container and has an approved label. The APVMA maintains a public database (PubCRIS) where you can check whether an agvet chemical product is registered or an active constituent is approved.

A pesticide cannot legally be used for any purpose other than the purpose shown on the approved label. It is also against the law to use a pesticide in excess of the recommended frequency or rate of application, or otherwise than in accordance with any direction or precaution shown on the label. However, the APVMA can issue a permit for the use of an agricultural chemical contrary to the label where it is a minor use, an emergency use; or for the purpose of research. The APVMA may authorise the importation of unregistered and unapproved agricultural and veterinary chemicals where necessary.

Suppliers

The supply of an unregistered product is an offence. Other offences include making claims that are inconsistent with the registered label, supplying pesticides with no or an unapproved label, importing an unregistered pesticide without APVMA exemption, and supplying pesticides in contravention of any conditions relating to that supply. To find out whether the product you are buying requires registration before it is supplied check the APVMA guideline: Does my product require registration?

A supplier selling an unapproved active constituent or a product that is not registered (where active constituent approval or product registration is required), or a product that has an unapproved label attached and is not subject to an approved permit, the supplier may have committed an offence under the Agvet Code.

The APVMA operates an Adverse Experience Reporting Program, which is a quality assurance program established to facilitate the responsible management of agvet chemicals throughout their life cycle. If in supplying or using an agvet chemical any adverse experiences occur, they should be reported to the APVMA.

Dangerous Goods

Many agricultural and other chemicals used on farms and in packing sheds legally fall under the definition of "dangerous goods". Full details about the classification of various chemicals should be obtained from the responsible state department (links to all state departments can be found at the bottom of the Safe Work Australia page on classifying chemicals).



Transport

Depending upon the quantity of a chemical transported, the carriage of such chemicals on public roads may require the vehicle to carry placards, protective suits for the driver or the chemical to be packaged in a certain way. Documents explaining the type of chemical being transported must be carried on all vehicles, irrespective of quantity. For full details on the transport of dangerous goods contact your responsible state department.

Storage

A place where dangerous goods were, are, or are intended to be stored or handled is defined as a "dangerous goods site". A person who has the control or management of a dangerous goods site commits an offence if State Regulations require the site to be licensed and the site is not licensed. A site may not be required to be licensed depending on the length of time the goods will be stored at the site, quantities and other factors. State Pesticide Regulations may additionally require commercial pesticide operators to store pesticides in a manner that ensures they do not contaminate a water supply or watercourse. For more information on licensing, contact the responsible state department(s).

Chemical Application

Failure to take steps to minimise the risk of damage to people, property or the environment under the respective state Dangerous Goods Legislation, may be an offence in relation to spray drift. Under the common law, a person affected by spray drift may also be able to take action in trespass, negligence or nuisance.

Where damage is caused by spray drift from (aerial) spraying, any damage to crops, trees, pastures, or animal life on a person's land must be reported to the responsible state department within a limited timeframe (e.g. 14 days) of observing the damage. Failure to give notice may remove the right of the injured party to claim damages against the person responsible for the spraying.

Pollution Controls

Usually, there are controls on the use of agricultural chemicals in catchment areas set aside for public drinking water. In most circumstances, it is an offence to place or use any pesticide, insecticide or herbicide in a water catchment area without written permission of the responsible state department.

A person storing, handling or transporting dangerous goods (including many agricultural chemicals) is required to report spills and other dangerous events to a responsible state department(s) as soon as practicable. Where an agricultural chemical spill is likely to cause pollution or environmental harm (i.e. because of the quantity, characteristics of the chemical or sensitivity of the location of the spill), the occupier of the land on which the discharge occurred may be required to inform several departments, e.g. in charge of environment, agriculture and or human health. A responsible department can take action against a person who causes pollution and harm to people, property or the environment.

Further pollution controls/regulations may apply in each state.

Ensure appropriate level of chemical users training is maintained for all team members/workers

Ensure that all team members/workers transporting or handling chemicals obtain and maintain the required current certification, e.g. via an accredited chemical users' training course, for the type of application they will perform (e.g. ground-spraying, aerial spraying, fumigation).

Check legal requirements for training/qualifications in agricultural chemical purchase, use, transport, storage and handling with the relevant state agency; regulations are different in each state and may change from time to time.

The **Chemical Accreditation** course must be nationally recognised and enable the holder to legally use restricted chemicals.

In other states, it is a legal requirement that the person applying an agricultural chemical is working under the direction and direct supervision of a licensed pesticide operator who has current Chemical Accreditation.

It is important to meet the required schedule for retraining/refresher courses to maintain currency of Chemical Accreditation and other certifications that are a legal requirement.

Some state governments may have specific requirements and it is the responsibility of the business owner(s) to be up-to-date with compliance.



Ensure appropriate procedures, work instructions and signage to ensure responsible and legal transport, storage, handling and use of chemicals

Ensure all staff who handle or apply agricultural or other chemicals receive **appropriate induction and training in responsible chemical handling, application and management**, as well as personal protection. Enforce the rules about Chemical Accreditation, especially only applying chemicals under supervision of certified staff where it is permissible or being certified. An induction alone is not legally sufficient.

Ensure that a sufficient number of staff have Chemical Accreditation to be able to cover for annual and personal leave and the size/area of the operation including different locations within the farming business.

Ensure you have **adequate, current procedures, work instructions** and signage to ensure responsible and legal transport, storage, handling and use of chemicals. The information must be accessible and understandable for relevant staff. You may need to provide documents and signage in more than one language, depending on the proficiency of your staff to read and understand English.

Review the production system to identify opportunities to minimise chemical use

Follow a **recognised approach to Integrated Crop Protection** to reduce the requirement for agricultural chemical use. Recommended practices regarding integrated pest management are detailed in section five.

Where possible, select cultural practices or products that have the lowest potential for environmental impact and risk for beneficial organisms. For example, consider whether **biopesticides might be an option**.

Only use chemicals when needed and if there are no suitable alternative practices or products.

If necessary for certification or market requirements, document the decision-making process to provide clear justification for the chemicals you use.

Use available pest and disease forecasting models, crop scouting and precision ag methods for the best, environmentally safe approach to pest, disease and weed control. Get advice on

technologies that fit your business.

Select, purchase and transport chemicals appropriately

Select chemicals carefully to ensure each product is appropriate for the intended use and authorised to be used for that purpose. Consider seeking advice from a qualified advisor regarding the selection of agricultural chemicals, particularly to check for new products and technologies that are environmentally friendly.

Select only agricultural chemicals/pesticides that are registered for use in your state by the Australian Pesticides and Veterinary Medicines Authority (APVMA), indicated by an APVMA product number on the label. Not to do so is illegal.

Select only agricultural chemicals/pesticides that are authorised for use for the pest, crop, and application method and concentration that you propose to use (as shown on the chemical label). This information is available on the Infopest website. Alternatively, a permit must be held for any uses that are not authorised on the label (off-label use). Not to do so is illegal.

DO NOT USE **S7 CHEMICALS AND ONLY MODERATELY USE S6 PRODUCTS**

- **Schedule 6** poisons are substances with a moderate potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label.
- **Schedule 7** poisons are substances with a high potential for causing harm at low exposures which require special precautions during manufacture, handling or use. These poisons should be available only to specialised or authorised users who have the skills necessary to handle them safely. Special regulations restricting their availability, possession, storage or use may apply.

Source: tga.gov.au/publication/national-guideline-retail-storage-schedule-6-and-schedule-7-poisons

Select agricultural chemicals/pesticides that are specific to the pest, do not harm beneficials or bees, break down quickly (rather than being residual), and of lowest risk to humans and non-target plants and animals.



Wherever possible, select agricultural chemical products that participate in the national **DrumMuster** program, which collects and re-uses empty farm chemical containers.

Consider the management of pesticide resistance and enhanced biodegradation in the selection of chemicals. Usually there are several products with the same active ingredient, so it is recommended to rotate the use of active ingredients according to resistance management advice, e.g. from **CropLife Australia** or your supplier.

Preferably, purchase agricultural chemicals only from an **AgSafe accredited supplier**.

Check that the chemicals you obtain are compliant with **APVMA regulations**.

Check that containers of chemicals obtained are in good condition and return any damaged or leaking containers to the supplier.

Never purchase opened containers of chemicals (for example, from farm clearance sales).

Follow legal requirements regarding transporting chemicals to the property. This includes (but is not limited to):

- Ensuring chemical containers are leak-proof and adequately secured during transport, are isolated from the driver and passengers, and are not transported with animal or human food.
- Observing safe handling practices when transporting pesticides and chemicals.

Store chemicals safely and securely

All states have strict regulations concerning storage of pesticides on farm and business sites, including occupational health and safety requirements. Check with your local authority to ensure compliance with all relevant regulations.

Consider storing agricultural chemicals at an appropriate off-site location or central storage point, such as a local spray contractor.

Ensure farm chemical storage facilities on the production site are located, constructed and equipped to minimise the risk of pollution of air, soil and water.

Any new chemical storage should meet the highest standards of design and construction.

Existing chemical sheds may need to be improved. The following considerations should be met:

- Locate chemical storage areas well away from residences / other occupied buildings, production facilities, water storages, waterways, floodplains, and areas subject to flooding.
- Chemical storage areas must meet building regulations and be structurally sound, well ventilated, well lit, fireproof and weatherproof.
- Storage facilities should be connected to a water supply to provide access to running water and contain firefighting equipment appropriate for the type of chemicals stored. Staff must be trained in the appropriate use of firefighting equipment (via induction, training and work instructions), including knowing what to use when and when to abandon the site to avoid injury.
- The floor should be impermeable and be easy to clean if there is a spill.
- The floor should include 'bundling' (a wall or embankment) to contain spills for collection and responsible disposal.
- Keep the storage area clear of extraneous or combustible waste materials and control ignition.
- Chemical storage areas should be appropriately signed for the size and nature of the storage, including a 'No Smoking' sign.
- The chemical storage area must be secured with a lock and unauthorised access must be prohibited.

Equip the chemical storage area to meet standards set out in the Material Safety Data Sheets (MSDS) for each chemical that is stored.

- Keep current Material Safety Data Sheets for all chemicals stored.
- Provide a chemical 'spill kit' as required in the MSDS. At a minimum, the kit should include a shovel, absorbent material that will not react with the chemical (such as dry soil, dry sand, kitty litter or vermiculite) and containers to store the absorbed spill.
- Store pesticides and chemicals in their original containers. Regularly check pesticide and chemical containers for any leakage or damage.
- Ensure that all chemical containers are adequately labelled. If labels become damaged, replace them with duplicate labels immediately. Store all farm chemicals on the property according to the directions on the container label.
- Store each category of farm chemical (for example, insecticides and herbicides) in



separate designated areas. Store pesticides separately from fertilisers and chlorine. Store liquid pesticides and chemicals in shelves below powders.

- Store only enough pesticide on site to meet short/medium-term needs.
- Store farm chemicals awaiting disposal separately in accordance with the MSDS and manufacturer's instructions, and clearly show that these chemicals are not to be used.

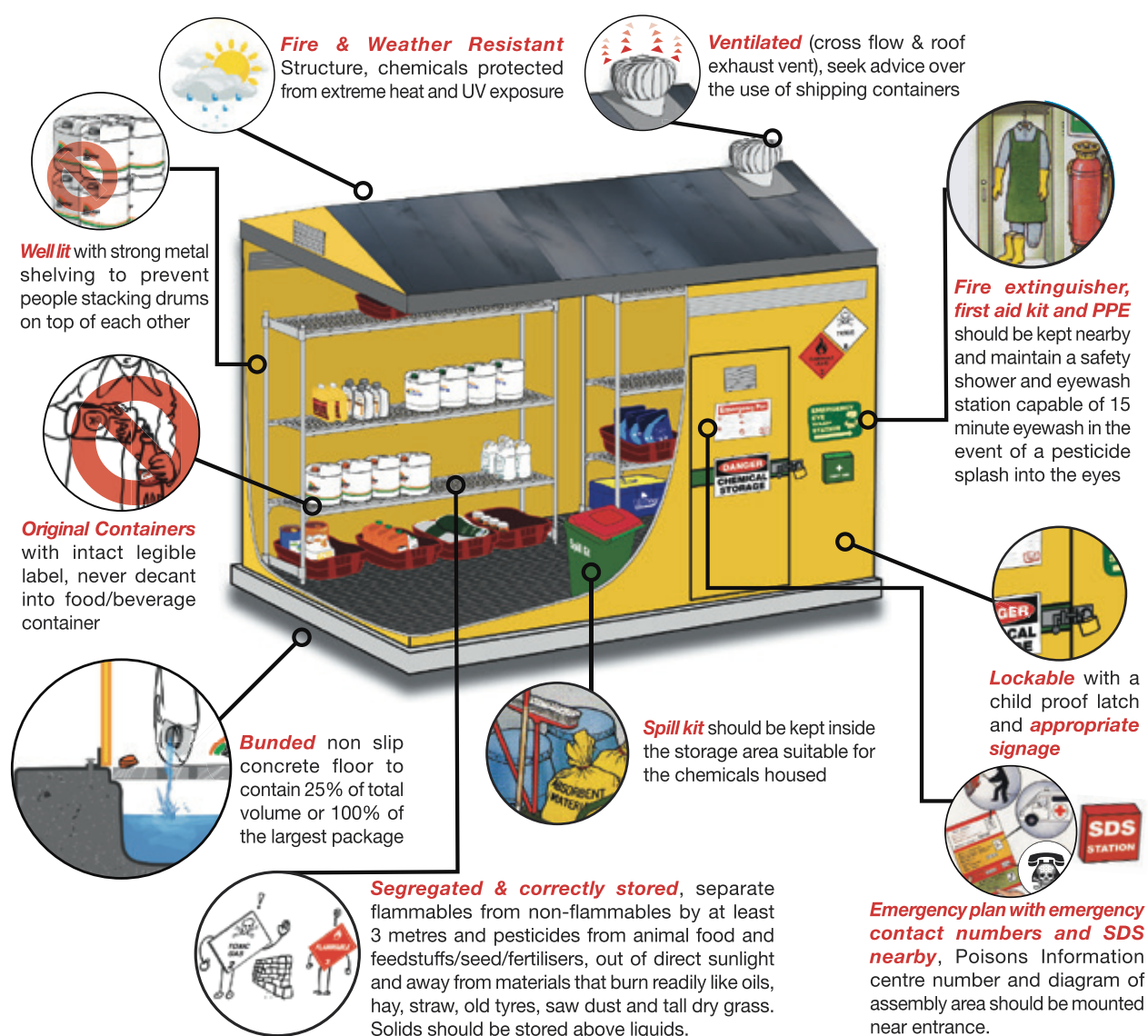
Manage chemical stocks to ensure they are in good condition at all times and do not pose a risk to health, safety or the environment.

Keep a comprehensive inventory of the chemicals stored on site, including records of

- Chemicals obtained and stored (date, place of purchase, batch number, label expiry date, permit number and expiry).
- Chemicals that are no longer usable (exceeded label or permit expiry date, had their registration withdrawn, and/or containers that are leaking, corroded or have illegible labels).
- Chemicals and chemical containers that have been disposed (date, method and by whom).

Review farm chemical stocks at least annually to ensure that all chemicals are stored responsibly and are appropriate for use. Check each container to identify any chemicals that have exceeded their label expiry dates, are no longer useable, have illegible labels or have leaking or corroded containers.

FIGURE 1: CHEMCERT STORAGE FOR HAZARDOUS CHEMICALS



Be prepared to manage chemical spills or emergencies

Prepare an **emergency plan** to guide the response to spills or emergencies for each type of chemical stored or mixed on the property. Follow management procedures indicated on MSDS documents.

Keep spill kits at storage facilities and mixing areas, which should include:

- A shovel
- Sufficient dustless absorbent material, such as 'kitty litter', activated charcoal, vermiculite, hydrated lime, clay or earth and dry sand (avoid using sawdust or other combustible materials)
- Containers to hold the absorbent material or other leaking containers.

Deal with spills promptly, guided by the relevant MSDS and emergency plan.

When cleaning up a spill, wear protective clothing, including gloves, respirator, boots and eye protection.

Unless advised otherwise in the MSDS, use absorbent material to absorb the spill. Do not flush spills into drains.

Properly dispose of the chemical-drenched absorbent clean-up material as indicated in the MSDS. It may be necessary to dispose of the material via a waste management company.

Use hydrated lime or bleach to decontaminate spill surfaces, but never use these two materials together.

Report the spill to authorities (such as the state government environmental agency) if it is large or if it has or may enter a waterway, according to your legal obligations.

Store and handle fuels and oil appropriately

Ensure permanent fuel storage facilities are located, constructed and equipped to minimise the risk of pollution of soil or water. The following considerations should be met:

- Locate fuel storage areas well away from production facilities, water storages, waterways and floodplains.
- Fuel storage areas must meet building regulations and be structurally sound, well-ventilated, well lit, fireproof and weatherproof.

- The floor should be impermeable and be easy to clean if there is a spill.
- The floor should include 'bundling' (a wall or embankment) to contain spills for collection and responsible disposal.
- Secure fuel storage areas with a lock and prohibit unauthorised access.
- Equip the fuel storage area to meet standards set out in the Material Safety Data Sheet (MSDS).
- Provide a 'spill kit' as required in the MSDS. At a minimum, the kit should include a shovel, absorbent material that will not react with fuel (such as dry soil, dry sand, kitty litter or vermiculite) and containers to store the absorbed spill.

Check your stored fuel and storage area regularly for leaks.

Use an appropriately qualified professional to check in-ground tanks regularly for leaks.

Manage mobile fuel tanks

- Ensure mobile fuel tanks do not leak and are resistant to accidental damage.
- Use mobile tanks with care, particularly near water storages, waterways or drains. Do not allow fuel to leak into water.
- Collect any significant spills of fuel into soil and dispose of responsibly at a licensed landfill or via a registered water contractor.

Use and apply agricultural chemicals appropriately

Ensure that all personnel with authority to handle, apply and dispose of chemicals are trained and certified through a recognised chemical users' course.

- Maintain a register of personnel authorised to store, handle, apply and dispose of chemicals and display this register in the chemical storage area.
- Ensure all personnel who handle or apply chemicals are trained in practices to minimise risks of chemical spills, leakage, spray drift or other environmental contamination.

To minimise potential conflict with neighbours, notify neighbours and others (e.g. apiarists) of your intentions to use chemicals when there is a risk of affecting their assets, or causing them concern.

Before use, check each chemical to ensure that it is useable and is within the label expiry date. Always follow the requirements of labels and/or permits and instructions outlined on MSDS.



Maintain and regularly calibrate chemical application equipment to reduce operating costs and wastage and to reduce the risk of damage to the environment.

- Ensure that chemical application equipment is appropriate for the proposed use and only applies the amount of chemical required.
- Check equipment for operational efficiency before and during each use (according to the manufacturer's instructions or other appropriate methods).
- Calibrate equipment after each nozzle change and at least annually (or according to manufacturer's instructions or other appropriate methods).
- Keep records of calibration including the date of calibration, equipment calibrated and the name of the person conducting the calibration.

Chemical mixing must be done in a way that minimises risks to water storages, water ways and other sensitive environments.

- Locate chemical mixing and wash down areas well away from production facilities, water storages, drains and waterways.
- The floor of the mixing area should be: bunded to contain spills for collection and responsible disposal; impermeable; and be easy to clean.
- Take care to minimise spills when pouring concentrate and filling spray units.
- Avoid back-siphoning from tanks when filling.
- Triple rinse empty chemical containers and mixing equipment into the spray vat.
- To reduce wastage or surplus, mix only the amount of chemicals required.

Record all chemical treatments – use **preharvest** and **postharvest chemical** application records.

Observe all withholding periods (where applicable) to ensure produce meets health, safety and market requirements.

Avoid spray drift or other off-target movement of pesticides or agricultural chemicals

If using a contractor to apply chemicals/ pesticides, provide a briefing regarding the farm plan, including the location of the target and any sensitive sites including waterways and native vegetation.

Ensure that chemical application equipment is appropriate for the proposed use. Use spot-spray equipment in preference to boom sprays where feasible.

- Ensure that chemical application equipment only applies the amount of chemical required.
- Ensure that spray equipment is set at correct operating pressures and is fitted with nozzles for delivering appropriate spray pattern and droplet size.

Spray only when there is low risk of rain, unless stated otherwise on the product label or permit.

Coordinate chemical application with irrigation to minimise runoff of chemicals into water supplies.

Spray only when there is a low risk of spray drift. Check conditions during spraying and stop spraying if the overall risk of drift is no longer low.

Protect water supplies and waterways from spillage, chemical run-off, spray drift or over spraying; keep a sufficiently wide unfarmed area/ riparian zone to achieve this; ensure erosion events do not cause soil entering the water.

Maintain buffers and vegetated barriers to reduce the off-target movement of agricultural chemicals

Establish buffer zones around sensitive sites. These are preferable vegetated areas in which no agricultural chemicals should be applied, to help minimise the risk of chemicals reaching a sensitive site from a spray operation.

- Refer to the product label and relevant state government departments for guidance on the location and width of buffer zones necessary to protect sensitive sites adjacent to the production site.
- Other factors that should be considered in determining the appropriate buffer width to prevent movement of chemicals in water runoff include: soil type, soil cover, steepness of the site, and the presence of drains and filters.
- The **Australian Pesticides and Veterinary Medicines Association (APVMA)** notes that to minimise harm to waterways, buffers of more than 500 metres downwind of spray sites may be required.

Use vegetation barriers to help protect non-target areas from chemicals.

- Vegetation barriers are not a substitute for responsible spray management and will not affect vapour drift or odour from spray operations. They can help filter spray droplets and dust from the air. Vegetation barriers can be sweet corn or other tall crops, or permanent windbreaks. Well-located vegetation



including native trees and shrubs can also reduce wind speeds and provide shade, shelter and habitat for beneficial insects (see Biodiversity section for more information on shelter belts).

- To optimise the functionality of vegetation barriers, the vegetation should:
 - be taller than the target plants, and the spray unit being used
 - have rough and thin foliage
 - be thin enough to see through which allows 50% of the wind to pass through
 - be located to take into account prevailing wind direction and location of crop, block and property boundaries or sensitive sites, such as water storages, waterways, neighbouring properties or adjacent residential areas.

Manage chemical waste, including surplus chemical solution, containers and unwanted chemicals

To avoid or minimise the volume of surplus chemical solution, mix only the quantity of chemical required.

Leftover chemical solutions are disposed of according to label directions where specified, or in a manner that minimises environmental harm.

Dispose of surplus chemical solutions from spray units, flumes, dips or postharvest treatment tanks, and rinsings from spray tanks or chemical containers in a manner that avoids potential pollution of soils or waterways. Check the product label for guidance on appropriate disposal and seek specialist advice if necessary. Disposal options may include:

- Storing rinsate or surplus spray in an appropriately labelled container and dispose safely with unwanted chemicals (storing for later use is not an option as efficacy disappears quickly).
- Diluting rinsate/surplus spray and spray on to target crop in a manner that will not exceed label rates or wash off chemical previously applied.
- Spraying leftover pesticide and washings from rinsing after spraying onto an area of ground away from people and from drains, low drainage areas, waterways and water storages (follow label guidelines).
- Emptying into a lime-filled pit (obtain advice as to quantities of lime and appropriate sites before using this method).

- Consider using enzyme products (new technology enzyme products are capable of almost complete breakdown of organophosphate insecticides, either in the spray tank or in a holding tank, and provide a useful option for rapid chemical clean-up). Contact your chemical supplier for advice on specific products and their application.
- Post-harvest dips may also be treated with lime to deactivate the agricultural chemical.

Dispose of used chemical containers appropriately.

- Un-rinsed containers can hold up to 3% of concentrate – representing a cost to the farm business as well as a hazard to people who handle the containers, and the environment.
- Triple rinse chemical containers and add the rinsate to the chemical solution (for example, a spray tank) for immediate use or disposal.
- Dispose of used chemical containers through registered collection agencies or in approved off-farm disposal areas to meet legal requirements. Return containers with the DrumMUSTER logo for reuse.

Disposal of unwanted chemicals (including unregistered or out-of-date chemicals in their original container) through the ChemClear program.

Manage contaminated sites

Any areas, buildings or equipment on the property that have been contaminated by fuels or chemicals (such as heavy metals, organochlorines) must be identified on the property maps.

Test to determine the extent of any contamination.

Isolate contaminated sites and do not use for production.

Seek specialist advice regarding the most effective ways to manage and/or rehabilitate contaminated sites.

Manage contaminated sites to minimise the off-site movement of residues by runoff, leaching or erosion.

If the business maintains organic certification, any contaminated sites may need to be identified within the Organic Management Plan.



FIGURE 2: FARM CHEMICAL STORE CHECKLIST

ITEM	YES	NO	COMMENT OR REQUIRED ACTION
1. Do you have a lockable chemical store? Ideally a stand-alone concrete or brick constructed store (an iron-clad store is acceptable) with a concrete floor			A section of an existing building can be partitioned off to form a chemical store
2. Is the chemical store construction suitable for the chemicals stored? - Fire rating - Concrete floor			Check the MSDSs
3. Is your chemical store located in the most appropriate position? - Close to delivery and despatch points - Complies with local government and OH&S legislation - Complies with separation distances from other buildings, services and roadways - Appropriate for wash-down and spillage clean-up - Ideally, a stand-alone store that is clear of other workplace services and activities			Check local Council laws and ensure that you comply with their requirements. Refer to the Dangerous Goods/Hazardous Substance Regulations or to "A Step by Step Guide for Managing Chemicals"
4. Has an interceptor trap been installed to the drain from the floor of the chemical store? - An interceptor trap needs to be installed so that the store can be washed out without any chemicals escaping into the environment - The contents of the trap can be pumped into a container and taken to the disposal depot			Ensure interceptor trap is installed. A manual pump should be used to avoid sparks. The interceptor trap may contain flammable materials and dangerous gases
5. Does the store have natural, filtered lighting? If the store is fitted with electricity, is there a risk of creating a spark?			Intrinsically safe lighting must be installed if natural lighting is not available
6. Is the chemical store vented correctly? There should be a vent at the highest point and the lowest point in the store to prevent the build-up of gases and vapours			Refer to the Dangerous Goods/Hazardous Substance Regulations for the details of vent location and size or to "A Step by Step Guide for Managing Chemicals"
7. Can the stored chemicals be affected by UV rays or excessive heat? UV rays might destroy labels as well as damage the chemical			It may be necessary to protect contents from direct sunlight
8. Has suitable bunding been provided for stored chemicals? Containers of chemicals are placed in bunding so any leaks will be contained. Also the complete store can have concrete floor bunding to contain any leakage			Bunding can be purchased or plastic containers not adversely affected by the chemical can be used. Refer Australian Standard AS 2508
9. Is the correct signage displayed? - The classes of chemicals stored - HAZCHEM signs at the entrances if the classes and quantities of chemicals stored require that. Refer to the Dangerous Goods/Hazardous Substance Regulations - Sign indicating where the PPE is located - Sign indicating where First Aid is available - Signage must comply with sizes and colours			Conduct an audit of chemicals stored and used on the property to ascertain if the amount is above the "Placarding Quantity" listed in the Dangerous Goods Regulations. Explain your situation to the shop that provides safety signs and they should be able to direct you
10. Is shelving suitable for the chemicals stored? - Shelving should be made from material which will not absorb chemical (wooden shelving is unacceptable) - Shelving must be strong enough to sustain the weight of the chemicals stored			Replace any wooden shelving with metal or other impervious material. Refer to Australian Standards AS 2508
11. Have segregation rules been applied?			Re-arrange the chemicals. Refer to Dangerous Goods regulations
12. Has suitable fire protection been installed? A fire extinguisher of the correct type should be available			Read the container labels and the Material Safety Data Sheets to determine the most suitable fire extinguishing agent and locate nearby but not in the store
13. Have correct signs been displayed for chemicals in the workplace?			Refer to the Dangerous Goods Regulations. If the chemicals stored and handled in the workplace exceed the "placarding quantity" then a HAZCHEM sign will be required at the entrance to the property



EXPECTED OUTCOMES

Improved management practice outcomes expected to be achieved through implementing these practices include;

Within 1-5 years

- Chemical use and management meets all legal requirements
- Employees are trained in responsible chemical management and certified or supervised as legally required
- Chemicals are appropriately selected (being registered or having permits), stored, used and disposed
- Appropriate chemical application equipment is selected and equipment is regularly calibrated and maintained
- Chemical spills or emergencies are effectively managed and reported as required by law
- Off-target contamination of soil and water is avoided
- All chemical treatments are monitored and recorded and withholding periods observed.

Longer term outcomes, which may take 5-10 years or more

- The use of chemicals (in particular S6 and S7) is reduced
- Chemicals are selected with consideration of their potential impact on aquatic life, beneficial, bees, etc.
- Chemicals are used appropriately and the off-site release of chemicals from vegetable production sites does not occur.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- [Soil Wealth email updates](#)
- [VegNET – extension officers](#)
- [AHR resources](#)

Horticulture wide updates

- [AUSVEG mailing list, including weekly updates](#)
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)

Industry updates:

- [Chemclear](#) – chemical disposal
- [APVMA](#) – chemical availability
- [Ag Chemical Update](#) – Hort Innovation, February 2018
- [Victorian Agricultural chemical permits](#)
- [ChemCert news](#)

“It’s important to concede that modern pesticides have helped to make farming more productive and to increase yields.”
- Chuck Norris

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Identification of potential alternatives to metham sodium

VG13045

The continued reliance on chemical soil fumigants such as Metham Sodium (MS) can largely be attributed to consumer demand for low cost, good quality, nice-looking vegetables. This drives the need for intensification and specialisation in the vegetable industry to maintain economical viability. Ironically, consumer expectations and market requirements may also affect the continued acceptability of using 'old style' broad-spectrum fumigants even if the products are not deregistered. A review or deregistration of MS is not planned at the time of writing this report. Unfortunately, intensification has, in many cases, changed soil conditions and reduced inherent disease suppressive soil properties, thus reinforcing a reliance on fumigation to deal with soilborne diseases, pests and weeds.

Improving the management of insect contaminants in processed leafy vegetables

VG12108

Insects are potential contaminants of processed leafy vegetables. Pest and beneficial species, in both the juvenile and adult stages of their life cycles can easily become unwanted contaminants if they make their way from the field into the final product, and to the end consumer. Insect contamination can result in rejections and lost sales for growers, added cost for processors and bad publicity for retailers. Ensuring year round supply of insect free produce is a difficult challenge. The main products affected are baby leaf spinach and coral leaf lettuce. The major insects causing problems are: moths, soldier flies, Rutherglen bugs and ladybeetles.

Management of insecticide resistance in the green peach aphid

VG12109

The green peach aphid (GPA) (*Myzus persicae*) is a widespread species and major horticultural pest within Australia. GPA attacks a broad range of plants, including capsicum, eggplants, tomatoes, broccoli and lettuce. Insecticides are the main tool presently used to control this pest, however, GPA can rapidly acquire insecticide resistance, which leads to control failures. Within Australia, GPA populations with resistance are increasingly common, posing issues both in the short and long term. This project was undertaken to better equip the Australian vegetable industry with knowledge of the current state of resistance levels in GPA populations across Australia. With this knowledge better insecticide resistance management (IRM) strategies may be devised.

Native Psyllid populations and the distribution of *Candidatus phytoplasma australiense*

PT10001

This is the final report for the project "Native psyllid populations and the distribution of *Candidatus phytoplasma australiense*", Project number PT10001. The recent accidental introduction of the tomato potato psyllid (*Bactericera cockerelli*) into New Zealand has raised fears that this insect pest could readily enter Australia and have a similar devastating impact on local solanaceous crop industries. The psyllid is a vector of the bacterium, "*Candidatus Liberibacter solanacearum*", which is associated with psyllid yellows disease in tomatoes, potatoes, capsicums, eggplants and tamarillos, and zebra chip disease in potatoes. Another plant disease "*Candidatus Phytoplasma australiense*" was also recently discovered in New Zealand potatoes and psyllids were implicated in its spread.

New in-field treatment solutions to control Fruit Fly (2)

VG13042

This project focused on two previously untested methods for managing and monitoring fruit fly in vegetable crops; Netting and repellents, and attraction with UV light.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

The Effects of Using Anhydrous Ammonia to Supply Nitrogen to Vegetable Crops

VG15062

Proper nitrogen management (N) on vegetable farms is essential for the health of the crop, soil and ecosystem. It has long been recognised that groundwater with nitrate from fertiliser origin is a serious environmental issue in areas of intensive agriculture around the world. Areas of intensive vegetable production typically produce two to three crops annually, with frequent irrigation and N applications, sometimes at rates that far exceed the rate of N removal of the harvested product. Nitrogen fertilisers interact with soils and plants in different ways, and understanding this is key to achieving the most profitable use of nitrogen. Anhydrous ammonia is a N fertiliser that interacts with the soil clay particles and moisture in a way that increases the retention in the soil and reduces leaching into ground water.

Identifying and understanding the factors influencing bioactive levels in vegetables

VG14027

This project collated information on the phytonutrients (bioactives) in levied vegetables. It builds on our previous project Veggycation® which largely focussed on the core nutrients (vitamins and minerals) for which claims are currently permitted by Food Standards Australia New Zealand (FSANZ). The initial Veggycation project collated some information on certain classes of phytonutrients but did not provide quantitative data. This current project added this information to the Veggycation framework, including the addition of new phytonutrients and further layers of information on these vegetable components. In particular, detailed data was added on the typical amounts of phytonutrients present, their status with regards to health claims and snippets of the latest research plus new information on postharvest effects.

Generation of data for pesticide applications in horticulture crops 2018

ST17000

Key research provider: Eurofins Agrosience Services and Peracto (these providers run separate research projects under the same project name and code)

What's it all about? The generation of pesticide residue, efficacy and crop safety data is required to support label registration and minor use permit applications made to the Australian Pesticides and Veterinary Medicines Authority (APVMA) which, when approved, provide access to safe and effective chemicals for the management of pests, weeds and diseases.

In May, Hort Innovation announced the securing of more than \$1 million in assistance grants under the Federal Government's Access to Industry Uses of Agricultural and Veterinary (Agvet) Chemicals program. This funding is being used, along with levy contributions, to generate the data required for a range of registration and minor use applications across a variety of horticulture crops.

Novel topical vegetable, cotton virus and whitefly protection

VG16037

Key research provider: The University of Queensland

What's it all about? Contracted by Hort Innovation in February, and due for completion in 2021, this Vegetable Fund project aims to minimise the economic impact of pest infestation on vegetables (and on cotton) through the development of an innovative topical protection medium, BioClay. The high-tech BioClay spray is anticipated to prime the plant's own defences, similar to how a vaccine works, helping the plant to naturally attack specific crop pests and pathogens. The preliminary research is now underway. The project has a range of co-investors, including the Cotton Research and Development Corporation.

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Improving processing vegetable yields through improved production practices

VG16011

Key research provider: University of Tasmania

What was it all about? In the face of rising competition from imported processed vegetables, this project was tasked with identifying, assessing and bringing to growers new innovations for increasing yields or reducing input costs for processing vegetable crops in Australia. It had a specific focus on broccoli, carrots, green beans, cauliflower and sweet corn.

Management and detection of bacterial leaf spot in capsicum and chilli crops

VG14010

Key research provider: The Queensland Department of Agriculture and Fisheries

What was it all about? Beginning in 2015 and recently concluded, this project aimed to increase the capacity of the vegetable industry to develop integrated disease management programs for bacterial leaf spot of capsicum and chilli field crops. As tomato was considered an alternative host for the leaf spot pathogens, investigation of the causal agents of the disease in tomato was also completed.

New end-point treatment solutions to control fruit fly (2)

VG13044

Key research provider: The Queensland Department of Agriculture and Fisheries

What was it all about? This project has developed a data package against Queensland fruit fly (*Bactrocera tryoni*) to meet requirements for a new market access protocol for the export of capsicums to New Zealand.

Australian capsicums are hosts for Queensland fruit fly and so must undergo a disinfestation treatment before they can be exported to countries with quarantine barriers against this pest, including New Zealand.

“Healthy, sustainable food production methods give us food that is nutritionally better and with fewer pesticides, antibiotics, and hormones.”
- Marion Nestle



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

E.g. Conduct a chemical audit across the business, including production site/s, packing facilities and the farm office.

Identify existing data and collate records.

Step 2: Assess your practices and risks

Complete the on-line EnviroVeg self-assessment

The report will identify critical risks and recommendations for actions/practices to implement

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a crop nutrition management plan/program and review and revise it regularly
Use the EnviroVeg action planning template

Further analysis of priority actions identified within the EnviroVeg self-assessment should be undertaken and steps put in place to assign responsibility/due date of implementing the actions.

Step 4: Monitor performance measures/indicators

Performance indicators for chemical management in vegetable production systems may include:
Performance indicators for chemical management in vegetable production systems may include:

- Pesticide sales, in terms of active ingredients
- Monitor trends in agrochemical records
- Soil and water tests
- MRL checks/annual check of produce at markets.

Step 5: Keep records

Key records for chemical management in vegetable production systems may include:

Essential records

Farm map, including;

- Production areas
- Chemical storage and mixing areas
- Sensitive areas
- Water storages and waterways
- Contaminated sites
- Buffers zones and areas of vegetation barriers

Plans:

- Pest, weed and disease management plan (also see Freshcare E4.1 compliance criteria 3)
- Spills and emergencies response plan
- OH&S plan.

Qualifications and training/induction records

Material Safety Data Sheets

Management records, including relevant Freshcare E4 forms:

- Pest and disease monitoring record
- Preventative pest and disease control program



- Chemical inventory
- Spill response procedure
- Chemical authorization record
- Preharvest chemical application record
- Postharvest chemical application record

Pest pressure monitoring results and/or external agency pest and disease alerts

Chemicals inventory, noting

- date purchased/received
- place of purchase
- name of chemical
- batch number (where available)
- expiry date or date of manufacture
- quantity
- [off-label permits, if applicable]

Annual review of chemical stores, noting

- date of the review
- name of the authorised person conducting the review
- name and quantity of chemicals identified for disposal that
 - exceed the label expiry date
 - exceed the permit expiry date
 - have had their registration withdrawn
- Action taken to manage any containers that are leaking or corroded or have illegible labels.

Agrochemical application records (Spray diary)

- date of application, noting start and finish times
- name of operator
- location address and treated area/blocks
- pest/disease target
- full name of product used
- rate of application (the amount of product used per hectare, number of hectares to which it was applied and to what crop)
- frequency of use (including any limitations on the frequency of chemical per crop/season)
- application equipment, noting, if applicable nozzle brand, type, spray angle, nozzle capacity and spray system pressure measured during application
- weather conditions, in particular speed and direction of wind, air temperature and relative humidity during application
- name of the worker/person/organisation that documented the control program.

Chemical application equipment maintenance and calibration, noting

- Description of method and calibration results
- Date of calibration
- Name of the person calibrating the equipment

Chemical disposal

- Chemclear® documentation, issued to prove

chemical collection dates or when chemicals are booked in for collection

- Receipts and invoices from recycling or commercial disposal businesses
- Disposal of surplus agricultural chemicals (can be recorded on spray records, particularly if sprayed back over the crop)

Register of authorised personnel with access to chemical stores and training in chemical handling.

Incident records and notifications.

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed;

- As per step 5
- The chemical management actions should be reviewed and updated annually. The name of the person completing the review and the date of the review are documented.
- Ensure actions and procedures have been appropriately embedded into the farm/property management system.
- Identify and prioritise any training that might be required.

Connect with like-minded producers, network and discuss your ideas;

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is @EnviroVeg

Come to EnviroVeg events, ask questions of other growers about their practices



PART THREE: REFERENCES AND RESOURCES

Regulations

[Commonwealth, State and Territory legislation: Commonwealth](#)

[Australian Capital Territory](#)

[New South Wales](#)

[Northern Territory](#)

[Queensland](#)

[South Australia](#)

[Tasmania](#)

[Western Australia](#)

[Victoria](#)

[Australasian Legal Institute](#)

[Australian Law Portal \(National Library of Australia\)](#)

[Environmental legislation - Environmental Defenders Offices](#)

State/Territory EPA:

- [ACT](#)
- [NSW Environment Protection Authority](#)
- [NT](#)
- [QLD](#)
- [SA](#)
- [TAS](#)
- [VIC](#)
- [WA](#)

[Australian Pesticides and Veterinary Medicines Association \(APVMA\)](#)

[Chemical classification compliance - Safe Work Australia](#) - links to State and Territory requirements

[State Legislation for Accreditation to ChemCert](#)

Chemical accreditation/training

[AgSafe Training](#)

[ChemCert Chemical Accreditation Course](#)

[Classifying chemicals training - Safe Work Australia](#)

[SMARTtrain](#) - Provides chemical use training and accreditation

Selection of appropriate chemicals

[InfoPest Chemical Database](#)

[National Registration Scheme for Agricultural and Veterinary Chemicals](#) - Chemical registrations and permits

[Public Chemical Registration Information System Search](#)

[Integrated Crop Protection](#) - Pest and disease management information

[Fertiliser Australia](#) - Cracking the nutrient code

[The Good Bug book](#) - IPM implementation information

Safe transport and storage of chemicals

[ChemCert guide to safe storage of chemicals](#)
[Australian Government Department of Infrastructure, Regional Development and Cities](#) - Transport of dangerous goods



For information on storage and handling of fuel and chemicals classified as 'Dangerous Goods', contact your: [State fire and emergency service organisation](#)

Appropriate use of chemicals on farm

[Aerial Application](#) - Aerial Agricultural Association of Australia Limited

[Adverse Experience Reporting Program](#)

[Resistance strategies](#)

[National Association of Testing Authorities](#) - Provides a list of NATA-registered testing laboratories

[Safe Work Australia - Hazardous Chemicals Safety Data Sets](#)

[Australia Best practice manual for pesticide application in nursery and garden industry](#)

[Material Safety Data Sheets](#)

[Farm management and chemical use](#) - Agriculture Victoria

[Responsible use of farm chemicals](#) - Agriculture Victoria

[Code of practice for the use of agricultural and veterinary chemicals in WA](#) - Department of Agriculture

[Animal health and diseases](#) - Department of Agriculture and Fisheries (QLD)

[Interactions between conventional and organic farming for biocontrol services across the landscape](#), Ecological Applications, for purchase book

Spray drift management

[Bureau of Meteorology \(BOM\) - Weather for Pesticide Spraying](#)

[Spray Sence](#), leaflet series for pesticide issues - NSW DPI

[Spray drift management](#) - AVPMA

[Spray Drift Management - Principles, Strategies and Supporting Information \(CSIRO\)](#), for purchase book

Disposal of unwanted chemicals and containers

[ChemClear®](#) - end-of-life disposal

[DrumMUSTER®](#) - container management

Managing contaminated sites

[Contaminated soil wastes in Australia](#) - Federal department of the Environment

[Identification, assessment and management of contaminated land](#) - NSW EPA

[Prevention and Management of Contamination of Land in Victoria](#) - Victoria EPA

[Site contamination](#) - SA EPA

[Assessment and management of contaminated sites](#) - DER WA

[Waste and chemical disposal](#) - QLD environment department

[Identification and assessment of contaminated land](#) - EPA Tasmania

[Contaminated land guideline](#) - NT EPA

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

ENERGY AND GREENHOUSE GASSES



PART ONE: MANAGEMENT GUIDELINES

Context

Vegetable production systems require significant energy inputs to power vehicles, machinery, equipment, irrigation systems, refrigeration and lighting. Vegetable producers across Australia are experiencing rapidly escalating prices for electricity and fuel so there are strong economic drivers to pursue energy and fuel efficiencies. Another important driver for the management of energy use in the vegetable industry is the need to reduce greenhouse gas emissions that cause climate change.

While greenhouse gases have natural sources, human activities increase the volumes of these gases that are released into the atmosphere. Greenhouse gases (including carbon dioxide, nitrous oxide, methane, hydrofluorocarbons and chlorofluorocarbons) help to create the 'greenhouse effect', which is changing the Earth's climate. In Australia our climate is becoming warmer. Rainfall patterns are also expected to change. These changes will have a significant impact on water availability, agriculture, coastal areas, biodiversity and human health. Reduction of greenhouse gas is a national and international priority.

Sources of greenhouse gases in vegetable production systems include fuel and electricity use, nitrogen-based fertilisers and manures, waste and refrigerant losses. The greenhouse gas of key concern in the vegetable industry is nitrous oxide (which is linked to use of nitrogen-based fertilisers), however, the management of carbon dioxide and methane emissions in vegetable production systems is also important. Fortunately, there are opportunities for energy efficiency and emerging opportunities for switching to renewable energy sources, which have the benefits of driving production efficiencies as well as reducing costs and greenhouse gas emissions.

Business benefits

Improvements in the efficiency of energy use, more effective fertiliser management and minimizing soil disturbance are key actions that can reduce the operating costs of vegetable operations while also reducing greenhouse gas emissions. The vegetable industry can contribute to the reduction of greenhouse gas emissions to ensure that impacts of climate change are reduced, delayed or avoided.

Scope

This section addresses energy sources, energy use, energy efficiency, opportunities to reduce greenhouse gas emissions in vegetable production systems, and the responsible storage and management of fuel and oil. Waste management is addressed in section nine, and fertiliser management is addressed in section three.

Management objectives

- Optimise efficiency of energy and fuel use in the production system
- Optimise use of energy from renewable sources
- Reduce the use of energy from non-renewable or polluting sources
- Activities are managed to minimise production of greenhouse gases
- Greenhouse gas is stored using native vegetation or other methods



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E10. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the following requirements as complete benchmarking requirements.

E10.1 Energy and fuel efficiency is optimised throughout the production system.

- 1. Electricity and fuel consumption is reviewed at least annually.
- 2. Efficient operating practices for premises, vehicles, machinery and equipment are identified and implemented.

- 3. Servicing and maintenance records are kept for vehicles, machinery and equipment.
- 4. Energy and fuel efficiency must be considered in the selection and/or design of new premises, vehicles, machinery and equipment.

E10.2 Bulk fuel is stored to minimise environmental harm.

- 1. Bulk fuel storages are located, constructed and maintained to minimise the risk of environmental contamination and container spillage.
- 2. A current Safety Data Sheet (SDS) is kept for all bulk fuel stored on the property.

“The basic science is very well established; it is well understood that global warming is due to greenhouse gases. What is uncertain is projections about specifics in the next few decades, by how much will the climate change.”
- Mario J. Molina

KEY HAZARDS AND RISKS

Hazards	Risks	Environmental	Business
Energy is not used efficiently in the production system	Greater greenhouse gas emissions		Wastage, high cost overheads
The production system has a high reliance on non-renewable energy sources	Greater greenhouse gas emissions		Market opinion, consumer backlash
	Business exposure to increased energy costs		
Energy use, production practices or waste management practices release high volumes of greenhouse gases	Greater greenhouse gas emissions		Wastage, higher cost of overheads
	Market opinion, consumer or community backlash		
	An increase in the frequency and severity of extreme weather events		

RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices in your energy management program and/or environmental action plan.

Understand your energy and greenhouse gas emissions profile and identify effective energy and greenhouse gas emission reduction options

Measure your **carbon footprint** – a measure of the greenhouse gas emissions produced by a particular product or activity, expressed as tonnes of carbon dioxide equivalents (CO₂e). Carbon footprinting is a method of carbon accounting. The carbon footprint of a vegetable enterprise would account for all on-farm emissions of carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and hydrofluorocarbon, i.e. all emissions occurring within the farm boundary from activities such as energy and fertiliser use.

CARBON SEQUESTRATION

Carbon sequestration is the general term used for the capture and long-term storage of carbon dioxide.

Consider using the **Vegie Carbon Tool** and/or similar tools (such as; **FarmGAS**, **NGIA EnergyCalc**, **Wine industry carbon calculator**, **Dairy Carbon Calculator** and **UK Cool Farm Tool**). Being sure that there is an ability to change **state emission factors** within calculations.

Consider an **audit of energy use** – this will measure energy use and identify potential areas of inefficiency and energy savings.

- Energy companies can give expert advice on how to save electricity and most can conduct an energy audit to identify areas for improvement. Be sure to consider the **level of energy audit**, its scope and the questions you want answered before commissioning an energy audit.
- Alternatively, use a professional service provider to conduct the audit and provide expert advice on opportunities for energy efficiency and/or reducing energy use or emissions.

Using the footprint or audit identify areas of the business/production system to:

- Identify opportunities to **reduce energy demand** (e.g. reducing wastage by turning off

appliances/lights when not in use) and increase use of renewables and therefore emissions.

- Consider **opportunities for improving energy efficiency** (e.g. adoption of new technologies, selecting more energy efficient equipment, maintenance of existing equipment, etc).
- **Reduce other sources of greenhouse gas emissions** that are directly generated on site (e.g. nitrous oxides from soil/fertilisers).

Re-assess energy use and emissions profile annually.

Reduce energy demand and use

Plan farm activities **to minimise vehicle/machinery use/movement** and unnecessary journeys / cultivation passes.

Always **turn off lights** when they are not needed, even for short periods. Consider daylight or movement sensors and/or timers so that lights are only on when needed.

Switch engines off when not in use.

Operate **refrigeration units** only when needed to maintain produce at the required temperature. Use timers and thermostats to help minimise refrigeration. A locked-down and energy-efficient coolroom should require less refrigeration.

Turn off lights and equipment at end of day. Avoid use of 'stand-by' mode on all equipment and appliances, where feasible, as this still consumes energy.

Review sources of energy used in the production system and switch to renewable sources

Consider **Green Power**, power produced from renewable energy sources such as solar, wind, water (hydro) or **bioenergy generators**. Note GreenPower is fully additional to the Government's Renewable Energy Target and therefore when you purchase GreenPower you are helping to increase the amount of renewable energy generated in Australia.

Review opportunities to **generate solar, wind or hydro power** on site.

- There are **a number of electrical power generation technologies** which are suitable for **use on farm**, however they need to be fit for purpose (match energy needs and suitable for the site).



Consider other options for use of renewables on your site.

- Use **biofuels** for vehicles, machinery and equipment where feasible.
- Select energy efficient office heating/cooling (for example, gas heating is more efficient than electric) and follow a regular service and maintenance programs for air conditioners.
- Select solar or heat pump hot water heaters to replace electric or alternatively use gas.

Consider the feasibility of **using biomass for energy generation** on site.

- **Biogas** will not be a viable option for every farm, particularly smaller operations.
- On-farm electricity generation through **Anaerobic Digestion (AD)** and the production of **biogas** could prove viable for larger properties (input volume >20 tonnes per day) with high-energy crops, high-cost waste management and high electricity use.

If an audit or assessment by a professional energy efficiency expert identifies use of batteries as complementary to renewable energy, consider this option.

Subscribe to **Greenfleet** as a means of offsetting GHG emissions from vehicle use.

Identify opportunities to drive energy efficiencies

Across the property and buildings;

- Review farm layout to optimise efficient movement of vehicles and machinery.
- Ensure any new, altered or extended buildings meet **current standards for energy efficiency**.
- Consider modifying existing buildings to improve energy efficiency, such as **installing insulation or window coverings**. Consider options for improving shading, using shade sails or cloth or planting hardy deciduous trees that provide good shade in summer while allowing sunshine through winter.

SOURCES OF ENERGY INPUTS USED IN VEGETABLE PRODUCTION:

Electricity, diesel, ULP, LPG, and natural gas.

In **greenhouse systems**;

- Greenhouse **design**, the technologies used for heating and cooling, the irrigation system and their coordinating controllers can all have implications for yield and energy intensity

(unit of energy per unit of output).

- **Research has shown** that improving technology in greenhouses can increase yield.
- Plant density can also increase yield and be used as a strategy to reduce heat loads in low technology greenhouses.
- **Consider using fully automated cooling and heating systems and irrigation controllers.**

In **irrigation systems**; (also see Section 4: Water)

- Irrigation can account for 70-80% of farm energy costs.
- Ensure that **pumps and motors are selected for optimal energy efficiency**, matched to the pressure flow required. Variable speed electric motors are generally more efficient than fuel-driven pumps.
- Follow a regular service and maintenance program for irrigation pumping, distribution and delivery systems. Ensure motors, switches and control panels are clean. Ensure connections are tight and moving parts are lubricated. Regularly check/maintain inlet sieves for dirt or organic matter.
- Regularly test pumps to ensure they are operating at their optimal operating range for best efficiency. Pumps should be operated at or above **70% efficiency**.

For farm machinery, equipment and vehicles;

- Select fuel/energy efficient machinery and equipment, and operate machinery and equipment at its optimal level of efficiency, such as dedicated LPG, electric, small or hybrid vehicles.
- Select appropriate engine size for tasks and match machinery to implements (minimising wheel slippage).
- Use satellite guidance systems.
- Follow a regular service and maintenance program. Keeping engines tuned can reduce GHG emissions by 15%. Regular servicing of air conditioners and fuel injectors can reduce fuel consumption by 5-15%.

In **packing facilities**;

- Optimise natural light and passive thermal energy through building design and orientation.
- Install insulation and air flow restricting curtains.
- Select energy efficient and long life light fittings, remove HID lamps and replace with LED.
- Follow a regular maintenance schedule for lighting. Dirt and dust build-up can reduce light output by 50% and decrease the life expectancy of fixtures and lamps.



In coolrooms;

- Place coolrooms in good shade and ensure they are fully insulated, including the floor.
- Install temperature control devices and calibrate thermostats regularly.
- Follow a regular maintenance schedule. In particular, regularly check door seals (if a piece of paper can be easily pulled out from under the base of the closed door, the seal should be replaced), hinges and catches to avoid warm air leaking into the room.
- Minimise the amount of time the coolroom doors are open. Install plastic door strips, automatic doors or rapid rise curtains to help keep warm air out of the room.
- Reduce heat load by using LED lighting, applying reflective paints to the outside and pre-cooling produce prior to storing.
- Use electric forklifts.
- Defrost the system regularly. Ice build-up on the evaporator can greatly reduce efficiency. Ensure defrost cycles do not overheat internal air.

In farm office;

- Incorporate passive thermal design and orientation into the office and windows.
- Use insulation (ceiling, walls, floors, doors).
- For lighting, use a selection of LED's and localised lighting.
- Select energy efficient office equipment including computers, printers, coffee machines.
- Use the 'power-save' function on office equipment and software.
- Set electric hot water elements to the overnight tariff if possible, particularly if using solar or heat pump hot water heating.

Minimise greenhouse gas (GHG) emissions that are directly generated on site

Adopt less GHG intensive practices such as;

- efficient post-harvest facilities.
- the use of low GWP (global warming potential) refrigerants.
- less packing materials.
- more efficient means of transport and distribution.
- Optimising energy and fuel use efficiency.
- Address nitrous oxide and methane emissions from the production site.

Manage fertiliser use to reduce nitrous oxide emissions:

- Poor nitrogen fertiliser management increases greenhouse gas emissions and wastes money. Nitrogen measurements indicate that up to 60% of the applied N may be lost to

the atmosphere or leached in high N use vegetable systems in Victoria.

- Maintain soil carbon content, soil moisture content and nitrogen inputs.
- Manage irrigation and drainage to reduce soil inundation and the loss of nitrogen from the soil.
- Match soil nitrogen supply to: crop demand, other inputs and prevailing conditions. Avoiding large single applications of nitrogen fertiliser.
- Follow the nitrogen management 4 Rs for soil.
- Implement crop rotation as a substitute for fertiliser use.
- Consider using direct drilling techniques over conventional cultivation options.
- Consider using enhanced efficiency fertilisers (EEF).

Minimise GHG emissions from waste and compost:

- Compost contains organic matter in various forms and can act as a soil conditioner to increase soil carbon and organic matter levels.
- Get the carbon: nitrogen (C:N) ratio correct. High N content composts produce more nitrous oxide and won't produce a better-quality compost.
- Apply composts to actively growing plants or physically incorporate into the soil soon after application (to reduce nitrogen losses).
- Reduce soil carbon losses. Soil carbon losses have the potential to be one of the largest

MEASURING CARBON FOOTPRINTS

The primary reason for measuring carbon footprints is to report or account for the level of greenhouse gas emissions to a third party. At present (August 2018) there is no requirement for horticultural growers to undertake carbon accounting on their farms or to comply with carbon labeling requirements. However, consumer preferences and government policy may create the need for carbon accounting and reporting by growers in the future.

sources of emissions from the vegetable industry.

See section 2: Land and soil for more information.

Incorporate carbon sequestering practices

Grow vegetation (see Biodiversity section eleven)

- Work with local catchment groups to identify possible revegetation or road side planting locations on or adjacent to the property.
- *Note: At this point there is limited opportunity to establish plantings on-farm with the intent of gaining a credit for the sequestered*



carbon. Revegetation for conservation, pest management or shelter is more common.

Increase [soil carbon levels](#) (see Land and soil section two)

- Maintain and prevent further [loss of stored soil carbon](#). The top 30cm of soil (top soil) will have more than 50 tonnes carbon/ha, [typical soil contains 1.5% soil carbon](#).
- Increase organic matter inputs (crop residues, cover crops and composts) and reduce losses (cultivation and fallow).
- Increasing long-term vegetable soil carbon sequestration is difficult due to the intensity of production.
- *Note: Soil carbon content is a driver of nitrous oxide emissions so doing things that increase soil carbon can work against nitrous oxide abatement. Conversely, pursuing nitrous oxide abatement can work against soil carbon sequestration. The whole system must be considered to ensure that its total carbon footprint is lowered, not just one aspect of it.*

Incorporate [biochar into soil](#)

- Aside from manures and biosolids, there is [little research into the long-term carbon sequestration value of organic amendments](#). [Sequestration value is determined by the amount and frequency of addition in combination with climate and soil type](#). Properties of biochar should be appropriate for your soil type in order to maximise benefits.
- *Note: Australia currently has no system for the classification and governance of biochars. Better characterisation and categorisation of biochars to match soil types and other uses is still required.*

BIOCHAR INTO SOIL

Biochar is a stable charcoal, or biomass derived black carbon, resulting from anaerobic pyrolysis of biomass.

EXPECTED OUTCOMES

[Improved water management practice outcomes expected to be achieved through implementing these practices include;](#)

Within 1-5 years

- The energy and fuel efficiency of equipment, machinery and pumps is improved
- The energy efficiency of farm buildings and sheds is improved

- The use of renewal energy sources is increased
- Methane emissions (from composting processes) are reduced
- Appropriate fertilisers/amendments are used and applied efficiently
- Cultivation and traffic is managed appropriately
- Refrigeration equipment is maintained
- Carbon sinks are established or maintained.
- Energy use on farm is minimised

Longer term outcomes, which may take 5-10 years or more to achieve

Energy use across the lifecycle of vegetable production, manufacture and transport is decreased. Direct and indirect emissions of greenhouse gases from vegetable production activities are measured and reduced.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- [Soil Wealth email updates](#)
- [VegNET – extension officers](#)
- [AHR resources](#)

Horticulture wide updates:

- [AUSVEG mailing list, including weekly updates](#)
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)
- [The Australian Farmer](#)

Industry updates:

- [Ag innovators](#) – channel for inspirational communications and educational material
- [Postharvest management of vegetables](#) – resources for Australian supply chains
- [Vegetable climate](#) – Impacts of climate on the Australian vegetable industry
- [Queensland farmers' federation](#) – energy savers audits

Government updates:

- [Biomass Producer](#) – bioenergy for Australia's primary industries
- [Renewable energy target](#) – Clean Energy Regulator
- [Business Queensland](#) – energy programs for agricultural businesses
- [Agriculture Victoria](#) – Agriculture energy investment plan
- [Buisness.gov.au](#) – Energy management resources
- [Energy Exchange](#) – efficiency, productivity, innovation



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Promoting plant probiotics

Research at University
of Queensland

Farmers should rely on science – rather than hype – according to UQ researchers who want to see commercial crop probiotics better regulated, and contribute to agriculture innovation aimed at achieving high-yielding crops with minimal environmental footprint.

Australian bioenergy roadmap

Government direction for
biomass in stationary energy

This Roadmap has been developed in collaboration with the bioenergy industry in Australia and is designed to set the strategy to build a strong and vibrant Australian bioenergy industry by 2020.

The development of the Roadmap was funded by the Department of the Environment, Water, Heritage and the Arts, and is the culmination of a collaborative approach working in partnership with key associations and bodies involved in the bioenergy industry. An extensive stakeholder consultation process was undertaken to test the data, conclusions and strategies identified in the document. The biomass resource appraisal carried out as part of the development of the Roadmap (i.e. stages 1 – 3 of the project delivery process) confirmed that Australia has an abundance of economically viable and accessible biomass resources for stationary energy production. The resource appraisal also determined that the technologies required to realise the potential of this resource are largely proven and based on established practices either locally or overseas.

Enhanced efficiency fertilisers (EEF)

Potential to mitigate
nitrous-oxide emissions

CSIRO research

A combination of fertiliser and breakdown inhibitors have been found to reduce N₂O emissions across a range of soil types. They work by delaying the chemical process that nitrogen compounds go through to produce ammonium and nitrate, both precursors to N₂O. Trials in Victoria showed great potential to reduce N inputs and to mitigate N₂O losses from soil by use of nitrification inhibitors on manures and fertilizers compared to the standard grower practice used at the sites without reducing yield.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Growcom Energy efficiency project

Horticultural production and packing operations are some of the most energy-intensive businesses in the agricultural sector. Initially, Growcom Land and Water has sought to provide tailored energy efficiency information, tools, systems and extension solutions directly to horticulture, enabling growers to identify and implement processes and systems to improve on-farm energy efficiency.

Available on this website are tools which you may find useful in assessing energy use, changing tariffs and selecting lights for a range of purposes. As Growcom progresses its energy services, more tools will be developed.

National Vegetable Protected Cropping Centre

VG17003

To develop the next crop of horticulture growers and meet rising food demand, Hort Innovation and Western Sydney University combined forces to launch the nation's first state-of-the-art vegetable glasshouse-production research centre in November last year. The aim is to manipulate inputs to create the optimum environment to drive maximum harvest windows and overall yield for a variety of vegetables, then share this information with Australia's growers. Through this facility, industry also aims to attract new entrants to horticulture careers by offering students access to some of the most advanced technology currently available.

Improved skill for regional climate in the ACCESS-based POAMA model

VG13092

POAMA is the CSIRO and Bureau of Meteorology's seasonal prediction system, and ACCESS is a new national modelling system for applications ranging from weather forecasting to climate change projections. This project has represented a component of work, evaluating improvements to the ACCESS model and allowing the vegetable industry to feed into its development. The overall aim has been to provide improved spatial and temporal forecasting in regions of interest to vegetable growers with the next version of the modelling system, ACCESS-S1.

NITROGEN IN VEGETABLE PRODUCTION

- Nitrogen (N) is a key input into vegetable production and necessary to achieve high yields, but it can also result in nitrous oxide gas being released into the atmosphere.
- Nitrous oxide has a global warming potential of 298 (298 times more potent than carbon dioxide as a greenhouse gas) Methane has a global warming potential of 25.
- As carbon dioxide (CO₂) levels continue to rise, vegetable crops will become more efficient in their use of nitrogen and therefore less will need to be applied. Matching crop needs with fertiliser application has the potential to impact on nitrous oxide emissions from vegetable production

Nitrous oxide (N₂O) emissions from soil microbial activity occurs through two processes. Nitrification is an aerobic process that converts ammonium (NH₄) into nitrate (NO₃) with N₂O as a by-product. Denitrification is an anaerobic process that converts nitrate (NO₃) into nitrogen gas (N₂) with N₂O being produced as an intermediate product. N₂O emissions vary depending on environment and soil type.



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Conduct an energy audit across the business, including production sites, packing facilities and the farm office.

Identify existing energy data and collate records.

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment.

The report will identify critical risks and recommendations for actions/practices to implement.

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare an energy management plan/program and review and revise it regularly. Include;

- What are your barriers to implementation?
- Diesel use
- Irrigation pumps
- Refrigeration and cool rooms
- Lighting
- Planned farm-movements (efficient vehicle travel)
- Source of energy and using renewable energy
- Where GHG emissions may come from
- Other recommended practices (listed in section one)

Use the EnviroVeg action planning template

Step 4: Monitor performance measures/indicators

Performance indicators for Energy and greenhouse gas management in vegetable production systems may include:

- Fuel use per tonne of production (l/ha or l/t)
- Electricity use per tonne of production (kWhr/ha or /t or m2 of premises)

Step 5: Keep records

Key records for energy and greenhouse gas management in vegetable production systems may include:

- Fuel and electricity use records/bills – understand the pattern of energy use, peak use periods and how this aligns with retail contracts
- Records of annual review of energy and fuel consumption (Freshcare)/internal energy audits
- Records of carbon footprint/GHG emissions estimates



- Equipment, machinery, vehicle and coolroom maintenance program and records (Freshcare form E10)
- Fertiliser records

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed;

- Review and update the energy efficiency action plan annually, document the name of the person completing the review and the date.
- Ensure actions and procedures have been appropriately embedded into the property management system.
- Identify and prioritise any training that might be required.

Connect with like-minded producers, network and discuss your ideas;

- EnviroVeg members on Social media;
- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is; @EnviroVeg

Come to EnviroVeg events, ask questions of other growers about their practices

ANAEROBIC DIGESTION (AD)

Anaerobic Digestion (AD) is a process by which organic matter, such as vegetable and animal waste, is broken down by microorganisms in an enclosed vessel. The microorganisms feed on the organic materials to produce methane, which is converted into electricity using a generator, heat and carbon dioxide (biogas) – a source of renewable energy. AD systems typically operate at the farm (or processing plant) scale using on-site waste streams, or at a centralised scale incorporating large volumes of waste from multiple sources. Their use has been demonstrated on properties where current waste disposal is costly, or in situations where there is no revenue being generated by vegetable waste management.

Consider factors effecting Anerobic digestion such as;

- scale of operation (the unit cost of energy tends to decrease with size),
- crop type (high energy crops such as sweet corn produce more electricity per tonne than crops like lettuce which are mostly composed of water),
- high and consistent energy (AD is typically set to match baseline energy use) and
- logistics (including high existing waste management costs and the ability to source additional consistent waste volumes, among others).



PART THREE: RESOURCES AND FURTHER INFORMATION

Carbon foot printing tools (relevant to horticulture)

FarmGAS

NGIA EnergyCalc

Wine industry carbon calculator

Dairy Carbon Calculator

UK Cool Farm Tool

Vegie carbon tool

Reducing greenhouse gas emissions

Soil Wealth Factsheet. Nitrous oxide emissions from vegetable soils: what's all the fuss about?

NANORP. 2016. Nitrous Oxide Research Program – Horticulture Fact Sheet

National Carbon Accounting System. 2003. Emissions sources of nitrous oxide from Australian agricultural soils and forest lands and mitigation options

AHR. 2016. Growing practices to reduce nitrous oxide emissions from processing tomato production

Porter, I and Riches, D. 2016. Benchmarking and mitigation of nitrous oxide emissions in temperate vegetable cropping systems in Australia resulting in improved nitrogen use efficiency

Lam et al. 2015. Measurement and mitigation of nitrous oxide emissions from a high nitrogen input vegetable system

Agriculture Victoria – GHG emissions from horticulture

Climate Friendly – Carbon farming opportunities

ClimateWorks – opportunities for reducing emissions from land use

Minimise GHG emissions from waste/compost – Dairy Australia factsheet

CO2 Australia – information for landholders

Opportunities for carbon sequestration from trees – CSIRO research

Biochar

Biochar showing positive benefits for organic vegetable grower in Darwin – Soil Wealth project resource

Biochar in horticulture: Prospects for the use of biochar in Australian horticulture – Hort Innovation project, (Project Reference AH11006)

Opportunities and constraints of biochar application – CSIRO research

Energy efficiency

Energy self-audit tool for farms – This self-audit tool highlights the most common energy saving opportunities for farms, and to provide guidelines and references for other farmers who wish to conduct an energy self-audit of their farms.

Energy efficiency tool – The primary function of the tool is to help farmers to systematically collect and analyse farm energy audit data and identify practical energy efficiency measures. It can also be used to generate quick scenarios using approximate data.



[Soil Organic Matter and Soil Function](#) – Review of the Literature and Underlying Data – Effects of soil organic matter on functional soil properties.

[Energy management plan sample](#) – from an American farm system.

[Australian Institute of Energy](#) – Represents energy management professionals.

[Energy Efficiency Council](#) – peak body for energy efficiency, cogeneration and demand management in Australia.

[Australian Institute of Refrigeration, Air Conditioning and Heating \(AIRAH\)](#) – Represents refrigeration, air conditioning, heating, ventilation and associated building services in the Asia-Pacific region, including energy auditors.

[Victoria Building Authority](#) – Maintains a list of registered building practitioners.

[Queensland Building and Construction Commission](#) – Maintains a list of registered building practitioners.

[Green Power](#) – Specialises in renewable energy sources for you household or business

[Greenfleet](#)

[Australian Government Department of the Environment](#) – Clean Energy Regulator

For information on energy management, grants and rebates, contact your:

- EPA or energy authority
- Energy supplier

For information on building standards for energy efficiency contact your Council.

[Energy Rating](#) – Information on energy ratings.

[EcoBiz program](#) – Includes sections on energy efficiency, waste and water use efficiency

[CSIRO Energy Innovation](#)

[Energy Exchange](#) – efficiency, productivity, innovation

[Case studies](#) – Agriculture Victoria energy investment plan

Coolroom operation

[Sustainable Energy Authority Victoria](#) – Solar Cooling Systems

[Sustainability Victoria](#) – Energy efficiency best practice guidelines, including industrial refrigeration

[Ag Innovators](#) – Energy efficient cool rooms

Transport and machinery

[Greener Motoring Australasian Fleet Managers' Association](#)

[Biofuels Association of Australia](#)

Pumps and efficiency

[Irrigation pump efficiency](#) – presentation from Agricultural Resource Management consultant James Curran

[NSW DPI](#) – selecting an irrigation pump

[Vegetable climate](#) – efficient irrigation pumps

Climate and weather

[Climate Council](#) – An independent non-profit organisation funded by donations by the public that provides expert advice to the Australian public on climate change

[Climate Kelpie](#) – A round-up of climate tools for Australian farmers

[Climate Change Services Australia](#) – Connecting government, community and businesses with industry practitioners in climate change services

Environmental legislation

[International, Commonwealth and State](#) – search 'environment' and 'law'

[Environmental Defenders Offices](#)

[Government initiatives towards climate change](#)

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.



WASTE



PART ONE: MANAGEMENT GUIDELINES

Context

Vegetable production can generate large volumes of unwanted material that becomes waste. Waste creates management challenges - and expense - for vegetable producers and packers. Waste from vegetable production systems may also become a matter of concern in the local community, and increase pressure on landfill and other waste management facilities. The generation of excessive waste may indicate inefficiencies in the business and may lead to multiple environmental impacts, including inefficient use of energy and production inputs and the risk of litter, contamination, pollution or greenhouse gas emissions. Best practice in waste management across all industries applies the following order of preference: avoidance, reuse, recycling, energy recovery, treatment, containment and, lastly, disposal. With the generation and management of waste becoming an increasingly high-profile matter of public concern, it is important that the vegetable industry takes steps to minimize and responsibly manage its waste.

Business benefits

Finding ways to avoid generating waste or to apply alternate strategies to waste disposal may drive production efficiencies or help reduce the costs of production.

Scope

This section considers a broad range of waste materials that may be generated through vegetable production, including surplus/reject produce and other organic matter, paper and cardboard, timber, plastics, glass, metals, tyres, oils, liquids and gases. Waste water is addressed in section four (Water) and waste chemicals are addressed in section seven (Chemicals). Greenhouse gas emissions are addressed in section three (Crop nutrition) and section eight (Energy and fuel).

Management objectives

Avoid or reduce the generation of waste to the greatest extent possible

Re-use or recycle waste to the greatest extent possible

Manage on-site storage of waste to avoid harbouring pests, spread of litter, pollution of soil or water, odour, greenhouse gases or unsightliness.

Ensure waste that cannot be avoided, reused, recycled or recovered for energy is contained, treated or disposed of responsibly to avoid environmental harm or health and safety issues.

Ensure waste management practices, particularly for controlled/prescribed wastes, meet all relevant regulatory requirements, local laws and known community expectations.



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E9. To achieve certification to this standard, vegetable producers must demonstrate their compliance with the requirements outlined here.

E8.1 Manage waste on the property

1. A Waste Management Program is documented and must include:
 - date developed
 - name of the person documenting the Program
 - waste type and location
 - management methods
 - worker/s responsible.
2. Waste that cannot be avoided, reused or recycled, is disposed of in approved off-site facilities.
3. Records of waste transport and disposal of controlled wastes are kept.
4. All stored waste is managed to minimise the risk of contaminating onsite and off-site areas.
5. The Waste Management Program is reviewed and updated annually. The name of the person completing the review and the date of the review is documented.

E8.2 Review input materials to reduce waste

1. Raw material inputs, size, quantity/weight, the potential for reuse and recycling, and the residual waste product must be considered in the selection of input materials.

RECOMMENDED PRACTICES

The following practices are recommended to manage these risks. Consider incorporating these practices in your action plan/waste management program.

Optimise the use of crop wastes/residues

Avoid creating pest management, biosecurity and food safety issues.

Use crop residues for ground cover or incorporation into soil, if appropriate.

Open harvested sites to grazing animals, if appropriate, or use waste produce for stock feed. Ensure the produce does not contain unacceptable chemical residues, plastic, glass or wood.

Consider composting waste vegetation and produce. The compost may be used as a soil amendment.

Compost sites and systems, however, must adhere to all regulations from any state or local environmental agencies and be carefully located and managed to avoid leaching or run-off of nutrients to sensitive areas or waterways.

Apply uncomposted vegetation/produce waste to fallow areas and incorporate, if appropriate.

Implement actions to avoid or minimize waste across the business

Aim to avoid and/or reduce waste at its source

Consider ways to avoid and/or reduce waste from inputs/packaging, for example –

- Select inputs with lower waste potential or returnable or recyclable packaging
- Work with suppliers to identify options to minimize use of non-renewable resources or factors that cause pollution/environmental impacts
- Work closely with supply chain partners to minimize the risk of having large volumes of obsolete packaging in stock
- Purchase inputs in bulk, where appropriate, to reduce packaging (note, however, this is not recommended for pesticides or fertilisers)
- Choose methods and equipment that offer extended life and produce relatively lower amounts of waste for disposal
- Consider selecting materials that biodegrade after they have been used
- Refer to green purchasing guides
- Ensure storage facilities for packaging are dust free and dry

Identify areas of production efficiency that, if addressed, could reduce generation of waste

The application of lean production principles may be helpful for identifying waste minimization opportunities

Implement actions to reuse, recycle or recover energy from wastes that cannot be avoided

Review options for reuse and recycling of waste

Consider ways to reuse plastic materials as often as possible before recycling or disposal as this slows and reduces the rate of waste generation.

If plastic items such as plant trays are to be reused, choose more durable materials that increase their useable life. Note, the cost and waste/wastewater generation from cleaning and reusing materials such as trays should also be taken into consideration.

Check with local council, relevant state government departments, licensed waste management contractors, or suppliers for reuse and recycling



options in your areas. Some charity groups/ community organisations collect materials for recycling as well.

Materials for recycling should be separated into designated areas for ease of collection/pick up. Ensure materials for recycling are safe before releasing them.

Wherever practicable, waste oil should be recovered for reuse and recycling. It should be stored in a leak-proof container in a bunded area prior to collection by a licensed and reputable recycling business, or delivery to a recognised disposal facility such as a local government collection depot or service station. Waste oil from farming activities may be contaminated with substances such as metal particles from engine wear, fuel from incomplete combustion, rust, dirt, carbon, heavy metals and water. Waste oil can lead to pollution of the environment and potential risk to public health and safety, if not managed carefully. Waste oil must never be applied to roadways as a dust mitigation strategy.

If there are limited or no waste reuse, recycling or recovery facilities or services available in your local area, consider lobbying the local council to improve the options.

Implement sound waste storage practices

Separate different waste types ready for reuse, recycling or responsible disposal.

Ensure that waste to be reused or recycled is cleaned and kept clean.

Ensure storage of waste does not generate litter or offensive odour.

Control pests in/around waste storage sites.

Manage waste storage sites to minimize the risk of runoff that could pollute waterways or groundwater.

Ensure stored waste is not unsightly to the local community.

Dispose of waste responsibly

Disposal of waste materials should be used only as a last resort, when all other options for avoidance, reuse, recycling and recovery for energy have been considered.

Use only registered landfill facilities for waste disposal. Check with the local authority which wastes are accepted at the landfill.

Use only waste management contractors licensed by state environment protection agencies to collect and responsibly dispose of waste. Do some due

diligence to check the contractor is following appropriate procedures as some companies have been found to be illegally disposing of collected waste in disused mineshafts, roadsides, national parks or other environmentally sensitive places.

Ensure regulatory requirements for disposal of **controlled wastes** are met. Controlled wastes are likely to include agricultural chemicals, chemical containers, tyres and oil.

Some wastes (such as asbestos) must only be handled and disposed of by a licensed contractor.

On-farm waste disposal

If disposal of waste on-farm is unavoidable, ensure waste disposal sites are located and managed to minimize the risk of polluting air, soils, ground water or waterways. On-farm waste disposal sites should be identified on the property map.

Burning waste on-farm is not considered to be an acceptable practice. If waste is burnt on-farm, ensure all necessary permits are attained and their conditions adhered to.

Communicate with neighbours

Keep neighbours informed regarding the practices in place to minimize and manage wastes that may be of community concern.

Ensure waste produce or dumping areas are well away from watercourses, dams, packing and handling facilities or residences to avoid potential contamination of harvested produce or the environment or to avoid attracting vermin or receiving complaints.

Implement strategies to reduce the volume of surplus or reject produce

Optimize production practices to achieve a high proportion of produce that meets market specifications and to avoid over production.

Avoid damage to produce from weather, pests or handling.

Seek additional/alternate markets for produce that does not meet specifications for primary markets/ customers.

Consider processing/value adding opportunities for produce that does not meet specifications for primary markets/customers.

Distribute unmarketable produce that is safe to be consumed to **food charities** such as Fareshare, FoodBank, SecondBite or OzHarvest. Some organisations will collect from the farm.



KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

┌ Horticulture production/packing systems generate high volumes of waste that cannot be reused or recycled

- └ Excessive use of resource/materials, including non-renewable resources
- └ Excessive demand on landfill facilities, reducing availability of land for other purposes
- └ Greenhouse gas emissions
- └ Below optimum productivity | Non-compliance issues
- └ High cost of waste disposal

┌ Large volumes of packaging received with farm inputs

- └ Excessive use of resources/materials
- └ High cost of waste disposal

┌ Packaging for produce such as cardboard and bags are superseded (market requirements) or spoiled/damaged during storage

- └ Excessive use of resources/materials
- └ Generation of landfill or air pollution, esp. if burned
- └ Financial loss | High cost of waste disposal

┌ Horticulture production/packing systems generate toxic or hazardous waste material

- └ Increased risk of toxins entering the natural environment
- └ Increased risk of toxins in the production site
- └ Potential contamination of produce
- └ Non-compliance issues

┌ Poorly managed stockpiles of organic and other wastes

- └ Leaching from stockpiles may cause contamination of soils and potentially waterways
- └ Potential impacts on terrestrial/aquatic fauna and biodiversity
- └ Leaching from stockpiles may cause contamination of soils and potentially waterways
- └ Potential impacts on terrestrial/aquatic fauna and biodiversity

┌ Stockpiled waste may harbour pests and diseases

- └ Increased presence of vermin, pests or disease in natural environments
- └ Increased problems with pests | Increased biosecurity risks

┌ Poorly managed or unlicensed composting of organic wastes

- └ Potential risk of leaching/runoff of nutrients to natural environments
- └ Potential for high greenhouse gas emissions
- └ Non-compliance issues
- └ Potential fines, penalties and/or closure of composting sites

FIGURE 1: DONATING TO FOODBANK

Why

- Financial returns
 - You can be reimbursed at the cost of production or current market price.
 - Tax donation receipts are provided for all donations – which provides product description and total weight or number of cartons for the donor to then apply either the cost of production or the current market price. Tax donation receipts can be helpful at the times when the market price is lower than the cost of production (please check in with your accounting team for further details on this process).
- Good social Return on Investment (ROI)
 - Strong social return on investment – food distributed by Foodbank provides a \$23/Kg social ROI to the community through; improved health and social benefits, as well as the environmental benefit from reducing unnecessary food waste. You will be providing nutrition to families in their time of need and reducing unnecessary waste.

How

- Delivery can be accepted/arranged from:
 - The Central Market for your state
 - A Transport Depot
 - From farm (opportunity for regular pick ups)

- Produce rejections that occur at retailer DC's can be picked up by Foodbank with your permission
- Private Label and proprietary or exclusive produce lines can be donated to Foodbank from anywhere in the supply chain
- Out of spec product – too big, too small, underweight packs, are perfect for Foodbank
- All Foodbank State operations have CHEP/LOSCAM/VISCOUNT and SAVI equipment accounts
- Foodbank helps/can arrange the transport if required
- Foodbank has to abide by all the same food safety rules and regulations, aside from being able to accept and distribute underweight packaged products.

What

- At a high level: anything fit for consumption – 'No Rots or Splits'
- Loose, bulk, pre-packed, chilled
- For products direct off farm that would normally be sanitised/washed prior to being supplied to consumers (like lettuce) – growers are encouraged to get in touch, some can be donated.

DONATIONS TO FOODBANK CAN BE MADE WHEN PRODUCE IS:



short dated



chill or
heat damaged



in excess



underweight



outside retail
or wholesale
specifications



packaged incorrectly
(not sealed or
is damaged)



rejected at retail or
wholesale level
(including supermarket
private labels)



Please donate
as soon as
possible to ensure
prompt distribution.

more information foodbank.org.au/want-to-help/donate-food/fruit-veg-program

EXPECTED OUTCOMES

Improved waste management practice outcomes that can be expected to be achieved within 1-5 years include:

Within 1-5 years

- Types and amounts of wastes produced on farm are identified and recorded
- A waste management plan is in place to guide avoidance, reuse, recycling, energy recovery, treatment, containment and disposal
- The overall production of all types of waste through farm production systems, packing and processing is reduced
- Waste disposal is reduced through avoidance and increases in reuse, including energy recovery, and recycling
- Wastes are disposed of responsibly; they are not dumped or burnt on site
- Staff are trained to achieve outcomes stated in the waste management plan

Longer term asset condition outcomes, which may take 5-10 years or more to achieve, include:

- Wastes are stored in a manner that ensures they do not create litter, offensive odours, seepage or lead to diseases/pests that affect crops or people
- Runoff from stored waste or treatment does not pollute soils, enter waterways or groundwater
- Waste management does not have a negative

effect on vegetation and biodiversity on the property or surrounding landscapes

- Waste management produces the minimum amount of greenhouse gases
- Properly composted (mature compost) organic waste is used to improve soil condition

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- Soil Wealth email updates
- VegNET – extension officers
- AHR resources

Horticulture wide updates

- AUSVEG mailing list, including weekly updates
- Hort Innovation newsletter
- Growcom email subscription

Industry updates:

- Grand Challenges in Waste Management in Agroecosystems - frontiers in sustainable food systems article
- ABC news – recycling and waste management topic
- Waste management review – Australian waste industry innovation updates

Government updates:

- Tackling Australia's food waste – Department of the Environment, national food waste policy
- Policies and governance for waste – Department of the Environment
- Waste management tips for business – Business QLD

“Pollution is nothing but the resources we are not harvesting. We allow them to be dispersed because we’ve been ignorant of their value.”

- R. Buckminster Fuller



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Innovative ways to address waste management on vegetable farms

VG13109

The aim of the project was to enable the Australian vegetable industry to consider alternatives to plastic use and recycling contributing to continuous improvement in farm management practices, efficiency and sustainability.

Biogas generation feasibility study

VG13049

This report presents the findings of the feasibility analysis of on-farm biogas for Australian vegetable farms. There is significant interest within the vegetable industry in maximising efficiency and productivity across the production process, including maximising value from waste streams. Previous analysis has suggested that generating biogas from on-farm vegetable waste could be a cost-effective option. This study was commissioned to explore in more detail the feasibility of biogas on Australian vegetable farms.

Production of fish feed from vegetable waste

VG13050

The purpose of this project was to evaluate the potential for using vegetable waste to grow insects, which could then be used to wholly or partially replace wild caught fishmeal in aquaculture feeds. Primarily a desktop study, the project also conducted some small initial trials examining the suitability of different vegetables for producing black soldier fly larvae and describes some of the issues that need to be addressed in commercializing this method.

Optimum vegetable portion size to meet consumer needs

VG12094

To outline the findings from the research study conducted on optimum portion sizes for six Australian vegetables.

Identifying new products, uses and markets for Australian vegetables

VG12046

The broad objective of this project was to quantify the waste produced by the Australian vegetable industry, with a focus on waste at the farm level. The project then reviewed alternative uses for vegetable waste and presented uses with potential for adoption by growers or processors.

Extraction of bioactives from cannery waste

CF07006

Book written by Greg White to improve waste disposal in processing plants in Australia.

Scoping horticultural industry waste streams to determine suitability for use in pet food manufacture

HG08026

Book written by Andrew Redman to improve waste disposal in horticulture.

Increasing the opportunities for use of organic wastes in the Tasmanian vegetable industry

VX99002

This project was undertaken to investigate some of the perceived barriers to greater use of recycled organic materials in the Tasmanian vegetable industry. Three of these barriers are; availability of suitable products, transport, handling and processing costs and concerns regarding food safety.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Innovative approaches to adding value to vegetable waste – Phase 2

MT06053

The project brings together scientists from Food Science Australia and New Zealand Crop and Food Research to work with Simplot to examine new technologies for adding value to vegetable waste. A waste audit for processing plants in Bathurst, Devonport, and Ulverstone (Phase I) was used as the basis for evaluating available technologies. The technologies were spread across bio-energy generation, edible fibre and starch recovery, fish and animal food manufacture, extraction of bioactives and biopolymers, and composting. The initial study identified four concepts for detailed analysis: conversion of potato waste to bio-energy, extraction of corn fibre and potato protein, and refinement of solid waste for pet food.

Global scan for vegetable innovation – Fresh and Minimally Processed

VG13080

The Australian vegetable industry aims to increase its vegetables' attractiveness and competitiveness as exports to Asian markets. To achieve this, research into the various types of innovation used within the vegetable industry was conducted to identify new, relevant and commercially viable solutions to assist Australian growers. A global scan of vegetable innovations – ranging from packaging and value-adding to new products and other initiatives – was conducted from April 2014 to January 2015 as it applied to fresh and minimally processed vegetables.

Market opportunity for vegetable juices

VG16016

This project was undertaken to help understand the market opportunity for vegetable juices; what drives consumption, and what potential (if any) the vegetable juice market offers to growers.

The objectives for this project were to estimate the size and composition of the vegetable juice market in Australia, identify consumer attitudes toward vegetable juice that are relevant to understanding current behaviour, identify opportunities to increase consumption of vegetable juice in Australia and to provide any other relevant information around the potential value of the market.

Increasing productivity through decreasing food waste and loss in the value chain, particularly pre-farm gate

RIRDC Report

Australian studies indicate that around 25 per cent of horticulture production is lost inside the farm gate. Most of this is thought to be avoidable with approximately 80 per cent of these losses able to be eliminated. The potato industry is the most significant but disproportionate contributor to this waste.

The project investigated the need for Australian agricultural and horticultural industries to increase productivity through decreasing pre-consumer food loss and post-consumer food waste in the value chain, particularly at the farm gate at a regional level. There was a focus on the potato industry; the world's third largest food crop.

Creating value from edible vegetable waste – CSIRO research

VG15076

This project developed new knowledge and processes to improve recovery of edible material, with a focus on brassica vegetables and carrots. Avenues of exploration include the extraction of 'nutraceuticals' from vegetable waste; the processing of edible waste into new fibre-rich, healthy raw ingredients and food products; and the use of fermentation to develop next-generation fermented vegetables.



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Conduct a waste audit across the business, including production site/s, packing facilities and the farm office:

- Identify categories and sources of waste generated, estimate volumes of waste produced annually, note current methods of management and disposal and potential environmental impacts. Refer to waste assessment table to help ensure a thorough audit of all potential sources of waste
- Also consider/review raw material inputs, including their size/quantity/weight, the potential for reuse/recycling, and their potential residual waste products
- Note any controlled/prescribed wastes that are produced and check if these are managed in accordance with regulations

- For each category of waste, review options for improved management
- Identify waste minimization and management priorities

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment

- The report will identify critical risks and recommendations for actions/practices to implement

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a waste management plan/program

- Use the EnviroVeg action planning template
- Incorporate into the waste management program the recommended practices outlined in Part 1
- Ensure legal obligations and catchment/regional priorities for managing waste and protecting local amenity are understood and met
- Communicate with neighbours regarding the practices in place to minimize and manage wastes that may be of community concern

Step 4: Monitor performance measures/indicators

Performance indicators for waste management in vegetable production systems may include:

- Tonnes or volumes of waste of all types that is sent to landfill annually per tonne of saleable vegetables produced, measured through receipts and sales information (aiming for a decrease over time)
- Tonnes or volumes of wastes of key categories (e.g. plastics, metal, glass, batteries, liquids) directed to recycling annually per tonne of saleable vegetables produced (aiming for an increase over time)
- Tonnes of organic waste that is composted



annually per tonne of saleable vegetables produced (aiming for an increase over time)

- Tonnes or volumes of waste of all types produced annually that is stockpiled on the property per tonne of saleable vegetables produced (aiming for a decrease over time)
- Results of surface water and soil tests from around waste storage, recycling or disposal areas (nutrients – particularly nitrogen and phosphorous, pH, EC, contaminants, heavy metals) to monitor potential effects of leaching/runoff
- MegaWatt (MW) of energy produced annually e.g. via biogas

Step 5: Keep records

- Waste review/audit, noting types and tonnages or volumes of waste generated at the production site annually
- Waste Management Program (Freshcare form E8)
- Compliance records as required by environmental or health authorities
- Receipts from waste to recycling facilities noting waste/material type, volume and dates of disposal
- Receipts from waste disposal to landfill noting waste type, volume and dates of disposal
- Property map, noting location of waste storage and disposal sites
- Soil and water testing reports
- Composting records
- Energy use and production records

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed;

- Review and update the waste management plan annually, document the name of the person completing the review and the date
- Ensure actions and procedures have been appropriately embedded into the property management system
- Identify and prioritise training requirements
- What waste will be produced in the future, compared to what waste is being produced now

Connect with like-minded producers, network and discuss your ideas;

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook
- Tweet to EnviroVeg members on Twitter; the programs handle is; @EnviroVeg,

Come to EnviroVeg events, ask questions of other growers about their practices

“The case for recycling is strong. The bottom line is clear. Recycling requires a trivial amount of our time. Recycling saves money and reduces pollution. Recycling creates more jobs than landfilling or incineration. And a largely ignored but very important consideration, recycling reduces our need to dump our garbage in someone else’s backyard.”

- David Morris



FIGURE 2: INNOVATION IN VEGETABLE WASTE MANAGEMENT

This project looked at the feasibility of alternative use of vegetable waste on-farm, and processing and reuse of waste. The below information summarises what plastic is used, the costs for landfill and using plastic mulch. For the full project report see: Innovative Ways to Address Waste Management on Vegetable Farms

SUMMARY OF PLASTIC QUANTITY BY TYPE

Plastic type	Total consumption (tonnes)	Total recycling (tonnes)	Total recycling rate (%)	Estimated quantity for horticulture sector (tonnes/year)	Main product on vegetable farms	Lifespan
1. Expandable Polystyrene (EPS)	43,800	4,300	9.9%	5,000	Seedling trays	Up to 30 years
2. Polypropylene (PP)	218,600	45,800	21.0%	9,000	Seedling trays, bed trays	Long (varies)
3. Polyvinyl Chloride (PVC)	194,100	6,900	3.6%	5,000-7,000	Permanent irrigation pipe	Up to 50 years
4. Polyethylene (PE)	400,100	93,200	23.3%	5,000-10,000	Drip/trickle irrigation pipe	1-10 years
5. High Density Polyethylene (HDPE)	400,100	93,200	23.3%	2-5% of total HDPE chemical containers, 2.2 million recycled in 2011-12	Chemical containers	drumMUSTER program exists to recycle chemical containers
6. Low Density Polyethylene and Linear Low Density Polyethylene (L/LLDPE)	213,200	66,700	31.3%	5,500	Mulch sheeting, polytunnel and protective housing and flooring	1-10 years
Total	1,477,800	216,900	-	36,500		

LANDFILL COSTS (GATE FEE AND LANDFILL LEVY) BY JURISTICTION

Note: while landfill levies are fixed across a jurisdiction (they often differ between urban and rural areas), the actual cost of landfill will differ for each landfill site. No useful 'average' exists for each jurisdiction.

State	Regional Landfill Levy	Landfill Rate/Tonne
Victoria	\$51.80/t (rural/industrial)	\$21900/t incl. levy and GST (Wangaratta Landfill)
New South Wales	\$120.90/t (regional levy)	\$308.40/t incl. levy and GST (Spring Farm, Camden)
Queensland	\$0.00 (\$35.00t removed 01.07.2012)	\$10700/t incl. GST (Toowoomba Council Landfill)
South Australia	\$12.00/t (inert rate)	\$112.20/t and levy including GST (Adelaide Hills Region Waste Management Authority)
Western Australia	\$50.00/t (inert rate)	\$135.00/t incl. levy and GST (Henderson Waste Recovery Park)
Tasmania	\$2.00-\$5.00/t	\$7900/t incl. levy and GST (Launceston Landfill)
Northern Territory	n/a	\$116/t incl. levy and GST (Alice Springs Landfill)
Australian Capital Territory	n/a	\$135.14/t (Mugga Lane Resource Management Centre)

COST-EFFECTIVENESS OF ALTERNATIVE PLASTIC MULCH RESULTS

The results of the cost-effectiveness assessment are provided in Table 4-10 comparing: standard plastic mulch with landfill disposal; plastic mulch with illegal disposal; and biodegradable mulch.

	Plastic with landfill disposal	Plastic with illegal disposal	Biodegradable mulch	Photodegradable mulch
Retail cost	\$678	\$678	\$1,444	\$907
Retrieval cost	\$280	\$280		
Transport cost	\$123			
Landfill cost (average)	\$32			
Total cost	\$1,114	\$958	\$1,444	\$907

Source: ausveg.com.au/app/data/technical-insights/docs/VGI3109.PDF



PART THREE: RESOURCES AND FURTHER INFORMATION

General

[On-farm waste management factsheet](#) - Growcom Land & water

[National waste policy](#) - national approach to waste management

For information on waste and waste management, contact:

- Councils
- Departments of Primary Industries
- Environmental Protection Authorities

State-specific information:

- [ACT](#)
- [NSW](#)
- [NT](#)
- [QLD](#)
- [SA](#)
- [TAS](#)
- [VIC](#)
- [WA](#)

Charities that recycle/redistribute surplus fresh produce in Australia:

- [Fareshare \(VIC only\)](#)
- [Foodbank](#)
- [OzHarvest Food Rescue](#)
- [SecondBite](#): food for people in need

Compost

[Ecorecycle Victoria and Agriculture Victoria, Guides to Best Practice](#) - Provides information to help industry and local government produce compost from garden pruning to the required standards

[Guide to best practice for organics recovery](#) - Sustainability Victoria

[Environmental guidelines, composting and related](#)

[organics processing facilities](#) - NSW Environment

[How to Compost](#) - Provides links to a wide range of information on composting

[The Industry Code of Practice for the Management of Biohazardous Waste](#) - available for purchase

[OECD/FAO \(2013\) OECD-FAO Agricultural Outlook 2013-2022](#) - analysis of the key challenges facing international agriculture

[How to compost on-farm](#) - NSW Department of Primary Industries

Packaging

[Australian Packaging Covenant 2017](#) - Australian Department of Environment and Energy.

[Ecobuy](#) - Provides a national database on environmentally-responsible products including packaging

[The Packaging Council of Australia](#) - Provides a directory of suppliers of packaging products

Recycling and waste reduction

[DrumMUSTER](#) - Provides Australian agricultural and veterinary chemical users with a recycling pathway for eligible empty agvet chemical containers

[ChemClear](#) - Provides Australian agricultural and veterinary chemical users with a collection and disposal pathway for their unwanted chemicals

[Oil recycling](#) - Australian Department of Environment and Energy

[EPSA](#) - national industry body for all manufacturers



and distributors of expanded polystyrene (EPS) products across Australia

[Plastics and Chemicals Industry Association \(PACIA\)](#)

[Waste and Recycling in Australia](#) - ACT Department of Sustainability, Environment, Water

[Fluorocycle](#) - Information on recycling fluorescent lights

[E-waste in Victoria](#) - Department of Environment, Land, Water and Planning (VIC)

[Mobile Muster](#) - Recycles old mobile phones

[FoodWise](#) - Fast facts on food waste

Advisors and service providers

[Australian Council of Recyclers](#) - Provides links to state and local government contacts for waste management

[Waste Management Association of Australia \(WMAA\)](#) - Maintains a list of waste management professionals

[Recycled Organics Unit](#)

[Australian Certified Organic Standard \(ACOS\) 2017](#)

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.



AIR



PART ONE: MANAGEMENT GUIDELINES

Context

Vegetable production can generate dust, odour, smoke, noise, or excessive light which may lead to conflict with neighbours or the local community and even a loss of public support for the industry. Maintaining cooperative relationships, informing neighbours of the need for activities that may generate air pollution, and discussing management options can help reduce the risk of conflict in the local community.

Business benefits

Management of potential nuisance and pollutants is important to ensure neighbourhood and community expectations are met and to comply with environmental regulations.

Scope

This section considers aspects of vegetable production that may result in air pollution – including dust, odour, smoke, noise and light. Greenhouse gas emissions are addressed in section 8.

Management objectives

Maintain harmony with the local community through minimising potential nuisance or pollution from vegetable production, including dust, odour, smoke, noise and light.

Vegetable production sites are managed to ensure compliance with all relevant environmental regulations.

“Clean air and water, a diversity of animal and plant species, soil and mineral resources, and predictable weather are annuities that will pay dividends for as long as the human race survives – and may even extend our stay on Earth.”
- Alex Steffen

ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E9. To achieve certification to this standard, growers must demonstrate their compliance with the requirements outlined here.

E9.1 Manage air quality

- 1. An Air Quality Management Program is documented and must include:
 - date developed
 - name of the person documenting the Program
 - issue/s to be addressed
 - area/location
 - management methods
 - worker/s responsible.
- 2. The Air Quality Management Program is reviewed and updated annually. The name of the person completing the review and the date of the review are documented.

KEY HAZARDS AND RISKS

Hazards

Risks Environmental Business

Poor traffic management or cultivation practices may generate dust	Localised impacts on air quality	Impacts on local amenity
	Neighbour complaints	Reduced produce quality
Animal manures, fertilisers, chemicals, waste disposal sites for produce, composting sites or activities, mulches and waste management equipment may generate odours	Localised impacts on air quality	Impact on local amenity
	Neighbour complaints	Loss of public support for the business
	Impacts on family and staff	
Burning of farm wastes may generate smoke	Risk of toxic fumes	Potential health impacts on local residents (e.g. asthma)
	Localised impacts on air quality	
	Neighbour complaints	Impacts on family and staff
Farm machinery (such as pumps, harvesters and vehicles), bird scaring devices, and/or frost protectors may generate excessive noise	Noise pollution reduces local amenity	
	Noise impacts the mental or physical health or wellbeing of local community members	
	Noise pollution impacts the mental or physical health or wellbeing of family members and staff	
Lighting used for pest management or night-time harvesting may generate excessive light in surrounding areas	Excessive light may reduce local amenity and impact local community members	
	Neighbour complaints	

Note that an increase in the frequency and severity of extreme weather events, driven by climate change, may exacerbate localised air pollution. For example, may increase the incidence of air pollution events such as dust storms. It is important that on-farm management of air quality hazards is ongoing to reduce the potential frequency and severity of such events.

RECOMMENDED PRACTICES

The following practices are recommended to manage these risks:

Consider community expectations for the management of air quality in your local area:

Ensure legal obligations and catchment priorities for managing air pollution and local amenity are understood and met. All levels of government play a role in managing Australia's air quality. For example, there are a number of **National Environment Protection Measures (NEPMs)** relevant to air quality, including ambient air quality, noise, hazardous wastes and motor vehicle noise and emissions. Decisions about the way in which NEPMs are implemented are made by each jurisdiction individually. For information on how each NEPM is implemented, please refer to the relevant **jurisdictional agency**.

Communicate with neighbours regarding the operation of the site and the management practices in place to minimise disturbance or impacts on local air quality.

Prepare an **air quality management program**, noting significant risks, management strategies, monitoring procedures and necessary records. Review the program annually and update as necessary.

Develop a response plan to guide actions to address significant air pollution events that may occur on the site. Keep records of air pollution events and responses taken.

To **manage dust**

Follow recommended cultivation practices in Section 2: Land and Soil.

Pre-irrigate dry soil before cultivation to reduce dust.

Use slower cultivation speeds when there is a risk of dust.

Use mulches.

Maintain windbreaks/shelter belts, designed to allow 30-50% of the wind to pass through. Note that protection extends no more than 20 times the height of the vegetation.

High use traffic ways should be sealed or finished with minimal dust materials, such as blue metal or hardstand, or wet down as necessary to reduce dust. Do not apply oil to traffic ways due to the potential for it to pollute waterways.

To **manage odour**

Only apply strong-smelling manures, soil amendments or fertilisers when weather conditions are appropriate. Avoid application if the wind direction will carry the smell towards neighbours or sensitive areas.

Manures should be well spread out and worked into the soil as quickly as possible to minimise odours. Adequate soil moisture facilitates rapid initial breakdown and helps reduce odour. Assess the risk of odour problems against the risk of exposing the soil to compaction or erosion from incorporating manure.

Manage storage sites and produce waste disposal areas that may produce odours.

- Locate as far a distance as possible from neighbours
- If possible, locate downwind of neighbours
- Establish a visual screen around storage or disposal sites to help reduce the perception of an odour problem
- Maintain a cover over disposed wastes to minimise odours and the risk of disease transmission, pest build-up and vermin
- Compost wastes where possible, using odour minimising methods.

To **manage smoke**

Reduce the **need to burn waste**, by following recommended waste minimisation and management practices in Section 9: Waste.

Burn waste only when there is no other option for its disposal.

Ensure necessary local government permits are obtained prior to burning wastes and manage fire carefully and in accordance with permit conditions. Do not burn wastes in windy weather.

Never burn on-site materials that **may generate toxic fumes**.

To manage noise

Ensure local government noise regulations and limits are understood and followed.

Communicate with immediate neighbours regarding the potential noise that may be generated at the site, in particular specific times when noise levels may increase or occur outside of normal business hours.

Consider establishing or maintaining buffer zones to manage the risk of noise pollution from the site.

Where pumps are located close to residential areas, consider changing from diesel to electric pumps or constructing a sound barrier around the pump. Electric pumps will most likely be run at night time, when electricity tariffs are lower.

Consider muffling equipment where daytime intermittent noise levels are excessive.

Where normal methods are not sufficient to reduce noise to acceptable levels, equipment that is continuously operated may require soundproofing or artificial mounds to help absorb and deflect the noise.

Some forms of seasonal activity, or current and accepted industry practice like harvesting, may require the use of machinery at night. Where

sensitive places are close to noise and night-time activities occur, consider starting work closer to the sensitive area and moving away as night falls. The converse applies for early morning activities.

Where noise may be an issue, keep records of machinery use.

Use bird deterrents, such as gas guns, and frost protectors in a considerate manner and in accordance with local bylaws, such as meeting guidelines on hours of operation and maximum accumulated peak level (APL) for impulsive noise devices.

Advise transport operators picking up packed produce to avoid use of exhaust brakes where this noise would create a nuisance to neighbours.

To manage light

Contact neighbours before planning changes to lighting that is likely to impact on them.

Plan lighting to light only the locations needed and use the minimum amount of lighting required. This includes management of harvest lighting (where used).

Install daylight or movement sensors, and/or timers so that lights are only on when needed.

FIGURE 1: CULTIVATION PRACTICES TO MANAGE DUST

Manage traffic	Maintain tracks to reduce dust movement onto crops or neighbouring properties. Restrict traffic to all-weather tracks or other specified areas. Design permanent tracks with adequate surface drainage and ensure water is not diverted to production areas. Plan farming activities carefully to minimise the movement of vehicles and machinery.
Protect the soil surface	Avoid bare fallowing, particularly during known periods of high rainfall, on sloping ground or ground that is prone to erosion. Limit fallow periods to the minimum time required. Maintain soil cover: use crops, crop residues, cover crops, mulches, organic amendments, grasses and/or native vegetation to maximise the amount of time soils on the farm are covered. Establish wind breaks and other vegetated areas in strategic locations to reduce wind speeds and/or to capture or slow run-off water down water across production areas.
Manage cultivation	Implement permanent beds and cultivate across the slope where feasible. Avoid over-cultivation by implementing semi-permanent beds and/or minimum tillage techniques. Ensure appropriate implements are selected and they are properly maintained (for example, sharp and correctly adjusted); reduce the use of power implements as much as possible. Do not till soil that is too wet or too dry.

For more information see section 2; Land and soil

EXPECTED OUTCOMES

Short term outcomes of effective air quality management practices, which may take up to 5 years to achieve, include:

- The generation of odour, dust, smoke, noise and light from vegetable production sites is minimised.
- The number and frequency of complaints from neighbours or the local community is reduced.

Longer term outcomes, which may take 5-10 years or more to achieve, include:

- Air quality around the vegetable production site is improved.
- Relationships with neighbours and the local community are optimized.

SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- Soil Wealth email updates
- VegNET – extension officers
- AHR resources

Horticulture wide updates

- AUSVEG mailing list, including weekly updates
- Hort Innovation newsletter
- Growcom email subscription

Industry updates:

- Dustwatch - Citizen science program gathering information about dust storms
- World Health Organization - ambient air quality guidelines

Government updates:

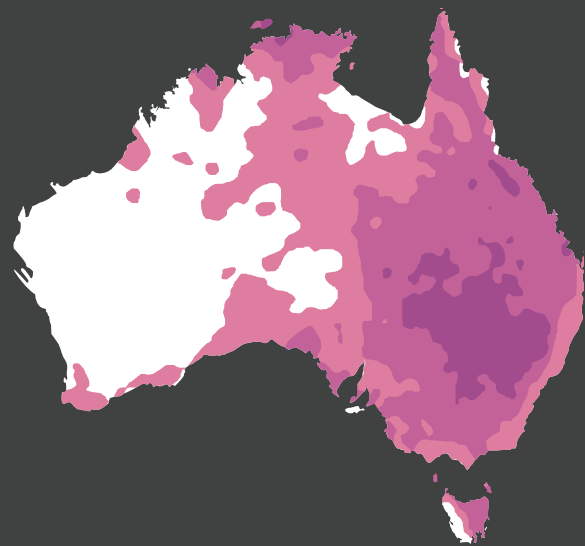
- Air quality legislation and administration of standards - Department of the Environment
- Access region-specific air quality monitoring agencies;
 - South Australia (EPA)
 - Victoria (EPA)
 - New South Wales (Dept of Environment)
 - Tasmania (EPA)
 - Western Australia (Dept of Environment)
 - Queensland (Dept of Environment)
 - Northern Territory (Dept of Environment)
 - Australian Capital Territory (ACT health)

FIGURE 2: AUSTRALIAN RAINFALL PATTERNS DURING EL NIÑO

Figure 2 shows that the average impact is for the six-month total rainfall to be ‘below average’ (that is, in deciles 2 or 3 and indicated by red shades on the map) across much of eastern Australia. Regions specifically affected include the northeastern half of Tasmania, almost all of Victoria, almost all of New South Wales (excluding coastal districts), eastern and coastal parts of South Australia, and much of Queensland. Small coastal areas in southern Western Australia are affected, as is the north of the Northern Territory.

It should be remembered that the winter/spring period covers a lot of the dry season for northern Australia. In the dry season, zero monthly rainfall totals are quite common in some northern and central parts even in ordinary years, so it is not surprising that there is little or no consistent El Niño effect for this time of year across central and southern parts of the Northern Territory and adjacent parts of Western Australia. In no parts of the country is there a consistent tendency towards ‘above average’ (decile 8 or higher) rainfall in El Niño years.

It should not be expected that winter/spring rainfall in any given El Niño year will follow the pattern of Figure 1, nor should it be expected that ‘above average’ rainfalls will not occur during an El Niño year. To see what happened as regards total winter/spring rainfall in each of these El Niño years select the year links in the table.



- | | |
|---------------|----------|
| Decile 10 | Decile 4 |
| Decile 9 | Decile 3 |
| Decile 8 | Decile 2 |
| Decile 7 | Decile 1 |
| Deciles 5 & 6 | |

Source: bom.gov.au/climate/enso/ninocomp.shtml

THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Predictive Ocean Atmospheric Model for Australia (POAMA)

[CSIRO research](#)

POAMA is the Bureau of Meteorology's dynamical (physics based) climate model used for multi-week to seasonal through to inter-annual climate outlooks. It is a state of the art long-range forecast system using ocean, atmosphere, ice and land data observations to initiate outlooks up to nine months ahead. POAMA was developed jointly by the Bureau of Meteorology and CSIRO Marine and Atmospheric Research. The Bureau utilises POAMA for several products including forecasts of the state of El Niño - Southern Oscillation (ENSO), Indian Ocean Dipole forecasts, and seasonal rainfall and temperature outlooks. Full details of the POAMA system and a range of experimental products can be found on [the POAMA site](#).

Landscape fires

[Centre for Air pollution, energy and health research](#)

Australia is unique in the frequency of its landscape fires such as bushfires and backburning. These contribute significantly to our air pollution by producing carbon monoxide and nitrogen oxides.

Exploring potential measurement and modelling techniques for estimating human exposure to airborne pollutants

[Clean Air and Urban Landscapes Hub](#)

This project will 'nationalise' some of the learning from the Western Sydney air quality study. This is a response to our recent user consultation. Western Sydney faces some particular problems regarding its air quality, a function of its rapid development and geography. Some of what we are learning about measuring, modelling and managing air quality is, however, transferable. This project will explore this extension. It will take careful regard of what is truly generalizable from the Western Sydney experience and what is feasible within CAUL's resources.

How does air pollution affect agriculture?

[International Institute for Environment and Development](#)

This paper examines the current and future importance of air pollution as a constraint to agricultural productivity in developing countries. It asserts that the key pollutants of concern are ground level ozone, given its potential to cause widespread yield loss in sensitive crops; and other pollutants, such as sulphur dioxide and nitrogen dioxide, which also have significant localised effects.

PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Review your Farm map (including production site/s, packing facilities and the farm office) and identify sites likely to generate dust, odour, smoke, noise, or excessive light and proximity of these to neighbours or sensitive areas. This information can be used to develop your Air Quality Management Program (Freshcare form F9).

Identify and collate a list of complaints from neighbours related to air quality (if any). Note the nature of the complaint, location and whether any action has already been taken.

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment.

Step 3: Prepare an action and implementation plan that addresses key risks

The report generated from completing the

EnviroVeg self-assessment will identify critical risks and recommendations for actions/practices to implement. Further analysis of priority actions should be undertaken and steps put in place to assign responsibility/due date of implementing the actions.

Step 4: Monitor performance measures/indicators

Performance indicators for air quality management in vegetable production systems may include:

- Site manager and or staff should regularly monitor odours, particularly in high risk areas of the site.
- Monitor noise levels from machinery, pumps, harvesting equipment, packing facilities.
- Community complaints (decreasing).

Step 5: Keep records

Essential air quality records include:

- Air Quality Management Program (Freshcare form E9), noting: date developed; name of the person documenting the program; issue/s to be addressed; area/location; management methods; and worker/s responsible.
- Farm map, noting sites likely to generate dust, odour, smoke, noise, or excessive light and proximity of these to neighbours or sensitive areas.
- Complaints register, recording the nature of complaints and action taken to respond/resolve.
- Cultivation, fertilizer/soil amendment, pesticide application records, including location, date, time, duration, description of activity, equipment used, person conducting the operation.
- Copies of any licenses/permits required for activities that cause air pollution e.g. burning.

Step 6: Review/evaluation procedures

- The Air Quality Management Program is reviewed and updated annually. The name of the person completing the review and the date of the review are documented.

PART THREE: RESOURCES AND FURTHER INFORMATION

Climate Change and air pollution:

[Clearing the air, air pollution report](#) - Environmental Justice Australia

[Environmental problems in Australia](#) - World Wildlife Fund

[Food security report, the effects of climate change on food and farming in Australia](#) - Climate Council

[Air quality toolkit](#) - EPA NSW

Guidelines and government information:

[Guidelines for sustainable agriculture supply chains in Australia](#) - SAI Platform Australia

[Environmental management in Australia](#) - OECD international report

[Australian Government Department of Environment & Energy. Air Quality](#)

[National Clean Air Agreement \(2015\)](#)

State-specific information:

[NSW](#)

[Department of Environment and Heritage \(NSW\) \(2012\). DustWatch](#)

[Office of Environment and Heritage \(NSW\). Air Quality Monitoring](#)

[NT](#)

[QLD](#)

[SA](#)

epa.sa.gov.au/xstd_files/Noise/Guideline/guide_bird.pdf

[TAS](#)

[VIC](#)

[WA](#)

Noise:

[Noise Injury Prevention](#) - Australian Centre for Agricultural Health and Safety

[National centre for farmer health](#) - Noise prevention

[Noise in agriculture](#) - WA government

[Noise](#) - Safe Work Australia

[Farm noise hearing injury](#) - Farmsafe Australia

Smoke and dust:

[Smoke from Biomass burning](#) - Australian Government Department of Environment

[Guidelines for managing the impacts of dust](#) - WA department of Environment

[Ground cover monitoring in Australia](#) - Federal Agriculture resource

[Centre for expertise in smoke taint research](#) - VIC government

[Burning in the open](#) - EPA SA

[Air quality guidance](#) - agricultural stubble burning, NSW EPA

Wind:

[Institute of Foresters of Australia](#) -

Maintains a directory of providers of farm forestry, windbreak design, native vegetation and wildfire management services.

[Dust watch Australia](#) - Wind erosion modelling for sustainable land management

Smell:

[Fertiliser Australia](#) - Maintains a directory of accredited nutrition advisors, and contractors

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

BIODIVERSITY



PART ONE: MANAGEMENT GUIDELINES

Context

Biodiversity is the variety of all life forms: the different plants, animals, fish, birds, insects and micro-organisms, their genes and also the ecosystems they form. Biodiversity conservation is a high national priority, and there is increasing recognition that maintaining biodiversity contributes to sustainability and productivity on farms. The presence of native plants and animals on production sites creates a pleasant working and living environment, improves the scenic amenity of farming districts and maintains the unique character of the Australian landscape. Native vegetation benefits from being acclimated to the Australian environment, enabling it to readily establish itself.

Bio corridors will add to the success of an IPM plan, aid in reducing soil erosion, and increase top soil production high in organic material. In addition, planting conservation areas can benefit mixed farming ventures by creating wind breaks for livestock. Many of the practices recommended in other sections will contribute to biodiversity outcomes; however, there are further specific actions that should be considered to protect and enhance biodiversity in vegetable production systems.

It is also important to note that as both natural and agricultural environments face increasing pressures, including climate change, the emphasis in biodiversity management has shifted from the preservation of species in their natural habitats and current locations to supporting resilience by ensuring that species and ecosystems have the spaces and opportunities to re-organise and adapt as needed. For example, it has been estimated that 75 percent of crop genetic diversity has been lost during the last century through genetic erosion.

Scope

This section focusses on the actions that can be taken by vegetable producers to protect native plants, animals and ecosystems and to enhance biodiversity – both on the property and in the wider landscape. Practices that contribute to biodiversity conservation are also found in most other sections of EnviroVeg, but particularly in the sections addressing land and soil, crop nutrition and pest management.

Management objectives

Manage the property and farming activities to maintain spaces and habitats where biodiversity can flourish

Ensure threats to biodiversity, such as weeds and pests, are reduced/controlled

Retain and improve remnant and riparian native vegetation and, where practical, optimise connectivity with vegetation in the wider landscape

Ensure any threatened or vulnerable species or ecosystems that are present on the property are protected

Ensure compliance with all relevant legislation, particularly regarding native vegetation management and wildlife conservation.



ACHIEVING ENVIRONMENTAL ASSURANCE CERTIFICATION

This section of EnviroVeg aligns with the Freshcare Environmental Standard section E7. To achieve certification to this standard, growers must demonstrate their compliance with the requirements outlined here.

E7.1 Manage biodiversity on the property.

- 1. A Biodiversity Management Program is established using strategies and practices to:
 - protect areas of biodiversity identified on the property map
 - reduce threatening processes
 - manage feral animals, invasive species, pests, environmental weeds and diseases on the property.

- 2. The Biodiversity Management Program is documented and must include:
 - date developed
 - name of the person documenting the Program
 - biodiversity issues or values
 - strategies/practices
 - worker/s responsible.
- 3. The Biodiversity Management Program is reviewed and updated annually. The name of the person completing the review and the date of the review are documented.

E7.2 Develop strategies to protect and improve biodiversity.

- 1. Biodiversity protection and improvement strategies are developed with consideration of regional biodiversity priorities.

“The value of biodiversity is that it makes our ecosystems more resilient, which is a prerequisite for stable societies; its wanton destruction is akin to setting fire to our lifeboat.”
- Johan Rockstrom

KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Cultivation and farming activities that impact on soil health and biodiversity	Reduced biodiversity in soils Increased erosion risk Reduced soil health	Reduction in crop yield or quality Increase in pest pressure
Farming systems and activities that impact on habitats for native species	Reduced biodiversity or biotic homogenisation Reduction in water quality in local waterways or on-site water storages Reduce quality and quantity of habitat areas for native species	Decreased populations of beneficial insects Potential reduction in appeal of property/lifestyle or property value

KEY HAZARDS AND RISKS

Hazards

Risks | Environmental | Business

Farming activities that impact on threatened or vulnerable species	Increased pressure on animal and plant communities Threatened or vulnerable plant or animal species or regional ecosystems Perception risk – need to be seen to be contributing to solutions for threatened/vulnerable species
Incorrect pesticide application practices	Reduced local biodiversity Build-up of toxic residues on or near the production site Impacts on non-target species Off-site movement of pesticides Build-up of toxic residues on or near the production site Financial loss
Poor application of fertilisers or soil amendments	Eutrophication of local waterways or water bodies/reduced ecosystem health Reduced local biodiversity Build-up of nutrients in soils or waterways on or near the production site Financial loss Reduced production efficacy
A high number/extent of weeds, non-native plants and feral/pest animals	Reduced local biodiversity, competition with native plants and animals Soil degradation Reduced water quality Increased weed management costs Lower yield/quality of produce
Inappropriate or poor management of native pest animals	Reduced local biodiversity Reduced quality of produce Financial loss through fines
Loss of native flora and fauna	Lack of competition leads to establishment of invasive species Increased costs of production (weeding, spraying etc.) Reduced quality of crop



RECOMMENDED PRACTICES

Comply with all relevant laws, particularly native vegetation management and wildlife conservation

Review legislative or policy requirements regarding biodiversity conservation in your region to identify any protected, vulnerable or significant species or ecosystems that are present on, or adjacent to, the property.

- Research any relevant legal requirements for conservation of vulnerable or threatened species or ecosystems and/or management of declared plants or animals.
- Review relevant biodiversity conservation, native vegetation management or natural resource management plans available for your catchment or region.
 - Queensland
 - Victoria
 - ACT
 - New South Wales
 - Northern Territory
 - South Australia
 - Tasmania
 - Western Australia

Noxious weeds must be controlled under legislation at a state or territory level. Of the 2700 species of introduced plants now established, 429 have been declared noxious or are under some form of legislative control in Australia. See this list of noxious weeds.

Conduct a review of the production site to identify any areas with high habitat values, areas that have good potential to support (native) biodiversity.

Cropped area, including soils and the crop itself

Areas near or around water, including on-farm water storages, drainage lines, wetlands and waterways.

- For example, a dam with a large surface area, variety of depths and gently sloping bank offers varied habitats for many vertebrate and insect species. Logs, rocks and boulders in and around the dam also provide habitat.
- River snags, submerged logs, branches and litter in water ways provide habitat for fish, frogs and invertebrates. Half submerged logs also provide perching spots for birds and turtles.
- Hollow logs provide homes for many species.

- Note that the natural cycles of flood and drought are important in maintaining ecosystems and habitats. In wetland areas, floods rejuvenate the soil and create temporary habitat and breeding sites for waterbirds, tadpoles and fish. Waterbirds eat many crop damaging insects, and the common backswimmer and the nymphs of dragonflies and damselflies eat mosquito larvae. Adult dragonflies and damselflies also prey on mosquitoes and crop damaging insects such as aphids.

Areas that are not in production, including wind breaks and areas of remnant native vegetation

Note that dead trees – standing or fallen – are often importance nesting/refuge sites

Assess threats to, or impacts on, biodiversity and habitat assets that occur on-site. Also consider threats that arise from adjacent areas.

Potential threats to biodiversity arising from horticultural production activities are identified in the hazard and risk tables in other sections of EnviroVeg.

The five key horticultural activities most likely to pose threats to biodiversity include:

- Spray drift
- Fertiliser/water use and leakage
- Topsoil loss and erosion
- Disposal of waste
- Poor management of native animal pests

Non-native pests and weeds

Waterway biodiversity

- Establish native vegetation buffers around water storages.
- Improve wildlife habitat in and around your waterways.
- Establish native vegetation, for a depth of at least 20 metres on each bank, to provide habitat for wildlife and shelter and shade to help keep waterways at the right temperature for water life. Use native vegetation expected in your locality endemic to your region, including trees, shrubs, grasses, logs, leaf litter, and dead standing trees.

Link waterway buffers to other areas of native vegetation, to improve access to water for wildlife.



FIGURE 1: WEEDS OF NATIONAL SIGNIFICANCE

Bridal Creeper (*Asparagus asparagoides*), which not only causes losses by shading citrus and avocado trees and interfering with fruit picking, but is also considered the most important weed threat to biodiversity. It is an introduced vine which invades and smothers native vegetation.

The Western Cape form of Bridal Creeper, is larger and more vigorous than the common form.

Why is it a problem?

Bridal creeper is an aggressive and highly invasive weed that has serious impacts on the environment.

Introduced to Australia as a garden plant in the 1870s, it has since jumped the garden fence and spread throughout many parts of Australia.

Bridal creeper invades bushland, smothers native plants and reduces the health and diversity of our natural and agricultural resources. Bridal creeper:

- Produces a large volume of seed, which is readily spread by birds and animals;
- Roots form a thick, impenetrable mat, preventing natural regeneration of native plants;
- Survives harsh conditions such as fire, frost, and drought; and tolerates a range of soil types;
- Limits access to beaches, parks and trails;
- Can spread further than its current range; and
- Impacts on the quality and yield of primary industries such as citrus and forestry.

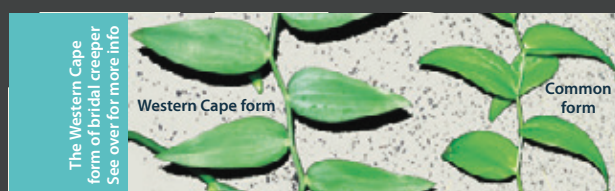
What does it look like?

Bridal creeper is a climbing vine with sharply pointed, shiny green leaves. A mass of scented white flowers appear in late winter, followed by small green berries in spring.

The berries ripen to red during summer and are an obvious food source for birds, who contribute to the weed's spread.

The plant typically loses its leaves in the dry summer months but its extensive root system allows the plant to survive and regrow with autumn rains. A mat of tuberous roots grows 10 – 20 cm below the soil surface and makes up 90% of the plant's biomass.

Bridal creeper prefers to climb, and is often seen scrambling over other plants, along fence lines and under bird roosting sites such as tall trees.



Leaves



Flower



Berries



Tuber

Bridal Creeper is one example of a Weed of National Significance – Target weed species approved for biological control by the Australian Weeds Committee (AWC) and the Natural Resource Management Standing Committee or under the Biological Control Act 1984.

Where does it grow?

Bridal creeper invades a range of situations including coastal areas, forests, heathlands, woodlands and riparian areas. Vegetation on roadsides and farms is particularly vulnerable.

For more information

Visit these websites for more details on who to contact, weed identification, control options and other *Asparagus* weeds: apwmc.gov.au, | weeds.org.au/works/bridalcreeper/



Prepare a property map that documents the habitats and biodiversity assets, relevant features in the wider landscape.

See property map template in section 1 – business.

Assets may include waterways or remnant vegetation or protected areas and sites/source areas where threats to biodiversity were identified.

Prepare a biodiversity management plan aimed to optimise habitats and biodiversity on the site and to address identified threats.

Develop an integrated property management plan and work through the range of potentially conflicting needs and allocate resources according to priority. Consider; soils, crops, water, wind breaks/shelters, wetlands, areas of native vegetation. Also see sections 2 and 5 of this manual.

Link to habitats offsite, such as a bio-corridor that leads to nearby reserves.

Reduce threats to biodiversity, including weeds, pests, and fire. Manage pets and other animals on farm to minimise their impact on native wildlife.

Retain and improve remnant native vegetation; riparian vegetation

Protect/improve threatened species

Optimise the benefits of having native animals on or near agricultural land. For example, many native birds eat insect pests, pollinate plants and disperse native seed.

Manage areas of native vegetation on farm

If appropriate, consider fencing off areas of native vegetation to exclude vehicles, people and stock. Select fence types that enable native animals to access natural drinking water sources and to move between habitats

Where practical, retain standing dead trees, logs, branches, twigs and rocks on the ground as habitat for birds, insects and other animals

Retain understorey grasses, shrubs and fallen trees to provide food sources and/or places where birds and beneficial native animals may hide from introduced predators or competitors

Protect areas of native vegetation from fertilisers. Avoid the use of fertiliser on native vegetation and ensure native vegetation is protected from accidental application such as drift. Fertilisers raise nutrient levels, encouraging invasion by exotic species and also reducing the amount of native ground cover species, including valuable perennial native grasses.

Consider participating in “Land for Wildlife” programs or a voluntary conservation agreement or similar with the relevant State agency to formalise your commitment to protect wildlife and significant habitat on the property.

Seek professional advice regarding fire management in areas of native vegetation.

- Ensure local and state laws are understood and met before implementing any fire management plans. See section 10: Air.
- Plan a fire regime to suit the desired outcome. Fuel load reduction burns are usually more frequent than fires intended to support tree regeneration. If the remnant vegetation includes threatened species, the fire regime should be designed to suit those species. Also consider the life cycle of plants when planning a fire regime: these will vary across Australia, however, autumn burns are generally best.
- Ensure fire breaks are established around production areas or other areas that must be protected from fire, and buildings are fireproofed prior to implementing a burning regime in areas of native vegetation.
- If the property is affected by bushfire or a prescribed burn, the native vegetation should recover, and the fire may provide a valuable opportunity for controlling weeds and kick-starting natural regeneration.

Maintain soil biodiversity.

Increase areas of native vegetation on the property

Planting native vegetation can enhance the property's productivity and wildlife habitat values. Well-designed native vegetation plantings may provide:

- Windbreaks or shelterbelts protecting crops, pastures, livestock and farm buildings
- Screening for buildings and facilities
- Additional habitat area – potentially boosting numbers of native animals that pollinate plants and control insect pests. Even individual trees can provide useful habitats
- Corridors to help increase connectivity between patches of habitat



- Help in reducing water tables and control salinity
- Erosion control
- Supply timber and fodder
- Improved water quality in wetlands, dams and watercourses

Consider using local native species for windbreaks, shelterbelts or buffer zones.

- Shelterbelts and windbreaks may be best placed on the property boundaries and developed with consideration of establishing interconnecting wildlife corridors. In addition to supporting productivity, plantings may provide habitat for beneficial native insects (and therefore contribute to Integrated Pest Management) as well as providing habitat for native species. Plantings of at least 20 m wide are likely to provide optimal benefits, however, if space is limited, narrower shelterbelts can still provide some protection to crops and provide some habitat.

Consider establishing a native vegetation restoration project, if feasible.

- Native vegetation restoration areas are best established in areas not currently used for farming, such as steep slopes, stream/dam sides, saline areas and wetlands. These areas are usually poorly utilised and don't make a major contribution to horticultural production.
- Select a mix of native plants, including trees, shrubs and grasses, preferably native to your local area (known as provenance species). Plantings should copy nature and not be as regular as a crop.
- With fencing and revegetation, wetlands, bogs and marshy areas can be turned from unprofitable areas to rehabilitated areas of great ecological significance. Some local authorities and organisations will provide advice and support to landholders for revegetation activities. Flora, fauna and bush regeneration consultants are also available to assist in design of restoration projects.

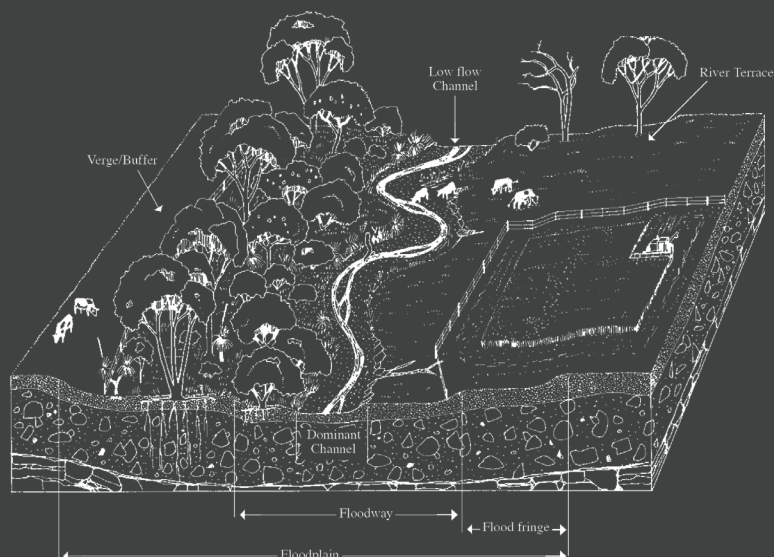
FIGURE 2: RIPARIAN ZONES

The first step in managing a river is to identify the riparian zone. The riparian zone can generally be described as the land that directly influences or is influenced by, a watercourse. That is, the corridor of land in which a stream functions.

The riparian zone includes the immediate vicinity of the stream, which consists of the bed, banks and adjacent land, as well as the floodplain, which carries large floods.

The width of the riparian zone can vary greatly depending on the type of river or stream and the catchment. Therefore the area of the riparian zone that requires special management will also vary. Upland streams with narrow valley widths generally have smaller riparian zones, but they are usually higher energy streams, and this can require more intensive management.

Lowland streams generally have broader valley widths and are more prone to meandering, therefore they usually have larger riparian zones. However, they are generally lower energy streams and can require less intensive management. Each watercourse is unique and it is best to assess the area of the riparian zone that requires active management on a case-by-case basis.



Contribute to biodiversity conservation in the wider landscape

Control **feral and pest animals** and native and exotic invasive plant species/weeds

- Seek advice from local council or relevant state government department regarding appropriate methods of control for pest animals such as feral pigs or deer, before a control program is commenced. Pest animals often prey on native animals and also may compete for the same space, food and shelter.
- Problem plants can be escapees or volunteers from commercial operations, if such plants start encroaching on native vegetation, management action is required.
- Identify and manage weeds on the property, ensuring compliance with all relevant local and state laws. Landowners are required by law to take all reasonable measures to prevent the land being infested with a declared weed and take all reasonable measures to prevent a declared weed or potential weed spreading to other land. In particular, management of "Weeds of National Significance" (WoNS) require urgent attention. Note that weeds around riparian areas and watercourses are the landowner's responsibility.

- Note that soil amendments, mulch and fill may harbor weeds. Source these products only from a trusted supplier and manage these inputs carefully. Inspect the places where these products are applied regularly to identify any potential weed incursions.
- Protect birds and other wildlife from poisoning.
- Safe use of granules or rodent control baits;
 - Cover granules completely with soil.
 - Clean up spills immediately.
 - Do not bait near wildlife habitat (for example, near waterways). Alternatively, use bait stations which prevent access by birds.
 - Distribute baits evenly.
 - Do not bait on bare ground, where birds may see baits.
 - Bait late in the evening when birds have finished feeding.
 - Promptly collect and bury rodent carcasses.

Manage native pest animals appropriately

- Every effort should be made to use non-lethal options for managing native pest animals.
- Lethal management options must only be considered as a last resort and must be humane and comply with all legal requirements, including permits and licences.
- For further information, see section 5: Pest Management.

EXPECTED OUTCOMES

Improved biodiversity management practice outcomes expected to be achieved through implementing these practices include:

Within 1- 5 years

- Native vegetation and wildlife is managed in accordance with legal requirements
- Existing areas of remnant native habitat and vegetation (including wildlife corridors, riparian areas, lakes, wetlands or significant water habitat) are protected
- Native habitat and vegetation is restored, increased and connected where possible
- Pests are managed in areas of native vegetation and waterways

- Pests and beneficial insects are monitored regularly
- Pests are managed in areas of native vegetation and waterways
- Habitat for threatened species is maintained
- Habitat for beneficial insects is maintained

Longer term outcomes, which may take 5-10 years or more

- Ecosystems, native vegetation and wildlife are maintained and managed and contribute, where feasible, to improved regional biodiversity
- The extent and condition of native vegetation on vegetable production sites is optimised
- Soil quality benefits? What about increased water retention in soil and reduced erosion?



SIMPLE WAYS TO STAY INFORMED

Vegetable Industry updates:

- [Soil Wealth email updates](#)
- [VegNET – extension officers](#)
- [AHR resources](#)

Horticulture wide updates:

- [AUSVEG mailing list, including weekly updates](#)
- [Hort Innovation newsletter](#)
- [Growcom email subscription](#)

Across the biodiversity industry:

- [Weeds Australia](#) - ‘Weeds of National Significance’ (WoNS) lists weeds that, by law, must be controlled if they are present on

your land. General information relating to identification and control measures for weeds

- [Environment.gov.au](#) – national vegetable information system
- [Environment.gov.au](#) – Australian vegetable attributes manual
- [CSIRO research](#) – landscape biodiversity
- [WWF](#) – habitat loss effects impacts
- [Parliamentary discussion](#) on biodiversity
- [Animals Australia](#) – managing wild animals
- [Weed management scoping study](#) – Hort Innovation project
- [QLD Government](#) - Threats to wildlife
- [Adelaide NRM](#) – native plants animals and biodiversity

FIGURE 3: BALANCING HABITATS WITH PRODUCTION

Balancing production, habitat for native species and ecosystem function in different land use intensities. Mobile species (e.g. most birds) cross unfavourable habitat; non-mobile species (e.g. many plants) require continuous habitat.

	Native vegetation – managed for conservation	Native vegetation – production uses	Moderate-intensity production	Highintensity production
Suggested proportion of landscape	≥ 10%	≥ 20%	0-70%	≤ 30%
Examples of land use	Conservation reserve, recreation area	Livestock grazing, native forestry	Native tree or shrub plantation, tree clearing to increase grazing production	Annual crops (cereals, vegetables), sown, fertilised pastures
Functions provided	≥ 70% of landscape covered with perennial vegetation			≤ 30% annual vegetation
Habitat provided for native species	Nearly all species, including those sensitive to human activities	Most species	Moderate number of species	Very few species highly tolerant of disturbance
Connectivity for non-mobile species	≥ 70% if ground layer is intact under moderate production; provides connectivity for most plants and invertebrates			≤ 30% not suitable for most plants and many animals to move through
Connectivity for mobile species	≥ 30% of landscape with trees and/or shrubs, providing connectivity for mobile species that require these elements for movement		Suitability will depend on species and land use	

Source and further information: research-repository.uwa.edu.au/en/publications/maximizing-retention-of-native-biodiversity-in-australian-agricul



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Native vegetation to enhance biodiversity, beneficial insects and pest control in horticulture systems

Nancy Schellhorn CSIRO
Entomology

VG05014

Revegetation by design could hold the key to combating insect pests, as well as encouraging beneficial insects and reducing the use of chemical sprays a Brisbane based CSIRO research scientist has found. Dr Nancy Schellhorn has worked in Queensland for the past year, focussing on the Lockyer Valley, including Gatton and Mulgowie. She and her team have conducted two types of surveys in the area to determine: 1) presence and distribution of key beneficial insects and pests from a range of native vegetation and weeds, and 2) if natural enemies and pests are multi-habitat users, for example, whether they are similarly found in native remnants, horticultural fields and the edges between the remnant and horticultural fields.

Landscape diversity and field margin management

Vesna Gagic CSIRO

VG14047

Australian vegetable production is under increased pressure to achieve more profitable and sustainable production as input costs are increasing together with increasing vegetable production (2% per annum), the Australian population (1.7% over the same period, Australian vegetable industry Strategic Investment Plan 2012 – 2017) and environmental degradation. Thus, an integrated approach that achieves reduced inputs and sustains natural habitats as refuges and a resource base for beneficial organisms is required. The homogenous nature of agricultural landscapes reduces biodiversity of natural enemies and thereby biocontrol, but this can be partly offset by developing refuges at field margins and in the surrounding landscapes as shown in a large body of international research. In this project, we review Australian and international literature related to the role of field margins and landscapes surrounding crop fields in providing resources to beneficial organisms and reducing arthropod pest pressure in vegetable and other crops.

Revegetation at property scale - designing the 'right' biodiversity for sustainable vegetable production

Glenys Wood South Australia
Research & Development
Institute (SARDI)

VG06014

On the Northern Adelaide Plains (NAP), pest thrips transmit tomato spotted wilt virus (TSWV) resulting in crop production losses of approximately \$25M p.a. Thrips control is heavily reliant on chemical use, which is expensive and biologically unsustainable. Research to determine how beneficial and pest insects interact with native vegetation near crops, will guide native plant selection which can be used to manipulate the horticultural environment to reduce pests, augment natural enemy populations and/or replace current pest management systems. Invertebrates associated with crops and native vegetation were sampled and classified. Their temporal and spatial association with plants and each other were analysed in field and laboratory-based trials to gain an insight into key interactions. Key findings confirm that judicious placement of select endemic plant species near horticultural facilities has potential for positively impacting on pest management and is likely to be more effective than traditional bare-earth buffers.

Phase II: Native vegetation to enhance biodiversity, beneficial insects and pest control in horticulture systems

Dr Nancy Schellhorn CSIRO
VG06024

The study examined the impact that more integrated land management and vegetable production have on pest issues. The project has undertaken an extensive literature review, experiments and grower surveys to determine what benefits will be realised by maintaining or creating native areas of native vegetations. The findings suggest that numerous native species are beneficial for revegetation of degraded areas on farms. These plants also cause beneficial insects to move from remnant vegetation into crops as do some pests.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Weed Management for the Vegetable Industry – Scoping Study

VG13079

Weeds are a persistent problem for many vegetable producers in Australia. The common features of vegetable cropping systems, including frequent cultivation that results in highly disturbed soil, irrigation (particularly furrow or flood irrigation), and the addition of large quantities of nutritional inputs before planting and during the growing period, mean that the potential for weed growth is high.

Guide to using native plants on the Northern Adelaide Plains to benefit horticulture

TL00155

This guide discusses the usefulness of native plant species with respect to horticulture and details six steps for undertaking revegetation on horticultural properties. Information relevant to the management of Western flower thrips (WFT), Tomato spotted wilt virus (TSWV) and other Thrips and Tospoviruses is included in this item.

A strategic approach to weed management for the Australian vegetable industry

VG15070

The overall goal is to give growers the very best weed management practices to ensure they can continue to deliver quality vegetables to Australian consumers and export markets for years to come. This work is based on two scoping studies conducted by the research team in this field: *Weed management for the Australian vegetable industry* (completed in 2014); and *Sustainable broadleaf weed control in cucurbit crops* (completed in 2011).

The project will deliver a suite of tools and techniques to make vegetable fields less hospitable to weeds, minimising the need for intervention and dealing weeds a knockout blow. As part of the project, we'll conduct field trials in various states, and consult with growers across the nation.

These findings will culminate in Australia's first Vegetable Industry Weed Manual.

Designing agricultural landscapes for biodiversity-based ecosystem services

Research published in: *Basic and Applied Ecology journal*

Sustainable and resilient agricultural systems are needed to feed and fuel a growing human population. However, the current model of agricultural intensification which produces high yields has also resulted in a loss of biodiversity, ecological function, and critical ecosystem services in agricultural landscapes. A key consequence of agricultural intensification is landscape simplification, where once heterogeneous landscapes contain increasingly fewer crop and non-crop habitats. Landscape simplification exacerbates biodiversity losses which leads to reductions in ecosystem services on which agriculture depends. In recent decades, considerable research has focused on mitigating these negative impacts, primarily via management of habitats to promote biodiversity and enhance services at the local scale. While it is well known that local and landscape factors interact, modifying overall landscape structure is seldom considered due to logistical constraints.



THE KNOWLEDGE AND INNOVATION PIPELINE

Project/research

Details

Food production, ecosystem services and biodiversity: We can't have it all everywhere

Research published in: *Science of The Total Environment*

Debate about how sustainable intensification and multifunctionality might be implemented continues, but there remains little understanding as to what extent they are achievable in arable landscapes. Policies that influence agronomic decisions are rarely made with an appreciation of the trade-offs that exist between food production, biodiversity conservation and ecosystem service provision. We present an approach that can reveal such trade-offs when used to assess current and future policy options that affect agricultural inputs (e.g. pesticides, nutrients) and practices. In addition, by demonstrating it in a pesticide policy context, we show how safeguarding a range of ecosystem services may have serious implications for UK food security. We suggest that policy change is most usefully implemented at a landscape scale to promote multifunctionality, tailoring pesticide risk assessment and incentives for management that support bundles of ecosystem services to specific landscape contexts. In some instances tough trade-offs may need to be accepted. However, our approach can ensure that current knowledge is used to inform policy decisions for progress towards a more balanced food production system.

Integrated landscape management for agriculture, rural livelihoods, and ecosystem conservation: An assessment of experience from Latin America and the Caribbean

Research published in: *Landscape and Urban Planning*

Approaches to integrated landscape management are currently garnering new interest as scientists, policymakers, and local stakeholders recognize the need to increase the multi-functionality of agricultural landscapes for food production, livelihood improvement, and ecosystem conservation. Such approaches have been attempted in many parts of Latin America and the Caribbean (LAC) but to date there has been no systematic assessment of their characteristics, outcomes, and limitations. To fill this gap, we surveyed participants and managers in integrated landscape initiatives throughout the LAC region to characterize these initiatives' contexts, motivations and objectives, stakeholders and participants, activities and investments, outcomes, and major successes and shortcomings.



PART TWO: PUTTING IT INTO PRACTICE

EMS cycle for continuous improvement



Step 1: Collect baseline information and data

Conduct biodiversity audit to identify existing data:

- Property map and biodiversity management plan
- Photos of significant remnant native vegetation, ecosystems, threatened species, native wildlife and/or habitat assets on the property
- Records of training and implementation of the Integrated Pest Management program applied on farm may be helpful for demonstrating biodiversity conservation strategies and outcomes in the business
- Strategies for control of problem native animals should be documented
- If lethal management of native pest animals is conducted on the property, licences/permits must be kept, along with records of take
- Soil test results will indicate number of organisms present in soils

Step 2: Assess your risks

Complete the on-line EnviroVeg self-assessment

The report will identify critical risks and recommendations for actions/practices to implement

Step 3: Prepare an action and implementation plan that addresses key risks

Prepare a Biodiversity management program and implement it annually

Use the EnviroVeg action planning template

Ask; what biodiversity impacts will your practices have on the landscape.

Further analysis of priority actions identified within the EnviroVeg self-assessment should be undertaken and steps put in place to assign responsibility/due date of implementing the actions.

Step 4: Monitor performance measures / indicators

Performance indicators for biodiversity management may include:

- % Extent of native vegetation
- % Protected areas on farm
- Populations of a relevant threatened species
- Resilience of biodiversity areas:

Signs of strong resilience (in native vegetation) include:

- Older trees, which will shower the site with seed;
- At least some natives in the shrub layer native grasses and ground cover plants;
- Native regrowth and evidence of regeneration;
- Natural watercourses;
- Leaf litter, fallen timber, lichen and mosses; and
- Intact soil profiles and soil that has had minimal impacts from farming.



Signs of reduced resilience include:

- Heavy weed loads;
- Introduced pasture grasses;
- Land degradation and soil erosion;
- Salt scalding;
- Few living trees, and signs of dieback;
- High nutrient levels from fertiliser or farm effluent runoff; and
- Stormwater runoff from urban areas and roads.

Step 5: Keep Records

Records may include:

- Information outlined in Step 1

Step 6: Review, evaluate, communicate

Review and update all records at least annually; or more frequently if required through your quality assurance systems.

Complete the EnviroVeg self-assessment annually, around the same time each year, to drive continuous improvement with minimal information gathering burden.

Ask what could be improved;

- Review 'Recommended Practices' section in Part 1
- Review 'References and Resources' section in Part 3
- Connect with specialists in the appropriate field

Compare against previous records, and ask what has changed from step 4

Connect with like-minded producers, network and discuss your ideas

EnviroVeg members on Social media;

- Join the EnviroVeg members group on Facebook, insert (Link here)
- Tweet to EnviroVeg members on Twitter; the programs handle is @EnviroVeg

Come to EnviroVeg events, ask questions of other growers about their practices

"If we pollute the air, water and soil that keep us alive and well, and destroy the biodiversity that allows natural systems to function, no amount of money will save us."

- David Suzuki



PART THREE: RESOURCES AND FURTHER INFORMATION

Key materials:

[Food Production and Nature Conservation](#) - CSIRO book and research by Iain Gordon et al (2017)

State-based property management and biodiversity planning resources:

- [Tasmania \(DPIPWE\)](#)
- [South Australia \(SARDI\)](#)
- [Victoria \(DELWP\)](#)
- [New South Wales \(OEH\)](#)
- [Queensland \(DES\)](#)
- [Western Australia \(DPLH\)](#)
- [Northern Territory \(DENR\)](#)

[Regional priorities](#) - Conservation advices and Recovery Plans by NRM region

Policy and strategy:

[Biodiversity Conservation Act](#)

[Australia's Biodiversity Conservation Strategy](#) - a guiding framework for conserving our nation's biodiversity over the coming decades. The vision of this Strategy is that Australia's biodiversity is healthy and resilient to threats, and valued both in its own right and for its essential contribution to our existence.

[Environmental taxation concessions](#) - Department of the Environment has responsibility for a number of administrative arrangements relating to taxation concessions that seek to conserve and protect the natural environment.

[Australian Weeds Strategy](#) - Natural Resource Management Ministerial Council.

Advisors and service providers:

[Environment Institute of Australia and New Zealand](#) - Maintains a directory of providers of environmental services

[Institute of Foresters of Australia](#) - Maintains a directory of providers of farm forestry, windbreak design, native vegetation and wildfire management services

[Greening Australia](#) - Your state branch of Greening Australia can also provide advice, access to grants schemes and in some cases direct support for revegetation works

[Australian Fauna Care](#) - A comprehensive list of wildlife care groups in Australia

Australian Government Department of Environment and Energy - [Biodiversity](#)

Australian Government Department of the Environment, Heritage and the Arts (ACT) - [Assessment of Australia's Terrestrial Biodiversity 2008](#)

Wildlife management

[Revegetation and Wildlife Guide](#) - a guide to enhancing revegetated habitats for wildlife conservation in rural environments.

[Integrating wildlife conservation and farm management](#) - NSW Office of Environment and Heritage

[Threatened species](#) as listed under the EPBC Act RSPCA (for wildlife injury)

[Vegetable IPM management in Tasmania](#) - Manual from DPIWE

[Managing Bird Damage to Fruit and other](#)



[Horticultural Crops](#) – Manual from DAFF

[Living with Wildlife](#) – Tasmanian Parks and Wildlife service

[Natural Resources Management agency](#)

[Biodiversity agency](#) for your state/region

[Land for Wildlife organisation](#)

[Field Naturalists group](#)

[Birds Australia](#)

Vegetation and habitat management:

[Revegetation by design guidebook](#) – [User guide National Trust](#) – Conservation organisation including natural, Indigenous and cultural heritage in every state and territory.

[Revegetation monitoring and reporting in Australia](#) – Bureau of Rural Sciences

[Environmental management on the urban fringe](#) – NSW government property management plan

[Australian River Restoration Centre](#) – Range of publications and guidelines on managing waterways on farm to achieve multiple benefits

[Wetland Care](#) – a national network of Non-Government Organisations and community groups involved in conservation and wise use of wetlands.

[Grow me instead](#) – [Nursery and Gardening industry Australia invasive weed management booklet](#)

[Managing bushland and wildlife habitat: Restoring native vegetation](#) – NSW Environment department

[Nature refuges initiative](#) – QLD EHP department

Reference lists

[Weeds in Australia](#) – [invasive species list](#)

[Flora of Australia Online](#)

[Biodiversity Atlas](#) – Department of Environment and Primary Industries (VIC)

Native vegetation

[Joint Venture Agroforestry Program \(JVAP\)](#) – Publications and guidelines on how to farm trees to protect crops and invest in another source of income, as well as how to establish and manage windbreaks.

[Master Tree Growers](#) – Courses and information available for farmers to become ‘master tree growers’ and generate income and environmental benefits on-farm

Fire management – [CFA Fire ready kit](#)

Land for wildlife – [NRM SEQ program](#)

[Native vegetation resource management portal](#) – Victoria DLWP

Books for purchase:

[Biodiversity Monitoring in Australia](#), CSIRO Publishing (2012)

[What makes a good farm for wildlife?](#) CSIRO Publishing (2011)

[Wildlife on farms – how to conserve native animals](#) CSIRO Publishing (2003)

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.



Join a network of certified sustainable vegetable growers.

Discover how a sustainable operation can increase your yield and grow your profits for years to come.

[LEARN MORE](#)

Become a sustainable business and grower

When you're a part of Enviroveg, you're not on your own. You'll have access to experts and tools to help get your operations sustainable.



EXPERTS

Get access to experts in sustainability. We're here to help.



MEASURE

Self Assess your sustainability efforts.



TRACKING

Work towards become sustainable certified.



EnviroVeg
Sustainable Vegetable Production

Freshcare Environmental

Danielle Park
Danielle Park
AUSVEG

3 glenarm road
Glen Iris
3146
Yarra River

Prepared By
Danielle Park
27-02-2022

Congratulations on completing your self - assessment, EnviroVeg hopes the information provided is valuable to you. In the interests of developing EnviroVeg to benefit Australian vegetable growers if you would like to provide feedback please go to info@enviroveg.com.au or visit www.enviroveg.com.au for more information.

The annual completion of an internal self-assessment is a requirement in order to maintain membership in the EnviroVeg Program. The self-assessment encourages uptake of environmental-best practice production techniques and relevant industry research as well as highlighting member requirements to progress to certification.

The data collected through the self-assessment is for two primary purposes:

- For EnviroVeg program members to track and benchmark environmental practices;
- For industry to understand the uptake of practices on-farm and direct research funding appropriately.

Data collected through the self-assessment will only be replicated in aggregated forms for these purposes, businesses will not be individually identified.

Regards, Danielle Park, EnviroVeg Coordinator



There are three main objectives to EnviroVeg:

- To support and improve environmental management on farm
- To facilitate program recognition of and competitive advantage from EnviroVeg branding
- Track industry progress regarding sustainable farming practices

The EnviroVeg Program

Established to improve the longevity of vegetable growing regions, benchmark industry data and develop industry recognition for environmentally responsible, sustainable production methods, EnviroVeg is industry-led and promotes best management techniques by providing resources, support, engagement and a pathway to certification recognition for vegetable producers.

EnviroVeg is underpinned by an Environmental Management Practice resource (the EnviroVeg Resource). This resource includes the most up to date information on achieving sustainable vegetable production and, having recently been updated by technical experts, its content is reviewed to ensure it remains current and useful. Importantly, relevant R&D levy research outcomes are integrated into the resource-manual for the easy adoption of outcomes of effective environmental practices for vegetable production.

Supporting the uptake of researched outcomes is the self-assessment, a process that identifies potential production and cost saving mechanisms, through efficient management of resources. The self-assessment is housed on a Hort-360 platform and is connected to supporting materials such as the EnviroVeg Resource and website through an individualised feedback report.

The EnviroVeg program provides a pathway to Freshcare Environmental certification for its members. Once certified, EnviroVeg program members can utilise EnviroVeg branding for business to business marketing and industry representation, while knowing this is underpinned by a quality, recognised, third-party environmental assurance program.

The EnviroVeg project represents a harmonised approach to achieving environmental best management practices in vegetable production and is achieved through the consolidation of processes, knowledge and resources of the partnering programs; EnviroVeg, Hort360 and Freshcare Environmental.

EnviroVeg Values

Members of the EnviroVeg program value the environment and their production resources. Members act as stewards of land, water and biodiversity by enacting the EnviroVeg Values;

- Minimise the impact of vegetable production on the environment
- Prioritise vegetable production techniques that use a minimum, sustainable amount of resources
- Production practices strive to align with farm resource management objectives
- Increase the uptake of quality research on farm
- Continuous improvement of vegetable production systems in these areas

The Values are also underpinned by the management objectives and are complementary and additional to other health, agricultural, environmental, food and production related regulatory requirements at federal, state, territory and other relevant levels.



Results Summary

Freshcare Environmental

My Farm Areas

Average Score

1. Land and Soil

Have room to improve

78%

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
3	4	4	3	3	3	4	3	3	3	3	3	3

2. Biosecurity

Have room to improve

82%

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
4	3	4	3	4	3	3	4

3. Chemicals

Have room to improve

78%

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
3	4	3	3	3	4	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3

4. Fertilisers and Soil Additives

Have room to improve

75%

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
3	3	3	3	3	3	3	3	3	3	3	3	3	3

5. Water

Have room to improve

84%

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
4	3	4	3	4	4	4	3	3	3

6. Biodiversity

Have room to improve

77% 

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
4	3	3	3	3	3	3	3

7. Waste

Have room to improve

75% 

Q1	Q2	Q3	Q4	Q5	Q6
3	3	3	3	3	3

8. Air

Have room to improve

77% 

Q1	Q2	Q3	Q4	Q5	Q6
3	3	3	3	3	3

9. Energy

Have room to improve

76% 

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
3	3	3	3	3	3	3	3	3	3	3	4	3

10. Business

Have room to improve

75% 

Q1	Q2	Q3	Q4	Q5
3	3	3	3	3

Overall Average Score: 78% 
Have room to improve

1. Land and Soil

1.1 Do you have eroded areas that have been identified as potential risks? (Land and Soil 2.1, 2.2)

You answered: 3 - Yes there are minor erosion issues, management of these is in progress and other areas have been identified

Your risk/s	Actions to take
Room for Improvement: Continuation of erosion, loss of soil and productive land, potential significant off farm impacts It is vitally important that areas at risk or potential risk are identified so that action plans can be implemented to either rectify the situation or minimise the risk.	Preventing erosion and enhancing soil quality should be a priority on every farm. It makes good economic and environmental sense. A systems approach to soil conservation provides multiple barriers against soil erosion and water quality degradation.

Resources

[Get to know the soil](#)
[Protect the soil surface](#)

[E2.1 Manage land and soil, and minimise degradation, erosion, compaction and contamination](#)

1.2 Are there any salinity issues on farm?

You answered: 4 - Yes areas were identified, management plan implemented and monitoring process is ongoing [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal	Maintain good practice

Resources

[Repair damaged soils](#)

1.3 What is the level of organic carbon in your soils?

You answered: 4 - Medium soil carbon (0.5% to 1.5%) [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal	Maintain soil organic carbon

Resources

[Maintain organic matter, fertility and biodiversity](#)

1.4 Do you have a good understanding of the soil types on your farm and is this documented? (Land and Soil 2.1)

You answered: 3 - Farm soil data mapping completed with management plan for each type implemented (eg crops grown to soil type)

Your risk/s

Room for Improvement: Minimal

Actions to take

Complete EM38 if required for planning purposes, utilise knowledge to optimise farming practices

Resources

[Get to know the soil](#)

1.5 How stable are your soils?

You answered: 3 - Stable - friable surface soils or medium-coarse sandy soils, sands, sandy loam; highly permeable

Your risk/s

Room for Improvement: A soils inherent vulnerability to erosion is its susceptibility to detachment and transportation by erosive water & wind.

Actions to take

Ensure adequate cover, good soil structure and good permeability.

Resources

[Manage traffic](#)

[Repair damaged soils](#)

1.6 To ensure soil conservation management you have incorporated?

You answered: 3 - A mixture of temporary and permanent structures are incorporated to ensure limited erosion

Your risk/s

Room for Improvement: Poor maintenance will result in structures not performing as designed

Actions to take

Ensure maintenance procedures are sufficient, monitor and review

Resources

[Manage cultivation](#)

[E2.1 Manage land and soil, and minimise degradation, erosion compaction and contamination](#)

1.7 Do you have structures that collect sediment which are of sufficient size, design and are maintained efficiently?

You answered: 4 - Structures / systems are working effectively

Deemed suitable for:

- structure / system catchment area
- sediment source / farming system

Maintenance is carried out prior to spring/summer rainfall period

[50%]

Your risk/s

Good Practice or Not Applicable: Minimal
Exceeds Reef Certification Requirement

Actions to take

Maintain and monitor sediment movement and sediment trap effectiveness

Resources

Protect the soil surface

Avoid contamination of soils and crops

E2.2 Manage areas with highly degraded, eroded or contaminated soil

1.8 Does farm runoff flow across vegetated buffers (or through buffer device) of sufficient width, type and quality before reaching a waterway or wetland?

You answered: 3 - Vegetated buffers in place, provides protection of waterways in the majority of instances

Your risk/s

Room for Improvement: Some farm run off may damage wetland values and / or downstream water quality, Buffer may be ineffective at reducing off site impacts
Meets Reef Certification Requirement

Actions to take

The width of a buffer strip is measured perpendicular to the stream. The chosen width will reflect the intensity of source, the topography, and whether the buffer is to protect streams from groundwater or surface water sources.

Resources

Manage the flow of water over production sites

E2.2 Manage areas with highly degraded, eroded or contaminated soil

1.9 Are headlands maintained to reduce runoff?

You answered: 3 - Maintenance procedures are implemented with minimal runoff issues

Your risk/s

Room for Improvement: Minor degradation of access tracks limiting access to paddocks, sediment movement onto productive areas

Actions to take

Incorporate headlands into a farm maintenance plan, redesign as necessary and review program annually

Resources

Manage irrigation

E2.2 Manage areas with highly degraded, eroded or contaminated soil

1.10 How do you ensure that soil is protected during non productive cropping periods? (Land and Soil 2.2)

You answered: 3 - Crop residue retention [50%]

Your risk/s	Actions to take
Room for Improvement: Minor loss of soil including any fertiliser / pesticide / herbicide	Soil cover and tillage practices protects the soil from erosion by reducing the displacement (movement) of soil particles caused by rain or overhead irrigation droplets, and by slowing the movement of water across the site.
Resources	

Protect the soil surface

[E2.2 Manage areas with highly degraded, eroded or contaminated soil](#)

1.11 To reduce infield loses your inter-rows are? (Trees)

You answered: 3 - Trees

Inter-rows managed with living (grass etc.) and or dead (mulch) to a minimum of 60%.

Should be practiced in conjunction with:

- vegetated drains / drainage areas, vegetated buffers

May also include:

- diversion and contour banks, contour plantings, , adequate silt traps, crop rotations, cover cropping, levelling and/or sediment retention

Your risk/s	Actions to take
Room for Improvement: Without adequate ground cover water flow across bare ground can be significant and will impact on run-off potential. Soil erosion results in the loss of productivity of our agricultural lands, causes sedimentation in downstream areas and has a negative effect on water quality. Meets Reef Certification Requirement	Reduce the potential of water to cause erosion by: • incorporating inter-row ground cover • reducing water speed flowing along furrows • creating stable seedbeds that resist erosion • maintaining a protective ground cover
Resources	

Protect the soil surface

[E2.2 Manage areas with highly degraded, eroded or contaminated soil](#)

1.12 To reduce infield loses your inter-rows are? (Annual / Pineapple)

You answered: 3 - Annual / Pineapple

• Inter-rows managed with living (grass etc.) and or dead (mulch) to a minimum of 60% cover

May also include:

• Vegetated drains, vegetated buffers, diversion and contour banks, adequate silt traps

Your risk/s

Actions to take

Room for Improvement: Without adequate ground cover water flow across bare ground can be significant and will impact on run-off potential. Soil erosion results in the loss of productivity of our agricultural lands, causes sedimentation in downstream areas and has a negative effect on water quality.

Meets Reef Certification Requirement

Adequate levels of surface cover play an important role in erosion control by avoiding the effects of raindrops falling on bare soils. Surface cover also encourages run-off to spread rather than to concentrate. However there is a natural tendency for run-off to concentrate as it moves down-slope.

Resources

[Protect the soil surface](#)

[E2.2 Manage areas with highly degraded, eroded or contaminated soil](#)

1.13 If your productive areas have a slope greater than 4% how do you ensure in-field runoff is reduced / slowed?

You answered: 3 - Crops are planted down slope and or across slope with regular spaced vegetation strip cropping

Your risk/s

Actions to take

Room for Improvement: Minimal

Manage soils with: minimum tillage, cross slope planting, suited to low pressure / low application rate irrigation systems, fallow cropping, mulching, maximum ground cover, contour banks, stubble retention.

Resources

[Manage traffic](#)

[Manage cultivation](#)

[E2.2 Manage areas with highly degraded, eroded or contaminated soil](#)

2. Biosecurity

2.1 Do you have appropriate biosecurity signage? (Biosecurity 3.1)

You answered: 4 - Signs are located at key entry points and office [50%]

Your risk/s

Actions to take

Good Practice or Not Applicable: Minimal

Maintain good practice, refine as necessary

Resources

[Implement biosecurity signage](#)

2.2 Do you have a biosecurity management program in place? (Biosecurity 3.2)

You answered: 3 - Program is complete however records and review processes could be improved

Your risk/s	Actions to take
Room for Improvement: Without an effective process in place your property is potentially exposed to pest and disease threats which will have significant production impacts. If an incursion does occur will staff know what to do and what processes to follow.	Finalise the recording process then regularly review and update as required.
Resources	

[Prepare a biosecurity plan / biosecurity management program](#)

[Assess biosecurity risks](#)

[E3.1 Manage biosecurity on the property](#)

2.3 Do you have an effective in-field exotic pest and disease monitoring and reporting process? (Biosecurity 3.2)

You answered: 4 - Monitoring is conducted as per crop requirement with some level of recording completed [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal	Maintain good practice, refine as necessary
Resources	

[Maintain an active surveillance and monitoring program and keep detailed records](#)

[Sourcing of plants/materials](#)

2.4 Do you ensure equipment is clean prior to use? (Biosecurity 3.2)

You answered: 3 - All equipment is visually inspected prior to use - to ensure cleanliness from plant material and soil

Your risk/s	Actions to take
Room for Improvement: Tools and equipment can carry diseases, pests and weeds seeds. The risk for disease spread is higher when equipment is borrowed, lent or bought second-hand from other properties.	Clean and disinfect tools and equipment before and after use on crops.
Resources	

[Manage vehicles, machinery and equipment on the production site](#)

[Manage packaging, bins and pallets](#)

2.5 Are your employees and contractors trained and able to follow appropriate hygiene protocols? (Biosecurity 3.2)

You answered: 4 - Occasionally training is conducted [50%]

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

[Farm visitors](#)

[Staff training and induction](#)

2.6 Do you have documented systems in-place (such as wash down procedures) to prevent pests and diseases from entering and exiting your farm site and or being distributed across your property? (Biosecurity 3.2)

You answered: 3 - Procedures are in place, are followed majority of time, no records

Your risk/s

Room for Improvement: When a vehicle or machine is driven through a weed-infested area, seeds and soil become lodged in cracks and crevices, including tyre treads, radiators, licence plates and the chassis. The seeds & soil may then be carried hundreds of kilometres before dislodging in new areas. Traffic of any nature onto a farm can attribute to the spread of pests and diseases, as can unmonitored farm tasks that result in movement of items and equipment around the farm.

Actions to take

Utilise appropriate procedures and systems as documented by such agencies as Biosecurity Queensland, to help with farm biosecurity. These guidelines and checklists have been developed to enable vehicles and machines to be cleaned and inspected effectively and safely. Specific standards and guidelines have also been established for specific plant diseases such as Panama Race 4, which could also be applied to other situations. Implement effective wash-down and decontamination as an essential component of on-farm biosecurity. BQ recommends all farms apply the practices described in the IPA Inspection Procedure

Resources

[Establish zones in growing areas and control access to growing areas](#)

[Manage vehicles, machinery and equipment on the production site](#)

[Manage plant waste, weeds and animals](#)

[E3.1 Manage biosecurity on the property](#)

2.7

Do you have the necessary information, protocols and procedures for the quarantine or isolation of specific diseases that may infest your farm? (Biosecurity 3.2)

You answered: 3 - Based on various information sources (detailed farm map) I know what to do but it isn't documented [75%]

Your risk/s

Room for Improvement: Quarantine forms part of on farm biosecurity. Not all pests / diseases are notifiable in the greater biosecurity sense, but containing and treating pests on farm is important to minimise spread and resulting damage.

Actions to take

Implement a quarantine protocol that incorporates appropriate actions and ensure ALL your staff understand and are able to implement. Implementing a zoning system demonstrates a heightened awareness of biosecurity and can bring benefits to current production and significant benefit in the event of an incursion

Resources

[Report unusual/unknown pests](#)

[Farm Zoning](#)

[E3.2 Monitor and report unusual findings](#)

2.8

Do you manage plant waste, packaging, bins and pallets to reduce biosecurity risks?

You answered: 4 - No packaging is reused [50%]

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

[Manage plant waste, weeds and animals](#)

[Manage packaging, bins and pallets](#)

3. Chemicals

3.1 In an effort to reduce pesticide use on farm do you use any Integrated Pest Management (IPM) methods? (Chemicals 4.1)

You answered: 3 - A full complement of IPM measures are implemented with a range of control strategies used

Your risk/s	Actions to take
Room for Improvement: Some opportunity to incur losses, potential off farm impact, potential for increased usage due to pest resistance Meets Reef Certification Requirement	Integrated Pest Management (IPM) is a farm management strategy to keep the population of harmful pests below the point where they are causing unacceptable loss in marketable yield. IPM considers the production system as a whole by looking at all management aspects as potentially impacting on pest populations, and where possible manipulating those components to reduce their numbers and uses a range of complementary tools and control techniques.

Resources

[Follow a recognised approach to Integrated Crop Protection and Pest Management](#)
[E4.1 Select pest and disease control strategies to minimise risk to the environment](#)

3.2 How do you determine crop / pest chemical requirements? (Chemicals 4.1)

You answered: 4 - Using your own and agronomist recorded crop monitoring results, action thresholds and labelled rates [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal Exceeds Reef Certification Requirement	Maintain good practice, refine as necessary

Resources

[Select, purchase and transport chemicals appropriately](#)
[Review the production system to identify opportunities to minimise chemical use](#)
[Manage contaminated sites](#)
[E4.1 Select pest and disease control strategies to minimise risk to the environment](#)

3.3 Do you review your historic pest/disease records to proactively plan future pest/disease management programs? (Chemicals 4.1)

You answered: 3 - Not recorded - I rely on remembering previous issues

Your risk/s

Actions to take

Room for Improvement: Your records form a valuable resource that will assist you to proactively plan your pest management program. Not making reference to them during this process adds a layer of potential guess work to your planning that could otherwise be avoided, using your records will allow greater accuracy and improvements in cost benefits.

Review relevant records and use them to assist with: identifying chemical use patterns; analysing the effectiveness of chemicals; assisting in the design and implementation of integrated pest management programs; assessing chemical resistance strategies; conducting financial planning and budgeting exercises; meeting legal obligations and demonstrating due care and attention.

Resources

Where pest or disease is present, develop an integrated management plan specific to the pests and diseases affecting your crops

Follow a recognised approach to Integrated Crop Protection and Pest Management

Monitor site conditions and embed integrated crop protection into business operations

3.4 Are there commercially available beneficial insects to assist against pests for your crop? (Chemicals 4.1)

You answered: 3 - Yes we use them as required

Your risk/s

Actions to take

Room for Improvement: Minimal

It is recommended that growers make contact with their local provider and discuss options for their crop pest situation. Use as appropriate.

Resources

Where pest or disease is present, develop an integrated management plan specific to the pests and diseases affecting your crops

E4.1 Select pest and disease control strategies to minimise risk to the environment

3.5 When considering which chemical to use do you opt for a soft option? (Chemicals 4.1)

You answered: 3 - Only if I know there are beneficial insects present

Your risk/s

Room for Improvement: Reliance on effective crop scouting

Actions to take

Ensure crop scouting is sufficient enough to inform chemical applications

Resources

Review the production system to identify opportunities to minimise chemical use

Select, purchase and transport chemicals appropriately

E4.1 Select pest and disease control strategies to minimise risk to the environment

Where pest or disease is present, develop an integrated management plan specific to the pests and diseases affecting your crops

3.6 All chemicals are sourced from an AgSafe accredited / Recognised / via Agreement supplier and received in good condition? (Chemicals 4.2)

You answered: 4 - Yes

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Select, purchase and transport chemicals appropriately

3.7 Do you maintain a chemical inventory? (Chemicals 4.2)

You answered: 3 - Yes but isnt well maintained

Your risk/s

Room for Improvement: Unknown / poorly recorded chemicals in storage pose a workplace health and safety risk and may impact any emergency procedure

Actions to take

Implement an inventory process to ensure records are kept and maintained

Resources

Store chemicals safely and securely

3.8 To reduce the impacts of waste chemical packaging you? (Chemicals 4.3)

You answered: 4 - Containers are always triple rinsed or punctured and stored within a secure area to be disposed of through controlled approval disposal scheme [50%]

Your risk/s

Good Practice or Not Applicable: None

Actions to take

Continue participation in government programs, maintain record of chemical use

Resources

Manage chemical waste, including surplus chemical solution, containers and unwanted chemicals

Manage contaminated sites

3.9 Do you keep up to date with the relevant Federal and State acts, regulations and duties of care regarding the storage, handling and use of pesticides? (Chemicals 4.3, 4.5)

You answered: 4 - Yes - codes of practice / chemical labels / regulatory and legislative standards are adhered to at all times

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Adhere to legal requirements

Meet all legal requirements

3.10 What does your chemical storage look like? (Chemicals 4.3)

You answered: 3 - Chemicals are stored in a lockable, structurally sound shed which is well ventilated, fire resistant, has an impervious floor, is protected from extreme heat / sunlight exposure, is weatherproof, is able to contain spills (ie bunded), has sturdy shelving and appropriate signage

Your risk/s

Room for Improvement: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Store chemicals safely and securely

Store and handle fuels and oil appropriately

E4.3 Store, manage and dispose of chemicals to minimise the risk of environmental harm.

3.11 Do you have a chemical storage and handling procedure? (Chemicals 4.3)

You answered: 3 - Yes we have a procedure

Your risk/s	Actions to take
Room for Improvement: Minimal	Maintain good practice, refine as necessary
Resources	
<u>Ensure appropriate procedures, work instructions and signage to ensure responsible and legal transport, storage, handling and use of chemicals</u> <u>E4.3 Store, manage and dispose of chemicals to minimise the risk of environmental harm.</u>	

3.12 Is there an emergency procedure in-place in the event of a chemical spill? (Chemicals 4.4)

You answered: 3 - Written procedure is complete, staff are trained, but still require spill kits and fire extinguishers (as required by SDS & WHS)

Your risk/s	Actions to take
Room for Improvement: WH&S issue for all staff, potential for staff safety litigation and major ecosystem impacts on and off farm	Ensure staff are equipped for situation
Resources	
<u>? Be prepared to manage chemical spills or emergencies</u>	

3.13 Are those that apply pesticides appropriately trained? (Chemicals 4.4)

You answered: 3 - All staff that apply pesticides have completed recognised farm chemical user training (AQF level 3 competency)

Your risk/s	Actions to take
Room for Improvement: Accreditation requirements can vary in each state. Know and understand what accreditation requirements are needed for your state. Must have level 3 accreditation to use S7's and restricted chemical products (this includes contractors)	All staff / contractors applying pesticides should undertake the Level 3 Chemical Accreditation course, especially if using S7's and restricted chemicals, through a recognised training service provider. If you've done the Chemical Accreditation course before, and it is about to expire; or if your accreditation expired less than 12 months ago, then you are eligible to do the Chemical Reaccreditation/Refresher course. There are various suppliers of accreditation training nationally - conduct a internet search for your nearest provider
Resources	
<u>Ensure appropriate level of chemical users training is maintained for all team members/workers</u> <u>E4.4 Train and authorise workers who transport, store, handle, apply and/or dispose of chemicals.</u>	

3.14 Are staff aware of the environmental impacts potentially caused when using pesticides? (Chemicals 4.4)

You answered: 3 - Authorised staff are trained to use pesticides in accordance with WHS, drift management, spill response procedures and have received on farm environmental impact training

Your risk/s

Actions to take

Room for Improvement: Staff are not necessarily aware of the impact issues when using pesticides

Continue to train staff in environmental awareness / certification, read and implement requirements as per environmental statements on label & Safety Data Sheet (SDS)

Resources

Maintain buffers and vegetated barriers to reduce the off-target movement of agricultural chemicals

E4.4 Train and authorise workers who transport, store, handle, apply and/or dispose of chemicals

Monitor site conditions and embed integrated crop protection into business operations

Ensure water use and management avoids pollution of water storages, waterways or groundwater

3.15 Do you maintain a register of authorised employees and their completed training? (Chemicals 4.4)

You answered: 3 - Full records are maintained / training is not current

Your risk/s

Actions to take

Room for Improvement: Traceability, unknown access / application, WH&S

Maintain records, keep up to date with training requirements

Resources

Ensure appropriate level of chemical users training is maintained for all team members/workers

E4.4 Train and authorise workers who transport, store, handle, apply and/or dispose of chemicals

Monitor site conditions and embed integrated crop protection into business operations

3.16 Do you know if the pesticides you are currently using have label or permit instructions for use on your crop or 'on permit'? (Chemicals 4.5)

You answered: 3 - Yes I assume so

Your risk/s

Room for Improvement: Off label permits can change from time to time, as can labels (to a lesser extent). It is important to regularly check the APVMA or Infopest for updates on product registrations and permitted uses. Unsanctioned off label use results in a violation of the state control of use legislation and may also cause unintended harm to the consumer and the environment or even the crop itself. In worst case situations, legal action can be taken against the grower by the state regulator.

Actions to take

Use Infopest or APVMA pubcris database to obtain copies of labels or permits for the purposes for which you are using pesticides. If a use is off-label, immediately stop using it in that manner and seek assistance through Horticulture Innovation Australia or your peak industry body to achieve label or permitted use.

Resources

[Use and apply agricultural chemicals appropriately](#)

[E4.5 Use chemicals according to regulatory, label and customer requirements](#)

3.17 To reduce the loss of chemicals via drift you? (Chemicals 4.6)

You answered: 3 - Spray in accordance with label requirements

In appropriate forecast weather conditions

Wind speed is visually assessed in addition to regional / local weather forecast or weather station check for wind speed and direction at time of spraying

Using fit for purpose spray equipment to control droplet spectrum with appropriate spray buffers in place

Your risk/s

Room for Improvement: Minor losses due to unfavourable weather conditions, erosive soils.
Meets Reef Certification Requirement

Actions to take

Investigate low volume and target directional technology / apply when conditions are suitable / ensure operators appropriately qualified / establish buffer zones

Resources

[Avoid spray drift or other off-target movement of pesticides or agricultural chemicals](#)

[E4.6 Avoid potential for spray drift or other off-target risks](#)

3.18 Is chemical application equipment properly & regularly calibrated? (Chemicals 4.7)

You answered: 3 - Spray equipment is calibrated annually according to manufacturer's instructions and checked for efficiency at every use & recorded

Your risk/s	Actions to take
Room for Improvement: Seasonal variation and wear may potentially result in incorrect applications rates being applied, possible damage to crops, reduced effectiveness of product, potential increase in pesticide losses off-farm Meets Reef Certification Requirement	Ensure spray equipment is calibrated and checked for efficiency at every use according to manufacturers instructions.
Resources	

E4.7 Maintain and calibrate equipment used for pesticide applications and other chemical use purposes (such as sanitising, cleaning, fumigation, machinery operation etc).

E4.6 Avoid potential for spray drift or other off-target risks.

Ensure application equipment for fertilisers/soil amendments is maintained and regularly calibrated

3.19 What procedures do you have in place for the disposal of leftover / old / unidentifiable chemicals? (Chemicals 4.8)

You answered: 3 - Leftover / old chemical is disposed of according to my state Environmental Protection Act

Your risk/s	Actions to take
Room for Improvement: Maintain current management procedures, look to reducing need	Maintain practice, refine as necessary
Resources	

Manage chemical waste, including surplus chemical solution, containers and unwanted chemicals

E4.8 Manage mixing and disposal of chemical solutions to minimise risk to the environment

3.20 Are your chemical mix and fill areas? (Chemicals 4.8)

You answered: 3 - Designated concrete / compacted pad near shed

Your risk/s	Actions to take
Room for Improvement: Poorly located, designed and maintained mix and fill areas pose a risk to the surrounding site, the environment and nearby waterways	Ensure chemical mixing areas are located, constructed and maintained to minimise the risk of contaminating the site and surrounding environment. Any leftover chemical solutions are required to be disposed of according to label directions where specified, or in a manner that minimises environmental harm.
Resources	

E4.8 Manage mixing and disposal of chemical solutions to minimise risk to the environment.

3.21 Do you maintain a record of postharvest pesticide applications? (Chemicals 4.9)

You answered: 3 - We maintain a electronic based system in accordance with food safety QA requirements

Your risk/s	Actions to take
Room for Improvement: Potential inability to market product, poor traceability processes	Produce transported intrastate, interstate or exported needs to conform with the destinations phytosanitary specifications. Only approved chemicals shall be used and withholding periods for the harvesting and release of produce observed
Resources	

E4.2 Obtain, check and record chemicals

Record details of all applications of fertilisers and soil additives

E4.9 Record all chemical uses/applications.

3.22 Are you maintaining accurate spray diaries? (Chemicals 4.9)

You answered: 3 - Spray use is recorded electronically as per industry standards and reviewed annually for ongoing decision making

Your risk/s	Actions to take
Room for Improvement: Record keeping is essential for traceability and evidence if required. It is recommended that spray diaries be kept for a minimum of 2 years. This forms part of food safety and quality assurance specification instigated by the market place. Failure to comply may limit your produce placement or exclude it all together. Meets Reef Certification Requirement	Keep spray diaries for two (2) years recording details such as: the product trade name; the date the product was used; the application rate of the product; the crop/commodity that was treated or the situation in which the product was applied; the extent of use (the area of land treated, or the volume of water treated, or the volume of stored commodity treated, or the weight of the commodity treated); the location where the product was used; the name and address of the applicator/supervisor; and the name and address of the person for whom the application was carried out. This will satisfy quality assurance programs and enable you to meet product specifications.
Resources	

E4.9 Record all chemical uses/applications.

4. Fertilisers and Soil Additives

4.1 Do you conduct leaf / sap / fruitlet testing?

You answered: 3 - Leaf / sap / fruitlet sampling completed annually per management zone

- a sampling regime recommended by a suitably qualified / experienced person

And

Collection / collation conducted as per industry recognised procedure

Testing conducted by NATA / ASPAC accredited lab

Your risk/s

Actions to take

Room for Improvement: Minor potential for poor plant health
Meets Reef Certification Requirement

Implement testing as plant leaf test is used to diagnose nutritional disorders in crops and assists in fine tuning ongoing fertilizer programs.

Resources

[Follow an evidence-based approach to nutrient management and a customised crop nutrition program](#)

[E5.1 Select fertilisers and soil additives to minimise risk to the environment.](#)

4.2 Do you conduct soil testing?

You answered: 3 - Soil sampling collected / collated annually per soil type / management zone

- a sampling regime recommended by a suitably qualified / experienced person

And

Collection / collation conducted as per industry recognised procedure

Testing conducted by NATA / ASPAC accredited lab

Your risk/s

Actions to take

Room for Improvement: Minor limitations for nutrient management plan, impacts on crop production and economic returns
Meets Reef Certification Requirement

Regular monitoring the nutrient status of your soils and/or crops is critical to the long term sustainability of a farming enterprise.

Resources

[Follow an evidence-based approach to nutrient management and a customised crop nutrition program](#)

4.3 What do you base the crop nutrient requirement on?

You answered: 3 - Application rates based on industry approved nutrient monitoring program

Your risk/s

Actions to take

Room for Improvement: Potential for losses of fertiliser via runoff / deep drainage / impacts on crop production

To effectively manage nutrient inputs it is important to determine the amount and type of nutrients to apply for each cropping situation rather than using recipe-type application rates. This can be done through soil testing and nutrient budgeting.

Resources

[Follow an evidence-based approach to nutrient management and a customised crop nutrition program](#)

4.4 Do you undertake nutrient target setting / budgeting? (Fertilisers and Soil Additives 5.1)

You answered: 3 - Developed on a crop / soil type basis

Your risk/s	Actions to take
Room for Improvement: Minor potential to over apply crop nutrient requirements Meets Reef Certification Requirement	Nutrient budgeting can help growers better understand the whole nutrient cycling and transformation system. This can lead to the design of more sustainable, integrated nutrition strategies. A nutrient budget is like an accounting system for nutrients.
Resources	

Manage the risk of applied or stored nutrients (from fertilisers, soil amendments) leaching through soils, moving off-site via run-off, or generating greenhouse gas emissions
E5.1 Select fertilisers and soil additives to minimise risk to the environment.

4.5 Has there been issues identified regarding soil acidity, agrochemicals, acid sulphate soil and heavy metals? (Fertilisers and Soil Additives 5.1)

You answered: 3 - Yes and a management plan is being undertaken to address the issues

Your risk/s	Actions to take
Room for Improvement: Possible groundwater and surface impacts / reduced nutrient availability / lower yields / fewer crop options / risk exposing iron, aluminium & heavy metals	Ensure management plan addresses issue, monitor, consult with a soil specialist
Resources	

Repair damaged soils

4.6 How do you manage the potential introduction of contaminants in soil amendments?

You answered: 3 - Large % of product used is certified

Your risk/s	Actions to take
Room for Improvement: Introduced inputs to a property, e.g. soil amendments, may contain impurities that could have a negative impact on farm production. These may include weeds, heavy metals & diseases.	Where possible always source certified farm inputs / request information to account for inputs from supplier / adhere to your food safety requirements / ensure it is keeping with the nutrient management plan
Resources	

Manage the risk of human pathogens in soil amendments

4.7 Do employees have sufficient skills to recommend nutrition requirements? (Fertilisers and Soil Additives 5.1)

You answered: 3 - Relevant staff have extensive experience

Your risk/s	Actions to take
Room for Improvement: Potential to under / over apply	Ensure workers responsible for crop nutrition are competent to make recommendations relevant to the crops under their management and or are capable of interpreting recommendations
Resources	

Ensure relevant personnel have been properly trained or hold appropriate qualifications

4.8 How do you store your fertiliser?

You answered: 3 - In a shed undercover close to frequented areas

Your risk/s	Actions to take
Room for Improvement: The location of a fertiliser storage facility should consider potential loss of nutrients via run-off.	All liquid fertiliser storage should be bunded to eliminate the chance of run-off into waterways.
Resources	

Ensure fertilisers/soil amendments are stored appropriately

E5.2 Store and manage fertilisers and soil additives to minimise risk to the environment

4.9 Are fertiliser safety data sheets (SDS) easily accessible? (Fertilisers and Soil Additives 5.2)

You answered: 3 - Filed in the office

Your risk/s	Actions to take
Room for Improvement: In the event that something should go wrong having immediate access to relevant SDS will reduce harm	A current Safety Data Sheet (SDS) should be kept for fertilisers stored on the property. These should be located near to where the fertiliser is stored and easily accessible. SDS's can be obtained from the supplier of the fertiliser or sourced online.
Resources	

Meet all legal requirements

4.10 Are workers trained to minimise environmental risk when using fertilisers? (Fertilisers and Soil Additives 5.2)

You answered: 3 - Employees are trained to undertake field operations ensuring no on / off farm impacts

Your risk/s	Actions to take
Room for Improvement: Without adequate training employees will go about their daily routine disregarding any internal / external ramifications	Train employees so they are better able to recognise & address risks when required
Resources	

E5.1 Select fertilisers and soil additives to minimise risk to the environment.

Ensure relevant personnel have been properly trained or hold appropriate qualifications

4.11 How do you store bulk manures and compost? (Fertilisers and Soil Additives 5.2)

You answered: 3 - In a designated area which is located to minimise off site impacts but requires further construction and maintenance for it to be fully functional

Your risk/s	Actions to take
Room for Improvement: Bulk manures and composts stored incorrectly are susceptible to leaching and run-off	If bulk manures and composts are required ensure storage area is designed and managed appropriately to minimise any losses
Resources	

Ensure fertilisers/soil amendments are stored appropriately

4.12 Is fertiliser application equipment (includes fertigation) properly & regularly calibrated & maintained?

You answered: 3 - Fertiliser equipment is calibrated & maintained on a seasonal basis

Your risk/s	Actions to take
Room for Improvement: Seasonal variation and wear may potentially result in incorrect applications rates being applied Meets Reef Certification Requirement	Ensure fertiliser equipment is calibrated & maintained seasonally AND after any changes to application equipment. This could be at specific production blocks and will include irrigation application systems (Uniformity of injection systems and application uniformity of irrigation system)
Resources	

E5.3 Maintain and calibrate fertiliser and soil additive application equipment.

Ensure application equipment for fertilisers/soil amendments is maintained and regularly calibrated

4.13 What method of fertiliser application do you use? (Fertilisers and Soil Additives 5.4)

You answered: 3 - Various application methods (fertigation, incorporation, broadcast, banding and / or foliar)
Typically small amounts often
In accordance with weather conditions

Your risk/s	Actions to take
Room for Improvement: Minor potential for losses of fertiliser via runoff / deep drainage / impacts on crop production Meets Reef Certification Requirement	Incorporate new technology and practices to improve application methods, timing and crop requirement considerations. Ensure that nutrient budgeting is accurate, application method is applicable to crop uptake & maintain equipment as per manufacturers requirement
Resources	

Record all fertiliser and soil additive applications.

Record details of all applications of fertilisers and soil additives

4.14 Do you record nutrient applications? (Fertilisers and Soil Additives 5.4)

You answered: 3 - All applications are recorded per management zone in line with nutrient targeting / budgeting

Your risk/s	Actions to take
Room for Improvement: Ensure recording aligns with nutrient budgeting requirements Meets Reef Certification Requirement	Maintain recording system so you are able to track applications
Resources	

Record all fertiliser and soil additive applications.

Record details of all applications of fertilisers and soil additives

Record details of all applications of fertilisers and soil additives

5. Water

5.1 Do you have enough water for your cropped area?

You answered: 4 - Marginal volume for cropped area in an average year [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal	Maintain good practice, refine as necessary
Resources	

Access appropriate water sources to meet the water volume and quality requirements for the production system. Ensure compliance with all legal requirements for any water accessed from regulated sources

Determine and regularly review the total volume of water required for the vegetable production system

5.2 How evenly does your system apply water within the block? (Water 6.1)

You answered: 3 - Some variation in applied volumes / at industry benchmark (80-90%)

Your risk/s	Actions to take
Room for Improvement: Minor issues crop germination & seedling development, water stress, increased pumping costs	Self conduct or contract an irrigation consultant to complete a uniformity assessment of the system / correct any issues or replace system / develop a maintenance procedure
Resources	
<u>Ensure efficient storage and distribution of water supply</u>	
<u>Achieve efficient and sustainable use of water</u>	

5.3 Do you have a procedure for determining when to irrigate and how much to apply?

You answered: 4 - Use objective tools (multiple)

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal Exceeds Reef Certification Requirement	Maintain good practice
Resources	
<u>Determine and regularly review the total volume of water required for the vegetable production system</u>	
<u>Access appropriate water sources to meet the water volume and quality requirements for the production system. Ensure compliance with all legal requirements for any water accessed from regulated sources</u>	
<u>E6.1 Manage water use on the property</u>	

5.4 How well do you match your irrigation interval and volume applied with the crop requirements and soil limitations?

You answered: 3 - Manually operated system, application rate suited to crop stages and soil types

Your risk/s	Actions to take
Room for Improvement: Minor issues with water logging, runoff, salinity, crop stress, reduced yield, nutrient loss	Incorporate automation were possible to reduce risk of over irrigation
Resources	
<u>Prepare a detailed water budget</u>	
<u>Consider soil characteristics as a key factor in farm water planning</u>	
<u>Achieve efficient and sustainable use of water</u>	

5.5 Are your irrigation practices coordinated with other farming system operations?

You answered: 4 - Moderate coordination with other operations [50%]

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Determine and regularly review the total volume of water required for the vegetable production system

Achieve efficient and sustainable use of water

5.6 Do you modify your irrigation application in response to weather conditions?

You answered: 4 - Always

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Prepare a detailed water budget

E6.3 Manage water to minimise environmental harm

Achieve efficient and sustainable use of water

5.7 Do you manage your irrigation/rain and soils to maximise moisture storage and minimise evaporation losses? (Water 6.1)

You answered: 4 - Some practices used but could be improved [50%]

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Consider soil characteristics as a key factor in farm water planning

Ensure efficient storage and distribution of water supply

5.8 Do you fully understand your right/licence to access water for irrigation purposes? (Water 6.2)

You answered: 3 - Good understanding

Your risk/s	Actions to take
Room for Improvement: Minor potential to act outside licensing agreements	Review and understand your right to take / Maintain your knowledge throughout the water year
Resources	
<u>Access appropriate water sources to meet the water volume and quality requirements for the production system. Ensure compliance with all legal requirements for any water accessed from regulated sources</u> <u>E6.2 Water is harvested, extracted, stored, used and discharged in accordance with licences and permits</u> <u>Dispose of waste water responsibly</u>	

5.9 What is the quality of water used for irrigation?

You answered: 3 - Satisfactory quality – minor effect on crop and/or equipment

Your risk/s	Actions to take
Room for Improvement: Potential for poor crop growth / high irrigation maintenance costs / filtration issues / soil degradation	Test water quality / source possible alternative / shandy / implement a leaching procedure / use water conditioners / check fertiliser solubility in sample water
Resources	
<u>Manage and monitor the quality of water used for crop production</u> <u>E6.3 Manage water to minimise environmental harm</u>	

5.10 Do you reuse water within the farm?

You answered: 3 - Yes - Full use / no water quality testing

Your risk/s	Actions to take
Room for Improvement: Test water quality - consider Food Safety, salinity / soil health, WH&S	Review capture and reuse potential for improved water use efficiency / ensure that nutrient and salt content is monitored for sustainable application
Resources	
<u>Consider options to collect and re-use water</u> <u>Record details of all applications of fertilisers and soil additives</u> <u>Dispose of waste water responsibly</u>	

6. Biodiversity

6.1 Do you have native vegetation on or bordering your property? (Biodiversity 7.1)

You answered: 4 - Yes along the creek [50%]

Your risk/s

Good Practice or Not Applicable: Minimal

Actions to take

Maintain good practice, refine as necessary

Resources

Manage areas of native vegetation on farm

Increase areas of native vegetation on the property

Assess threats to, or impacts on, biodiversity and habitat assets that occur on-site. Also consider threats that arise from adjacent areas.

6.2 Does the native vege form part of a native vege corridor

You answered: 3 - Yes but only through sections of the property [75%]

Your risk/s

Room for Improvement: When native vegetation is cleared without forethought, patches of vegetation may be partially or completely disconnected from other patches. Some animals may not be able to move to or from these isolated patches, especially if they have poor mobility or are prone to predation when crossing developed areas.

Actions to take

Corridors should ideally:

- contain a variety of different habitat types;
- have a complex vegetation structure (i.e. contain grasses, shrubs, small and large trees);
- connect lowlands to hills and not just follow waterways;
- be maintained by controlling weeds and stock access and minimising disturbance; and
- be as wide as possible to reduce edge effects.

Resources

Contribute to biodiversity conservation in the wider landscape

Conduct a review of the production site to identify any areas with high habitat values, areas that have good potential to support (native) biodiversity.

E7.2 Develop strategies to protect and improve biodiversity.

Manage areas of native vegetation on farm

6.3 Are you impacted by native animals

You answered: 3 - Yes - a range of practices (lethal & non lethal) are used where permitted

Your risk/s	Actions to take
Room for Improvement: Loss of production through animals eating crops and or damage to crops and threat of disease.	Options for responding to problem native animal management will include how to mitigate the problem and live with them. As standard practice, always consider non-lethal management options. These may include: netting, fencing, sound or light based systems, encouraging predators (eg birds of prey), providing alternative habitat
Resources	

[Manage vertebrate pest animals in compliance with legal requirements](#)

[Contribute to biodiversity conservation in the wider landscape](#)

6.4 How do you manage invasive weed species (native and or exotic weeds)? (Biodiversity 7.1)

You answered: 3 - Occasional control of weeds in natural systems as part of an integrated weed management plan for the farm, but activities are not coordinated with neighbouring farmers

Your risk/s	Actions to take
Room for Improvement: Minimal	Seek advice from regional CMA / NRM group or similar, engage neighbours
Resources	

[Manage weeds on the property](#)

[Comply with all relevant laws, particularly native vegetation management and wildlife conservation](#)

[Increase areas of native vegetation on the property](#)

[Increase areas of native vegetation on the property](#)

6.5 How do you manage pest animals / ferals? (Biodiversity 7.1)

You answered: 3 - Occasional control measures used but not coordinated with neighbouring properties

Your risk/s	Actions to take
Room for Improvement: Minimal	Seek advice from regional CMA / NRM group or similar, engage neighbours
Resources	

[Manage vertebrate pest animals in compliance with legal requirements](#)

[Comply with all relevant laws, particularly native vegetation management and wildlife conservation](#)

[Contribute to biodiversity conservation in the wider landscape](#)

6.6 Do you have a map which identifies areas of biodiversity / native vegetation for your property? (Biodiversity 7.1)

You answered: 3 - Have several mapping layers but havent ground truthed the information

Your risk/s

Room for Improvement: Some understanding of what is currently on the property and hence it is at risk of being damaged / removed

Actions to take

Conduct a ground truthing exercise to verify mapping

Resources

Prepare a property map that documents the habitats and biodiversity assets, relevant features in the wider landscape

Conduct a review of the production site to identify any areas with high habitat values, areas that have good potential to support (native) biodiversity

E7.1 Manage biodiversity on the property

6.7 How do you improve vegetation in wetlands, natural areas, riparian areas & water storages? (Biodiversity 7.2)

You answered: 3 - Existing vegetation is retained and left to regenerate naturally with some planting and management implemented to improve native vegetation

Your risk/s

Room for Improvement: Ensure species selection is of benefit to the vegetation area

Actions to take

Seek advice on what can be undertaken / planted / how to proceed.

Resources

Contribute to biodiversity conservation in the wider landscape

Ensure water use and management avoids pollution of water storages, waterways or groundwater

E7.2 Develop strategies to protect and improve biodiversity.

6.8 What actions have you implemented to enhance the habitat in natural areas for native animals and fish? (Biodiversity 7.2)

You answered: 3 - Fallen branches, trees, vegetation debris and rocks are left in place in streams and on land to provide habitat for native animals

Your risk/s

Room for Improvement: Minimal

Actions to take

Develop actions in conjunction with neighbours, CMA / NRM groups and landcare to improve / build on the areas of concern

Resources

Prepare a biodiversity management plan aimed to optimise habitats and biodiversity on the site and to address identified threats. Assess threats to, or impacts on, biodiversity and habitat assets that occur on-site. Also consider threats that arise from adjacent areas.

Protect and enhance aquatic habitats and biodiversity

E7.1 Manage biodiversity on the property.

7. Waste

7.1 Does your Waste Management Plan set out the methods and actions per waste type and assign responsibility? (Waste Management Plan)

You answered: 3 - A few methods and actions need improving before being compliant

Your risk/s	Actions to take
Room for Improvement: An incomplete farm waste management plan with no accountability	Finalising and maintaining a waste management plan will assist you to identify waste types, on farm location, management options and staff responsibilities.
Resources	

E8.1 Manage waste on the property

Optimise the use of crop wastes/residues

Implement actions to reuse, recycle or recover energy from wastes that cannot be avoided

Implement actions to avoid or minimize waste across the business

7.2 What practices do you have in place to dispose of inert materials (metal, rubble, glass)

You answered: 3 - Waste is separated then delivered to an approved collection site

Your risk/s	Actions to take
Room for Improvement: Minimal	Maintain good practice
Resources	

Implement actions to avoid or minimize waste across the business

On-farm waste disposal

Dispose of waste responsibly

E8.2 Review input materials to reduce waste

7.3 How do you dispose of toxic materials (oil, batteries, treated timber)? (Waste 8.1)

You answered: 3 - Waste is separated then delivered to an approved collection site

Your risk/s

Room for Improvement: Minimal

Actions to take

Maintain good practice

Resources

[Implement actions to avoid or minimize waste across the business](#)

[On-farm waste disposal](#)

[Dispose of waste responsibly](#)

[E8.2 Review input materials to reduce waste](#)

7.4 What practices do you have in place to dispose of biodegradable materials (paper & cardboard, growing media, vegetative waste, reject produce)

You answered: 3 - Waste is separated and collected by an approved contractor

Your risk/s

Room for Improvement: Minimal

Actions to take

Maintain good practice

Resources

[Implement strategies to reduce the volume of surplus or reject produce](#)

[Implement actions to avoid or minimize waste across the business](#)

[Dispose of waste responsibly](#)

[On-farm waste disposal](#)

[E8.2 Review input materials to reduce waste](#)

7.5 What procedures do you have in place to dispose of persistent materials (timber, packaging, plastic, tyres, twine)? (Waste 8.1)

You answered: 3 - Waste is separated then delivered to an approved collection site

Your risk/s

Room for Improvement: Minimal

Actions to take

Maintain good practice

Resources

[Implement actions to avoid or minimize waste across the business](#)

[On-farm waste disposal](#)

[Dispose of waste responsibly](#)

[E8.2 Review input materials to reduce waste](#)

7.6 Do you consider the potential waste from input materials when purchasing? (Waste 8.2)

You answered: 3 - Progressively phasing out / minimising waste inputs

Your risk/s

Room for Improvement: Managing waste can be time consuming and costly.

Actions to take

Resources

Implement actions to avoid or minimize waste across the business

Implement actions to reuse, recycle or recover energy from wastes that cannot be avoided

Implement sound waste storage practices

E8.2 Review input materials to reduce waste

8. Air

8.1 What practices do you have in place for the storage and use of manure products

You answered: 3 - Composting procedures are undertaken on site using mature product and used ASAP [75%]

Your risk/s

Room for Improvement: Odour may become an issue with neighbours. If not stored correctly can become a water quality issue with the loss of nutrients.

Actions to take

Where possible use composted manures, store in areas not exposed to wind, develop a storage area to reduce run off, minimise storage time.

Resources

Manage odour

Consider community expectations for the management of air quality in your local area

8.2 What practices do you have in place to reduce dust

You answered: 3 - Wet down roads and high traffic areas

Your risk/s	Actions to take
Room for Improvement: Excessive dust can cause annoyance and in some cases health problems to neighbours and staff. Dust created around packing sheds can also settle on packed produce, affecting visual quality and potentially having food safety implications.	Control measures may include planting shelterbelts and windbreaks where practical, modifying cultural practices or reconsidering the appropriateness of particular cropping activities on exposed sites.
Resources	

[Manage dust](#)

[Consider community expectations for the management of air quality in your local area](#)

8.3 What practices do you have in place to reduce smoke

You answered: 3 - With appropriate permits & notifications burning of non harmful products is undertaken on farm

Your risk/s	Actions to take
Room for Improvement: Excessive smoke can cause annoyance and in some cases health problems to neighbours and staff.	Avoid burning if it will cause a nuisance to nearby residential areas. Check wind direction before burning – only burn when wind direction is away from neighbours.
Resources	

[Manage smoke](#)

[Consider community expectations for the management of air quality in your local area](#)

8.4 What practices do you have in place to reduce noise - infield

You answered: 3 - Buffer zones are implemented / Majority of activities conducted during daylight hours

Your risk/s	Actions to take
Room for Improvement: Noise is a form of pollution that may result in environmental harm. Assessments of environmental harm include consideration of: The degree and scale of impact; The health and safety of people; Property damage; Unreasonable interference with the amenity of an area	Buffer zones are useful to reduce noise and are also helpful to mitigate impacts of off-target spray application. Where pumps are located close to residential areas, consider changing from diesel to electric pumps or creating a sound barrier around the pump.
Resources	

[Manage noise](#)

[Consider community expectations for the management of air quality in your local area](#)

8.5 Do you have a formal Air Quality Management Program in place? (Air 9.1)

You answered: 3 - Program is complete however records and review processes could be improved [75%]

Your risk/s	Actions to take
Room for Improvement: Without appropriate management strategies in place on-farm practices can have a detrimental impact on the immediate and adjacent environment	Finalise the recording process then regularly review and update as required.
Resources	

Consider community expectations for the management of air quality in your local area

E9.1 Manage air quality

Manage light

8.6 Do you have wind breaks on your farm? (Air 9.1)

You answered: 3 - Some parts of farm area

Your risk/s	Actions to take
Room for Improvement: Varying risk of wind erosion, dust pollution	Develop a planting program, implement the strategy and complete a wind break
Resources	

Manage dust

Manage light

9. Energy

9.1 How often do you service and maintain your tractors?

You answered: 3 - Periodically

Your risk/s	Actions to take
Room for Improvement: Tractor operating inefficiently - impacting on fuel and oil consumption / WHS issue	Review procedure and conduct as per manufacturers recommendations
Resources	

Identify opportunities to drive energy efficiencies

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.2 Is the size of the tractor appropriate for the job to ensure the highest level of fuel efficiency?

You answered: 3 - Most of the time

Your risk/s

Actions to take

Room for Improvement: Inappropriate use / excessive fuel consumption

Ensure tractor size is appropriate for implement, gear up throttle down

Resources

Identify opportunities to drive energy efficiencies

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.3 Is the packing shed facility, associated infrastructure and surroundings orientated / designed to maximise natural cooling, heating & light?

You answered: 3 - Some aspects have been implemented

Your risk/s

Actions to take

Room for Improvement: Low operational costs / poor use of natural surrounding environment

Go for a walk, gain an understanding of the environment surroundings / Implement strategies to mitigate environmental impacts / incorporate design aspects to reduce environmental impacts

Resources

Review sources of energy used in the production system and switch to renewable sources

Identify opportunities to drive energy efficiencies

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.4 Are the cool rooms fitted with insulating strips/air flow restricting curtains to minimise air exchange when doors are open?

You answered: 3 - All doors but need repairing / replacing

Your risk/s

Actions to take

Room for Improvement: Higher than necessary refrigeration costs

Fit appropriate devices to restrict air flow and cool air movement

Resources

Identify opportunities to drive energy efficiencies

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.5 How often do you calibrate the cool room thermostats?

You answered: 3 - Periodically

Your risk/s	Actions to take
Room for Improvement: Higher than necessary cool room cycling costs / reduced product quality	Calibrate thermostats as required by manufacturer and or replace / ensure room isn't overloaded / keep heat sources away from cool rooms / shut doors / install strip curtains or rapid doors

Resources

Identify opportunities to drive energy efficiencies

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.6 What powers your forklift inside the packing shed?

You answered: 3 - Electric

Your risk/s	Actions to take
Room for Improvement: Heat / use rate against charging times	At a minimum use electric, however consider fuel-cell technology to reduce the need for charging

Resources

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.7 To reduce heat load is product pre-cooled?

You answered: 3 - We have partially implemented hydro cooling

Your risk/s	Actions to take
Room for Improvement: Longer than necessary cooling down phase for some products, impacts food quality	Implement a pre cooling process that suits the requirement of the product, ideally vacuum cooling / monitor the system

Resources

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.8 Is your cool room in reasonable condition so that it doesn't leak and door seals, hinges, catches & insulation are well maintained?

You answered: 3 - All in reasonable condition and checked intermittently

Your risk/s

Room for Improvement: Potential for unnecessary energy, maintenance & repair costs

Actions to take

Implement a regular maintenance program / repair replace as needed / monitor

Resources

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.9 Have you determined what is impacting peak demand? (Energy 10.1)

You answered: 3 - Currently working through this process (internally)

Your risk/s

Room for Improvement: High energy costs

Actions to take

Gather energy consumption data from energy supplier / review energy use patterns / determine reason for high demand

Resources

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

Understand your energy and greenhouse gas emissions profile and identify effective energy and greenhouse gas emission reduction options

9.10 Do you review energy consumption annually? (Energy 10.1)

You answered: 3 - Electronic records are maintained and reviewed annually

Your risk/s

Room for Improvement: Without effective record keeping the business is unable to effectively monitor usage and make critical decisions

Actions to take

Implement effective recording procedures that are traceable and easily interrogated

Resources

Reduce energy demand and use

Review sources of energy used in the production system and switch to renewable sources

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.11 Are energy efficient items considered when purchasing? (Energy 10.1)

You answered: 3 - Where economically possible

Your risk/s	Actions to take
Room for Improvement: Potentially unnecessary energy use	Review purchasing strategy, purchase high energy efficient rated products at all times

Resources

Reduce energy demand and use

Identify opportunities to drive energy efficiencies

Review sources of energy used in the production system and switch to renewable sources

Reduce energy demand and use

E10.1 Energy and fuel efficiency is optimised throughout the production system

9.12 How do you store fuel on farm?

You answered: 4 - In an above ground storage tank upslope of water supply with measuring equipment but no contamination measures in place [50%]

Your risk/s	Actions to take
Good Practice or Not Applicable: Minimal	Continue good practice, monitor condition of storage & containment area annually

Resources

E10.2 Bulk fuel is stored to minimise environmental harm.

9.13 Are bulk fuel SDS' easily obtainable on farm? (Energy 10.2)

You answered: 3 - Filed in the office somewhere

Your risk/s	Actions to take
Room for Improvement: Where possible the risk of fire should be minimised	Ensure Material Safety Data Sheet (MSDS) for all bulk fuel types are easily accessible.

Resources

E10.2 Bulk fuel is stored to minimise environmental harm.

10. Business

10.1 Is the scope of your business defined and recorded, including a property map, organisational structure and business activities?

You answered: 3 - Electronic records for activities and business areas are kept

Your risk/s

Actions to take

Room for Improvement: Minimal, ensure you backup systems

Backup system, ensure its organised and available

Resources

Define the business scope and the scope of Freshcare certification

Identify property areas, infrastructure and surrounds on a property map

Define the business organisational structure

Define the scope of your business operations

Plan for property management

10.2 Do you understand and support the local environment, including managing the risk of environmental emergencies?

You answered: 3 - Environmentally responsible products and services are used

Your risk/s

Actions to take

Room for Improvement: Resources are mismanaged, either being overlooked and neglected or over managed therefore wasting resources, Business is negatively perceived by local communities and supply chain, relationships deteriorate

- Understand the environment and your region of production/operation
- Prepare for environmental emergencies
- Use environmentally responsible products and services

Resources

Understand the environment and your region of production/operation

Prepare for environmental emergencies

Use environmentally responsible products and services

10.3

Are records and documents maintained that verify compliance requirements and the scope of environmental practices?

You answered: 3 - Environmental practices are documented

Your risk/s

Room for Improvement: Potential for; lack of compliance, damage to and depletion of natural resources, a financially unviable business

Actions to take

- Maintain appropriate records
- Document the business commitment to the Freshcare Code of Practice
- Verify compliance with the Freshcare Code of Practice through relevant documents and records
- Conduct internal audits to verify ongoing compliance with this Code of Practice
- Complete corrective actions for any non-compliance

Resources

[Maintain appropriate records](#)

[Document the business commitment to the Freshcare Code of Practice](#)

[Verify compliance with the Freshcare Code of Practice through relevant documents and records](#)

[Conduct internal audits to verify ongoing compliance with this Code of Practice](#)

[Complete corrective actions for any non-compliance](#)

10.4

Are staff trained and appropriately skilled, with opportunities for development and according to compliance requirements?

You answered: 3 - Management staff access personal development opportunities regularly

Your risk/s

Room for Improvement: Minor potential for; loss of business knowledge, the environment is damaged, damage to reputation, ability to do business and cost to business

Actions to take

- Train and treat staff members appropriately
- Complete Freshcare training
- Train all workers who complete tasks relevant to this Code of Practice to ensure a base level of environmental awareness
- Comply with customer requirements

Resources

[Train and treat staff members appropriately](#)

[Complete Freshcare training](#)

[Train all workers who complete tasks relevant to this Code of Practice to ensure a base level of environmental awareness](#)

10.5 Are business decisions made based on good quality information, taking into account external pressures?

You answered: 3 - Return on investment costs are calculated for investment

Your risk/s

Room for Improvement: Reasonable business decisions are made, impacting environmental resources is reduced, minor damage business reputation and remove the ability to manage resources

Actions to take

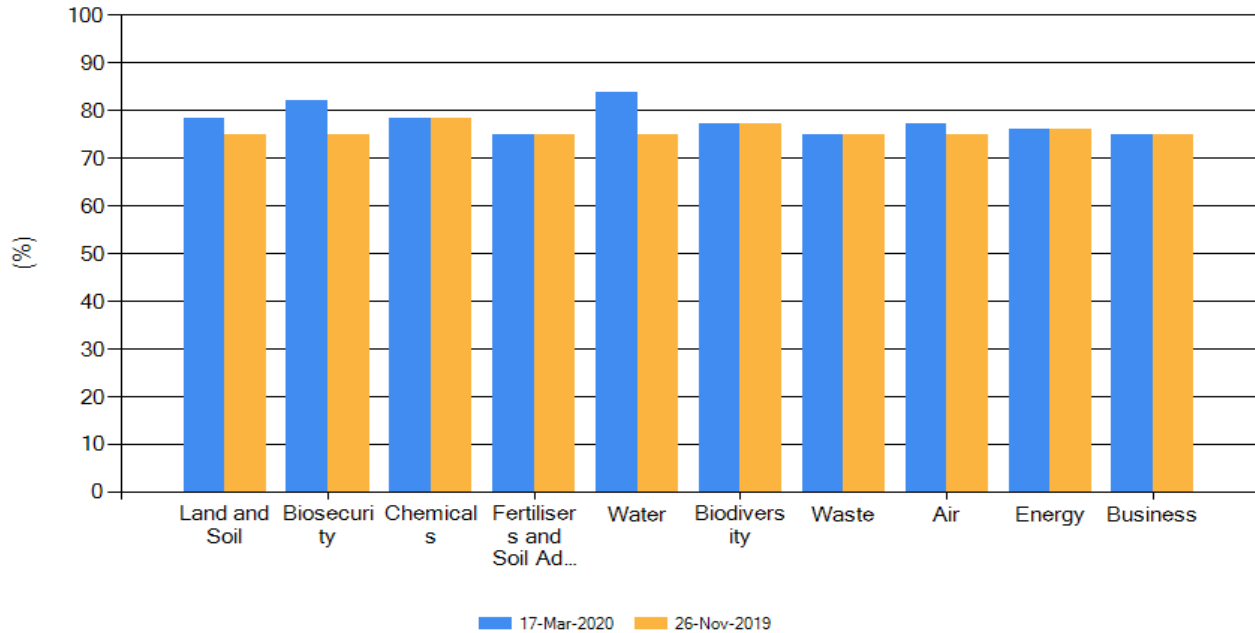
- Consider the cost-benefit ratio of business expenditures
- External factors and internal management decisions that can influence your business

Resources

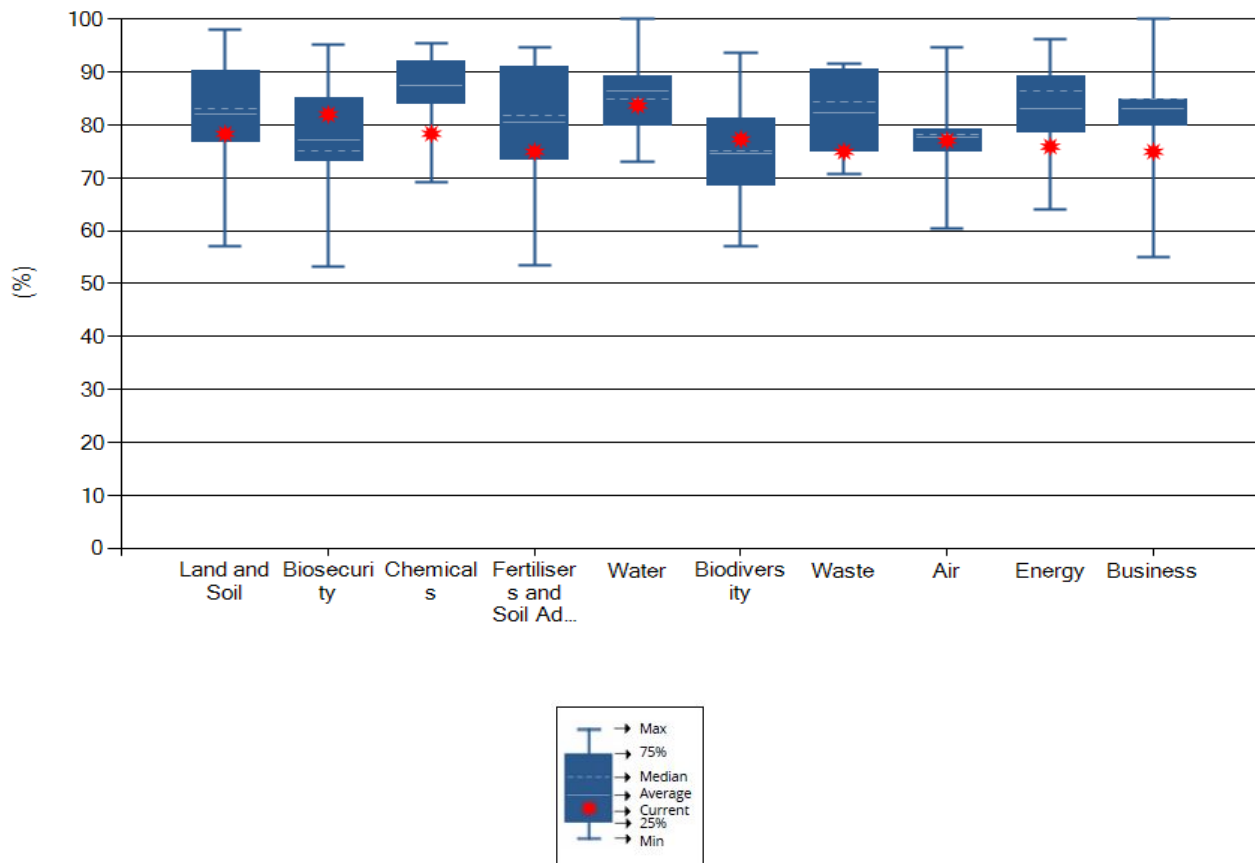
Consider the cost-benefit ratio of business expenditures

External factors and internal management decisions that can influence your business

Freshcare Environmental - How Is My Progress



Freshcare Environmental - How Do I Compare





EnviroVeg
Sustainable Vegetable Production

Action Plan: Freshcare Environmental

**Danielle Park
Danielle Park
AUSVEG**

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Glen Iris
3146
Yarra River

Prepared By
Danielle Park
27-02-2022

Congratulations on completing your self - assessment, EnviroVeg hopes the information provided is valuable to you. In the interests of developing EnviroVeg to benefit Australian vegetable growers if you would like to provide feedback please go to info@enviroveg.com.au or visit www.enviroveg.com.au for more information.

The annual completion of an internal self-assessment is a requirement in order to maintain membership in the EnviroVeg Program. The self-assessment encourages uptake of environmental-best practice production techniques and relevant industry research as well as highlighting member requirements to progress to certification.

The data collected through the self-assessment is for two primary purposes:

- For EnviroVeg program members to track and benchmark environmental practices;
- For industry to understand the uptake of practices on-farm and direct research funding appropriately.

Data collected through the self-assessment will only be replicated in aggregated forms for these purposes, businesses will not be individually identified.

Regards, Danielle Park, EnviroVeg Coordinator



RGB : 121,171,73
CMYK: 58,9,100,6
Pantone : 368c



RGB : 253,187,45
CMYK: 0,20,100,0
Pantone : Yellow 012c



RGB : 114,115,118
CMYK: 0,0,0,70
Pantone : Cool Gray 11 C



RGB : 168, 207,69
CMYK: 40,0,100,0
Pantone : 375c



RGB : 237, 50,55
CMYK: 0,100,100,0
Pantone : 2347c



WHAT IS THE ENVIROVEG PROGRAM?

This project has been funded by Hort Innovation, using the vegetable industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

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THE ENVIROVEG PROGRAM

EnviroVeg is an industry-led environmental best-practice management program for vegetable production businesses. It provides resources for sustainable growing techniques and represents vegetable businesses as responsible stewards of land, water and biodiversity.



INDUSTRY REPRESENTATION

Established to improve the longevity of vegetable growing regions, benchmark industry data and develop industry recognition for environmentally responsible, sustainable production methods, EnviroVeg is industry-led and promotes best management techniques by providing resources, support, engagement and a pathway to certification recognition for vegetable producers.



RESEARCH & DEVELOPMENT

EnviroVeg is underpinned by an Environmental Management Practice resource (the EnviroVeg Resource). This resource includes the most up to date information on achieving sustainable vegetable production and, having recently been updated by technical experts, its content is reviewed to ensure it remains current and useful. Importantly, relevant R&D levy research outcomes are integrated into the resource-manual for the easy adoption of outcomes of effective environmental practices for vegetable production.



BEST PRACTICE IMPROVEMENT

Supporting the uptake of researched outcomes is the self-assessment, a process that identifies potential production and cost saving mechanisms, through efficient management of resources. The self-assessment is housed on a Hort-360 platform and is connected to supporting materials such as the EnviroVeg Resource and website through an individualised feedback report.



CERTIFICATION

The EnviroVeg program provides a pathway to Freshcare Environmental certification for its members. Once certified, EnviroVeg program members can utilise EnviroVeg branding for marketing and industry representation, while knowing this is underpinned by a quality, recognised, third-party environmental assurance program.



HARMONISED STRUCTURE

The EnviroVeg project represents a harmonised approach to achieving environmental best management practices in vegetable production and is achieved through the consolidation of processes, knowledge and resources of the partnering programs; EnviroVeg, Hort360 and Freshcare Environmental.



PATHWAY

MORE DETAIL

Members receive access to EnviroVeg resources including; the updated **EnviroVeg manual**, **EnviroVeg self-assessment**, management templates such as **Freshcare forms** and **Industry research**.



SELF-ASSESS

The **EnviroVeg self-assessment** is an online tool housed within the Hort360 platform. To maintain membership this must be completed annually.

MORE DETAIL

The **EnviroVeg report** is an output of the self-assessment and identifies; beneficial management techniques and research through the **EnviroVeg manual**, tracks environmental risks, hazards & actions and benchmarks your practices. The **EnviroVeg report** provides a clear path to training and/or certification (optional).



TRAIN

EnviroVeg training will further your knowledge of environmental management techniques and will train you for certification.

MORE DETAIL

EnviroVeg training delivers In-depth analysis of business management practices and prepares you for audit (if you want) based on the needs shown through your input and the **EnviroVeg report**.



CERTIFY

EnviroVeg certification is to the Freshcare ENV3 standard, which requires verification through an independent audit and approved training.

MORE DETAIL

Becoming a certified EnviroVeg member requires passing the requirements of membership in the Freshcare Environmental program, including an **independent audit** and **training**, as well as annual completion of your **EnviroVeg self-assessment** through Hort360.

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JOIN ENVIROVEG

RECOGNITION BENEFITS

Become a part of the industry's flagship sustainability program. Access to the EnviroVeg Manual.

REQUIRED ACTIONS

Submit details of your property, business and production types at enviroveg.com.au.

STEP 1 ■



ENVIROVEG SELF-ASSESSMENT

RECOGNITION BENEFITS

Reference EnviroVeg membership in promotional materials and on your company's website.

Inclusion in EnviroVeg business membership registry as an 'EnviroVeg member'.

REQUIRED ACTIONS

Submit information on your current business and production practices.

Complete annually in order to maintain membership.

STEP 2 ■



ENVIROVEG TRAINING

BENEFITS/RECOGNITION

Certificate signifying completion of EnviroVeg training.

Become listed as a 'progressing EnviroVeg member' within EnviroVeg business membership registry.

REQUIRED ACTIONS

A day of training with a knowledgeable environmental management consultant.

STEP 3 ■



FRESHCARE ENV3 CERTIFICATION

BENEFITS/RECOGNITION

EnviroVeg logo use on product and packaging.

Listed as a 'certified EnviroVeg member' within EnviroVeg business membership registry.

REQUIRED ACTIONS

Completion of Freshcare Environmental program requirements, including training and auditing.

STEP 4 ■

THE ENVIROVEG MANUAL

EnviroVeg is underpinned by an Environmental Management Practice resource; the EnviroVeg Manual. This resource contains the most up to date information on achieving sustainable vegetable production. It has been redeveloped through a review process to ensure it is current and useful. Importantly, research outcomes are integrated into the EnviroVeg Manual to make them easily actionable – It is a quick access to a reference tool to industry research.

The EnviroVeg Manual is designed to:

- Provide an overview of farm management priorities for sustainable vegetable production
- Address key environmental risks
- Enable the monitoring and recording of environmental management outcomes
- Support members in achieving industry recognised environmental certification
- Identify quality, up-to-date resources and research for environmental production techniques

FOR EXISTING MEMBERS OF:

FRESHCARE ENVIRONMENTAL (CERTIFIED): You will only need to complete a simplified self-assessment to join EnviroVeg. Your certification to Freshcare Environmental reduces your number of questions.

HORT360: You will have completed some requirements for membership. The questions in Hort360 and EnviroVeg are aligned where possible.

ENVIROVEG: You will need to transition across to this new program by creating a login online and progressing to the level that best suits your needs.



PROGRAM SUMMARY

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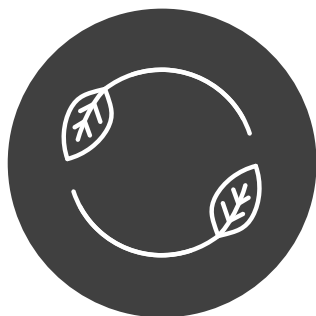

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GAP ANALYSIS

Identify production savings
and benchmarking



FACILITATED TRAINING

Receive individual support to build
knowledge and training



CERTIFICATION

Achieve recognition and underpin
environmental credentials

WHAT DO I DO?

Find out your environmental management practices strengths and weaknesses by completing the EnviroVeg self-assessment. This delivers a feedback report detailing improvement areas and methods for production and cost savings, as well as referencing the EnviroVeg Resource, associated resources and certification requirements.

WHAT DO I DO?

Build on the knowledge you have gained from the self-assessment feedback report and target environmental management practice weaknesses by completing one on one training with a best management practice specialist from Growcom.

Use modules of the Hort-360 program to improve on the gaps identified within the self-assessment.

Participants also meet the training requirements for Freshcare Environmental (required for certification).

WHAT DO I DO?

Gain certification to the Freshcare Environmental program via use of the EnviroVeg resources to meet audit requirements.

Certified EnviroVeg members will be supported before, during and after the audit process and program resources will evolve for this purpose.

Access EnviroVeg program branding.

Achieve recognition from retailers, communities and consumers.

WHAT DO I GET?

Increased production efficiencies
Identified cost savings
Recognition as an EnviroVeg member
Benchmarking against industry data

WHAT DO I GET?

Increased support and identification of production and cost efficiencies/savings
Refinement of environmental management practice knowledge, especially strengthening practices identified through the self-assessment
Improvements on the benefits from the gap analysis

WHAT DO I GET?

Certification to a recognised Environmental Standard
Access to EnviroVeg Branding and recognition for environmental commitment
Benefits from gap analysis and training levels



EnviroVeg
Sustainable Vegetable Production



Industry
Representation



Research &
Development



Best Practice
Improvement



Progress to
Certification



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Industry representation

EnviroVeg is industry-led and supports and promotes environmental best management techniques. It provides technical resources and produces benchmark data for vegetable production businesses to track performance.



Best Practice Improvement

EnviroVeg provides access to a self-assessment tool to help prioritise areas for improvement within a vegetable business. The tool is housed on a Hort360 platform. Completing the self-assessment will result in an individualised report including benchmark data.



Research & Development

EnviroVeg is underpinned by an Environmental Management Practice resource. Up to date information is available to support sustainable growing techniques and approaches.



Progress to Certification

The EnviroVeg program provides a pathway to Freshcare Environmental certification. This option to progress to certification will grant access to EnviroVeg branding and recognition of a vegetable growing business as a responsible steward of land, water and biodiversity.



EnviroVeg Program: What's next?

In 2019, the EnviroVeg Program underwent a pilot phase and feedback collated from participating vegetable growers was used to drive the next stage. Now incorporating improved features, the program is open to all levy-paying Australian vegetable growers. *The EnviroVeg Program 2017-22* is a strategic levy investment under the Hort Innovation Vegetable Fund.

The EnviroVeg program was established to improve the longevity of vegetable growing regions, benchmark industry data and develop industry recognition for environmentally responsible, sustainable production methods. EnviroVeg is industry-led and promotes best management techniques by providing resources, support, engagement and a pathway to environmental certification for those businesses looking to take that next step.

Program steps

1. Self-assessment

The EnviroVeg self-assessment is an online tool housed within the Hort360 platform operated by Growcom. There are 10 areas to complete in the self-assessment.

Once it's completed, an EnviroVeg report is generated for each business, including benchmarking information and identifying the areas where good practice is already occurring, and the priority areas for focus and possible change.

2. Training

EnviroVeg training delivers in-depth analysis of business management practices based on the needs identified through the self-assessment stage. The training will prepare a business for an audit if that is what a business is seeking.

3. Certification

The EnviroVeg program provides a pathway to Freshcare Environmental certification for those growers seeking this step. Once certified, EnviroVeg program members can utilise EnviroVeg branding for marketing and industry representation, knowing that this is underpinned by a quality, recognised, third-party environmental assurance program.

Program pilot

Throughout this year, the EnviroVeg program, including the linkages with Growcom and Freshcare, was piloted with vegetable growers from across key growing regions. Feedback from these vegetable growers has been collected and used to help improve the EnviroVeg self-assessment and the EnviroVeg training program.

There are a range of reasons why vegetable growers have participated in the EnviroVeg program:

- Recognition for environmentally sustainable practices.
- Benchmarking farm practices over time to track improvement.
- Benchmarking farm practices against similar businesses.
- A report that summarises farm management priorities.
- Access to up-to-date research and information on sustainable practices.
- Review the efficiency of inputs and outputs.
- Environmental certification for the potential benefits in the marketplace.
- Environmental certification for the benefits when communicating with local community, local government and natural resource organisations.

Getting involved

The EnviroVeg program has been reviewed and tested by the pilot growers and is now ready for vegetable growers to join.

During 2020, there will be no charge to access the EnviroVeg self-assessment as well as receiving the EnviroVeg farm management report and benchmarking information.

"EnviroVeg was the next step for our business.

"The self-assessment highlighted areas where we already had the practices in place and we just needed to formalise our paperwork. We now have the evidence we're doing the right thing."

– EnviroVeg pilot grower 1

"Waste management was an eye-opener. Our business has changed a lot of our ways in the recycling area. After the training, we placed a greater focus on our approach to waste, together with a few small changes, and now it just works."

– EnviroVeg pilot grower 2

Find out more

Please visit enviroveg.com.au.

For help with accessing the EnviroVeg self-assessment, please contact AUSVEG EnviroVeg Coordinator Danielle Park on 0432 324 822 or at danielle.park@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

Project Number: VG16063

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Introducing the new EnviroVeg website

It's finally here! The EnviroVeg program has launched a new website to ensure technical resources and up-to-date information is readily available to levy-paying Australian vegetable growers. AUSVEG EnviroVeg Coordinator Danielle Park explains how the website can be used.

The new EnviroVeg website is aiming to increase awareness around the vegetable industry's environmentally responsible practices. It focuses on the emerging sustainable production methods that are beginning to be adopted to continue to improve industry resilience.

The EnviroVeg program was established to improve the longevity of vegetable growing regions, benchmark industry environmental performance, and develop recognition for environmentally sustainable production methods and growers. This new website is a great resource to access if you would like more information about the program.

The *EnviroVeg Program 2017-22* is a strategic levy investment under the Hort Innovation Vegetable Fund.

Program changes

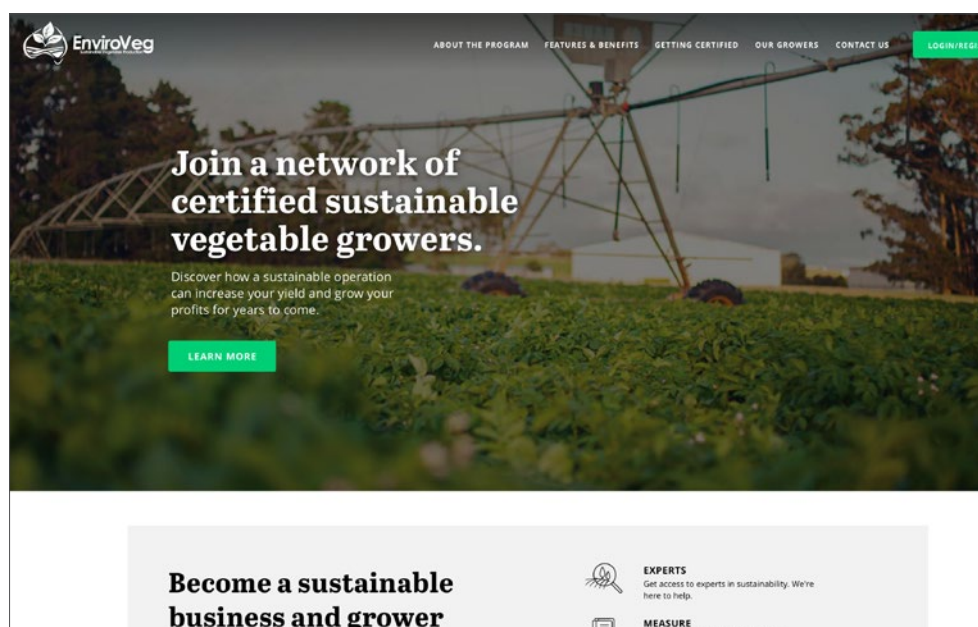
The program has recently undergone a significant review, and improvements have been sought and captured from vegetable growers from key growing regions around Australia.

Following the review that took place throughout 2019, a number of improvements have already occurred. One of the necessary improvements identified was a more user-friendly and accessible website.

Register to access the EnviroVeg Technical Manual

The website provides vegetable growers with access to EnviroVeg technical resources from across a wide range of aspects of vegetable production, which include:

Land and soil: This section addresses risks to soil health and structure, soil stability and soil degradation.



Biosecurity: This focuses on biosecurity at the property scale – it outlines the hazards and management practices that can guard against the entry, establishment and impact of exotic pests, pathogens or diseases.

Water: This considers each of the key aspects of water management in vegetable production systems, including water sources, water application/irrigation, irrigation water quality, produce washing water, wastewater and run-off, and the maintenance of healthy waterways.

Crop nutrition, fertiliser and soil additives:

This addresses nutrient management in vegetable crops and the responsible storage and application of fertilisers and soil amendments.

Pests, weeds and diseases: This addresses the integrated and environmentally sustainable management of pests and diseases in vegetable production systems.

Chemicals: This addresses all chemicals potentially used in vegetable production including agricultural crop protection products, growth regulators, cleaning products, sanitisers, water treatment products, fuels and oils.

Air: This considers aspects of vegetable production that may result in air pollution – including dust, odour, smoke, noise and light.

Energy: This addresses energy sources, energy use, energy efficiency in vegetable production systems and the responsible storage and management of fuel and oil. It also includes opportunities to reduce greenhouse gas emissions in vegetable production.

Waste: This considers a broad range of waste materials that may be generated through vegetable production, including surplus/reject produce and other organic matter, paper and cardboard, timber, plastics, glass, metals, tyres, oils, liquids and gases.

Biodiversity: This focuses on the actions that can be taken by vegetable producers to protect native plants, animals and ecosystems and to enhance biodiversity – both on the property and in the wider landscape.

Business: This details procedures and key topics for making environmentally responsible, sustainable management decisions in vegetable production systems including community relationships, catchment priorities, local objectives, access to expertise and support, supply chain management, farm layout and farm plans.

Business management underpins all the other sections within the scope of EnviroVeg and can affect how practices are implemented on-farm.

Find out more

Please visit enviroveg.com.au.

For help with accessing the EnviroVeg self-assessment, please contact AUSVEG EnviroVeg Coordinator Danielle Park on 0432 324 822 or at danielle.park@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

Project Number: VG16063

Hort Innovation
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Sharni, Shane and Caitlin Radford. Image courtesy of Rabobank.

Developing evidence of good environmental stewardship

The EnviroVeg Program 2017-2022 is a strategic levy investment under the Hort Innovation Vegetable Fund. In this article, Program Coordinator Danielle Park speaks to Tasmanian vegetable and potato producers and EnviroVeg members, Shane and Sharni Radford, about the value in collecting evidence of good environmental practice for vegetable producing businesses.

In 2019, the EnviroVeg Program underwent a pilot phase and feedback collated from participating vegetable growers was used to drive the next stage.

Involved in this pilot were north-west Tasmanian producers Sharni and Shane Radford, who completed two of the program's three phases. The couple grow a range of crops, including beans, broccoli, carrots, onions, and potatoes, at their Moriarty operation.

As with other vegetable producers, many of the biggest environmental risks facing the Radford's production system have been addressed over the many years of operating on their property. Having evidence to support claims of following environmental best practice has been vital for many years.

"Even in the early days when we were supplying onions to a processor for them to export, there was a need to collect the evidence of doing the right thing," Sharni says.

Over 20 years ago, Shane and Sharni began to tackle the challenges of supplying processing onions for export to England. The experience of assisting the processor to meet another country's environmental requirements, and having to produce evidence of good environmental practices, taught some important lessons.

"The more proactive you are, the better prepared you are for opportunities," Sharni says.

"There's an element of chance if you wait and don't get involved. If you get in first, you can help shape the program to work for you."

This proactive approach led Shane and Sharni to volunteer to test out the revised EnviroVeg program in 2019. This program's pilot phase has been completed, and is now open for vegetable levy-paying growers to join.

The importance of environmental credentials

Increasingly, the question of environmental sustainability is being asked by different sectors. One group asking the question and looking to better understand the practices occurring on-farm, are financial institutions such as banks.

"A program such as EnviroVeg provides documentation that I can use when I'm asked these questions by our bank," Sharni says.

The value of collecting and keeping evidence of good environmental practices over time has also been identified by Sharni.

"Our work 20 years ago with Nature's Choice has now become part of our records, and the information from that program is still useful. It has become a resource for our business," she says.

"Our daughter Caitlin has now joined the business and succession planning has commenced.

"The information and records collected can support both succession planning and new entrants to the business. We have records of practices and farm infrastructure for many years, which has value for our business. It's part of the property value."

Undertaking the new-look program

The first phase of the new EnviroVeg Program is an online self-assessment. This involves identifying the current practices occurring on vegetable farms from 10 distinct aspects of farm operation, including soil management, irrigation, energy use and biosecurity.

A business report is produced once the self-assessment has been completed. This report highlights the business' strengths, or where it has already addressed an environmental risk. It also identifies risks within certain areas or any further investigation that might be needed.

The second phase of the program is EnviroVeg training, where the results of the self-assessment are highlighted.

Sharni attended this training with other EnviroVeg members in Tasmania who were helping to pilot the revised program. There were benefits in reviewing the identified on-farm environmental risks and discussing the short- and long-term practical actions.

This discussion – with other local

The Radford's property. Images courtesy of Sharni Radford.



The Radfords grow a number of vegetable crops, including carrots (pictured).

producers or with key decision makers in the business – has been identified as being very valuable.

Improvement the key

The EnviroVeg Program aims to support and improve environmental management on-farm. It is willing to assist vegetable producers who are looking to improve their long-term environmental sustainability.

When completing their first EnviroVeg

self-assessment, many aspects of Shane and Sharni's vegetable production business was already achieving best management practice for environmental sustainability.

Two areas scored a little lower and were flagged as needing further investigation – energy and biosecurity.

One of the steps to improving energy management is to firstly become aware of the energy requirements of different machinery.

In response to their lower score in this

area, Shane and Sharni have increased their vigilance in ensuring equipment is maintained and serviced to remain optimal efficiency.

In addition, Shane and Sharni have recognised the need to develop an on-farm biosecurity plan. They now have biosecurity signage, but more work is required.

"We're now looking to further develop our biosecurity plan. Having policies around site-access is something we're considering," Sharni says.

From their EnviroVeg training, Shane and Sharni have been able to review the risks identified. They have since completed a re-assessment, which has resulted in a new farm report and a better result on the benchmark.

What is the EnviroVeg Program?

The EnviroVeg Program was established to improve the longevity of vegetable growing regions; benchmark industry data; and develop industry recognition for environmentally responsible, sustainable production methods.

EnviroVeg is industry-led and promotes best management techniques by providing resources, support, engagement, and a pathway to recognition for vegetable producers.

There are three main objectives to EnviroVeg:

- To support and improve environmental management on-farm.
- To facilitate program recognition of and competitive advantage from EnviroVeg branding.
- Track industry progress regarding sustainable farming practices.

The EnviroVeg program is underpinned by an 'Environmental Best Management Practice' resource. The resource contains up to date information on achieving environmentally sustainable vegetable production.

For vegetable growers looking to assess their current practices on-farm, the EnviroVeg program is one way of identifying opportunities for improvement, as well as benchmarking against others in the industry.

Find out more

Please visit enviroveg.com.au.

For help with accessing the EnviroVeg self-assessment, please contact AUSVEG EnviroVeg Coordinator Danielle Park on 0432 324 822 or at danielle.park@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

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Practising good environmental stewardship

Paul Gazzola is a third-generation vegetable grower, with his main operation located at Somerville on Victoria's Mornington Peninsula. AUSVEG EnviroVeg Coordinator Danielle Park speaks to Paul about the challenges faced in 2020 and his long-time involvement in ensuring environmental best-practice in the vegetable industry.

The challenges facing vegetable producing businesses throughout 2020 have been immense.

The ramifications of changing levels of COVID restrictions and large fluctuations in the demand for vegetables – along with a simultaneous spike in interest among consumers about the importance of fresh, nutritious vegetables – have made the year a test for everyone.

Changing operating requirements, and the challenge of accessing labour, have resulted in an increased workload for many producers. This has made the task of looking at the bigger picture of on-farm environmental sustainability moved down the list of grower priorities.

In response to the time constraints facing growers, the EnviroVeg Program has begun to test facilitated group sessions in some locations. The use of a group session to support vegetable producers complete their EnviroVeg self-assessment is available upon request (see breakout box for further details).

The EnviroVeg Program 2017-2022 is a strategic levy investment under the Hort Innovation Vegetable Fund.

Case study: Paul Gazzola – Gazzola Farms, VIC

Victorian vegetable grower Paul Gazzola produces broccoli, celery, lettuce, bok choy, choy sum and Chinese broccoli at his Mornington Peninsula operation.

Paul has a long history with programs looking to understand the environmental impacts of vegetable production.

Paul was involved with the Vegetable Growers Association of Victoria (now AUSVEG VIC) when it helped to develop a precursor to the EnviroVeg Program. This ensured the program was developed by the vegetable industry for the vegetable industry.

Paul is currently AUSVEG VIC President, and his operation has been involved in various environmentally sustainable programs – such as EnviroVeg – for a long time. Paul's years of experience in

this space has provided him with a depth of experience and insight on the topic.

"Being environmentally sustainable is not something you actively live and breathe every day, it's more something you do subconsciously," he says.

"It needs to be more than a tick-a-box exercise. Environmental sustainability is a little like integrated pest management – it's a way of farming."

This is where EnviroVeg comes in.

"EnviroVeg is a tool that I have used to look at my system to find where the next improvement is going to be made," Paul says.

COVID-19 impact

For this article, Paul reflects on the time management challenge and being a good environmental steward in the middle of a pandemic.

"Everyone – including our business – has been impacted by COVID-19. During this time, the workload for our quality assurance has increased," Paul says.

The current EnviroVeg Program was able to provide benchmarking information that can work out where to begin and where to focus time to reduce a business' environmental risk.

The program allows growers like Paul to benchmark their business against environmental best management practice.

As Paul says, growers must ask themselves several questions when undertaking the benchmarking exercise, including:

- "What am I doing?"
- "What is the industry standard and what are the expectations?"
- "What do I need to get upskilled in or improve?"

The answers to these questions can help direct the next steps on the path to improvement.

Developing solutions

The EnviroVeg Program is ideal for those looking to start a vegetable growing

business or develop a new site for production. It allows growers to look at the longer-term implications of farm design and operation.

However, most vegetable production occurs on established farms; each with its own established challenges to manage. Opportunities to make improvements do exist and they may result in longer term changes.

A key challenge for the Gazzola property has been the management of run-off and the resulting sediment loss.

"It took time to get the system right," Paul says.

EnviroVeg stepped in to assist. An initial solution was able to keep sediment on the property, managing water through a drainage system terminating in a catchment area contained within the property.

Over time, the decision was made to invest in a more permanent solution where topsoil was captured and returned to growing blocks. The solution included a concrete-lined catchment pit.

"There's only so much topsoil and we cannot afford to lose any," Paul says.

Although a solution was found to address this issue, there is always further work to be done.

"You're never finished. There is always something new or a better idea or new innovations. It is an ongoing exercise," Paul concludes.

Find out more

Please visit enviroveg.com.au.

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Championing sustainable environmental practices



Graeme Pitchford.

South Australian vegetable grower Graeme Pitchford has been a long-serving member of the EnviroVeg Program's Steering Committee. In this column, AUSVEG's Danielle Park speaks with Graeme about his involvement with EnviroVeg, and the importance of environmentally sustainable practices in 2021.

A strong advocate for sustainable vegetable production in South Australia, Graeme Pitchford is continuing to investigate innovative practices to improve his vegetable growing operation.

Graeme's business, Pitchford Produce, is located near Currency Creek on the Fleurieu Peninsula, south of Adelaide. Crops grown include baby cos, iceberg lettuce and broccolini, with a few additional lettuce lines included.

It all starts with the soil

Soil is a strong focus for Graeme and Pitchford Produce, with most of the property consisting of sandy loam over clay.

"Managing the soil is important. The aim is to look after the soil the best we can," Graeme says.

Cover cropping through the cooler months of winter is an important part of managing the soil. Different cover crop types have been used at Pitchford Produce.

To control broadleaf weeds, a cereal cover crop option has been a more recent choice. Graeme is very interested in continuing to investigate a wider range of cover crops, including options that might allow nitrogen fixation while not providing a host for club root.

"We are always trying to work out the best scenarios, looking after the microbes in the soil using crop rotation and adding organic matter back in through compost," Graeme explains.

Graeme is also interested in

incorporating biofumigant cover crops to maintain and build a healthy soil biology without using fumigation. Better quality produce is also a sought-after benefit.

Preventative measures

When it comes to managing pests and diseases, Graeme is a strong advocate for Integrated Pest Management (IPM). However, he is aware that it can be difficult to get the balance right all the time.

"It is challenging. You can do your very best at times – you keep monitoring and find a bug or two. You can still get caught out," Graeme says.

"We're trying to be the best we can, but preventative measures are needed sometimes."

Overall, Graeme is keen to continue to improve his IPM practices.

"I like the thought process. I like the idea of only when necessary and targeting specific insects at specific times," he says.

When it comes to disease management, the issue of white blister on brassica crops has created a new challenge for Graeme over recent years. As with any new disease or pest, there is a need to learn and apply different methods of management or control.

The use of drip irrigation to keep the leaf dry and allow for efficient application of irrigation water has been the option chosen to best manage both the disease risk, and to reduce the loss of water and nutrients when fertigating.

Raising awareness

One area that the EnviroVeg Program has highlighted for Graeme is the potential risk posed with his current level of preparation for any on-farm biosecurity challenges.

The EnviroVeg biosecurity section highlights the benefit of on-farm biosecurity signage, procedures to prevent pests and diseases from entering and travelling across a property as well as monitoring and recording unknown pests and diseases, among other practices.

However, the topic of on-farm biosecurity had not been included in earlier versions of the EnviroVeg program. Therefore, when Graeme completed the online EnviroVeg self-assessment for Pitchford Produce, several new areas to improve were highlighted for the business.

He admits that biosecurity wasn't something the business had focused on beforehand.

"It has made me think about who is coming on-farm. We take part in a local program that includes school visits and have re-sellers visiting the site too," Graeme says.

"On-farm biosecurity is now something to keep at the forefront of our minds."

Through EnviroVeg, Graeme is also looking at the potential sources of on-farm waste.

As with most vegetable production systems, there is a certain level of organic waste created and crop residue can be a sizeable waste stream. However, this is



Pitchford Produce grows a range of green leafy vegetables, along with broccolini.

dependent on the type of crops grown.

As a grower who is already using compost within the production system – and with approximately 50 tonnes per hectare of green waste generated from an average brassica crop – Graeme is looking at opportunities to better utilise crop residue and investigating options for improvement in reusing organic waste.

Environmental stewardship in-focus

EnviroVeg is an industry-led program that aims to support and promote environmental best management practice techniques among vegetable producers in Australia.

The involvement of vegetable producers and industry representatives is an important element to the longevity of the EnviroVeg program.

“Many years ago, I was approached to be a part of the EnviroVeg Steering Committee. I had the opportunity to jump on board. I’ve always thought it was a good idea to be kept up-to-date and to express an opinion,” Graeme says.

There have been several changes to the program in recent years. It has sought to move the program online, developing a nationally consistent program while investigating options to allow for the challenges and practices in across different vegetable growing regions in Australia to be addressed.

The importance of looking after the environment and telling the story of vegetable growing businesses as being

responsible stewards of the land, water and biodiversity is as important as it has ever been.

“I’d like to see all the great work that AUSVEG has done in the area of environmental sustainability continue, with recognition,” Graeme says.

Graeme will continue to be a strong supporter of the EnviroVeg Program, as well as actively seek out opportunities to improve the environmental benefits available for a commercial vegetable farming business.

“I’m very aware that we’re left to look after a piece of ground and to do our best with that piece of ground. By doing this, it benefits everything in the long run,” he concludes.

Find out more

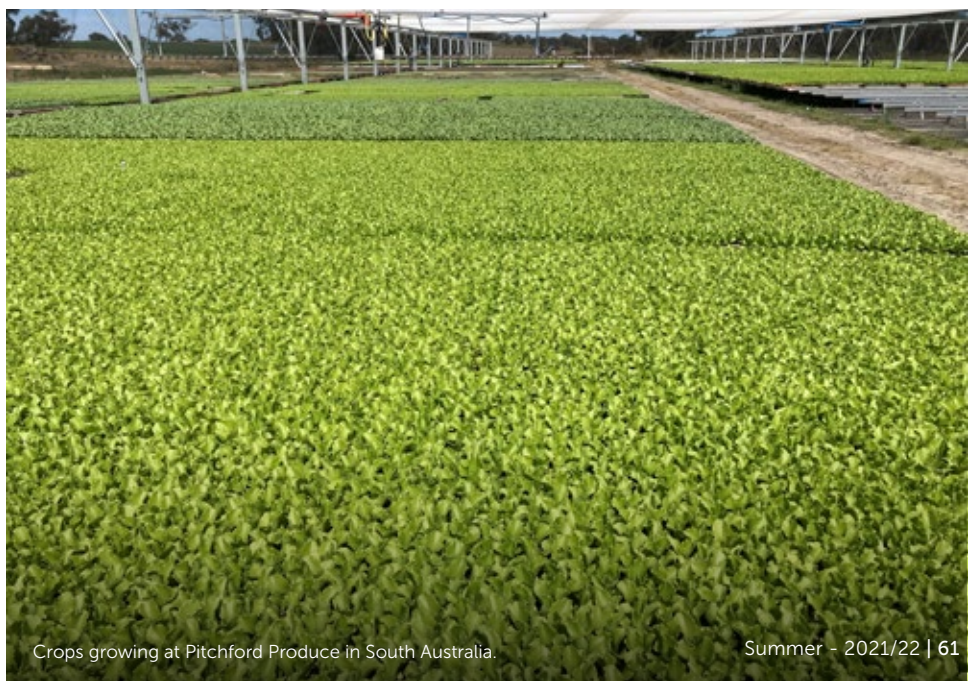
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Crops growing at Pitchford Produce in South Australia.

ahead of the pending Federal Election to prioritise funding for this behaviour change strategy, given the health benefits to the public and the returns to industry from increased sales.

There is a compelling case for public investment in demand driving activity to support vegetable growers noting the significant rises in cost base due

to COVID-19 (labour, freight, global volatility) and climatic change (fires, floods, drought).

There is also an urgent need for government and invested organisations to increase investment and collective efforts in effective funding of broad and narrow cast communications that 'meet consumers where they are' (physically,

mentally, and socially in a post-COVID world) to achieve the same increased intake goal.

Find out more

Please contact Fruit & Vegetable Consortium Managing Director Justine Coates on jcoates@nutritionaustralia.org. Further details can be found at thefvc.org.au.

Climate positive practices: Aussie veg producers acknowledged on the world stage

In September 2021, two members of the AUSVEG-led EnviroVeg Program were acknowledged for their implementation of climate positive practices and the ecosystem benefits on-farm. Western Australian mixed cropping/livestock producer Jake Ryan and Sharni & Shane Radford from north-west Tasmania were among those honoured, with nominees named from right across the globe.

Corteva Agriscience's 2021 Climate Positive Leaders Program is a nomination-based farmer and rancher recognition program designed to uplift the voices of early adopter producers around the world who are implementing, scaling and sharing climate positive practices.

Launched in March 2021, the program will amplify their successful experiences with the intention of accelerating the broad adoption of those practices where applicable.

Farmers who met the program criteria were nominated by regional third-party groups including grower groups, nonprofits, universities or other technology assistance partners.

A panel of industry-leading judges completed an anonymous review of the farmer applications and confirmed the winner and runner up producers.

The program focused on growers in the U.S.A., Canada (except Quebec Province), Brazil, Argentina, Germany, France, Australia, and Kenya.

Australians recognised

Jake Ryan, winner

Jake Ryan received the Australian Climate Positive Leaders Program award. Alongside his parents Gary and Tracey, Jake runs The Three Ryans – a mixed cropping/livestock operation in Manjimup, Western Australia. The operation uses holistic grazing, minimal tillage, cover cropping, and mineral nutrition to produce a wide variety of winter vegetables; cereal and oilseed commodity crops; ewes for wool and lamb production; first cross Angus Friesian heifers; and pasture-raised laying hens.

Jake has implemented a strip-tilling and cover crop process for his vegetable crops, ensuring there is a living root feeding carbon into the soil and stimulating soil microbes. Acres are rotated with one year of vegetable production, followed by four years of pasture production for livestock and soil regeneration. Cover crops are planted on the entire operation to improve soil, then are grazed or cut for silage.



Further practices

In addition to traditional cover crops, Jake has recently begun intercropping with flowering cover crops to increase the population of beneficial insects and reduce the number of predatory insects that are damaging to crops and livestock. With the adoption of holistic grazing and a focus on mineral nutrition and tracking minerals proportions, he has been able to dramatically reduce the need for nitrogen base fertilisers from the pasture/cover/vegetable crops as well as reducing the phosphorous requirements. Profits have increased consistently five to 10 per cent annually.

Jake says the Climate Positive Leaders Program will help him to communicate to other farmers that climate positive practices are for the betterment of agriculture and the environment.

"Farmers learn best from other farmers, especially when they can see the results in-person. Through this program, I will help demonstrate to other farmers that regenerative practices not only will improve their land but increase productivity and lead to potential financial gains," he says.



Shane Radford and his daughter Caitlin. Shane and wife Sharni were named runner-up in the Australian Climate Positive Leaders Program award.

Sharni and Shane Radford, runner-up

Sharni and Shane Radford from Moriarty is Tasmania's north-west were named as a runner-up in the Australian awards. The pair – along with their daughter Caitlin – produces potatoes, onions, carrots, green beans, broccoli, wheat, grass seed, hay, prime lambs, and beef cattle, and apply numerous practices to retain water and prevent run-off in hilly terrain.

As soon as crops are harvested, natural grasses and other cover crops are planted for the 90-day period between cropping to improve soil structure, build organic matter, improve microbial activity, and reduce compaction. Wheat straw is also used in run-off vulnerable locations to reduce soil erosion.

These practices have increased crop yield as well as improved on-farm biodiversity and support for coastal water quality preservation. The Radfords have made a long-term commitment to the conservation of area birds, specifically the ground nesting Swamp Harriers that offer natural pest management. Water quality is monitored to protect the frog and eel populations. Leveraging livestock manure to increase dung beetle populations has also increased soil fertility and moisture retention.

"Climate positive is about thinking differently, focusing on managing the farm so that it can be productive for future generations. The Climate Positive Leaders Program will help us to continue improving the health of our

soils with new methods and technologies as they emerge," Sharni says.

Having a voice

Winners – including Jake Ryan – will receive a global platform to share their experience and advocate for climate positive practices. They will also engage with a strong network of other early adopters and leaders in agriculture.

Other opportunities include:

- An expenses-paid international trip, lifetime membership and other benefits with the Global Farmer Network.
- Access to other early adopters and agriculture leaders through engagement with Global Farmer Network and its broad platform.
- Leadership and communications training to support farmers as they share their experience.
- Soil sampling and soil health guidance, including carbon sequestration measurements and an estimation of carbon from Dr Rattan Lal and his team from the Carbon Management and Sequestration Center, based at Ohio State University. Producers will also receive a personalised report with recommendations along with a lecture and interactive discussion with Dr Lal and the program winners.

Find out more

For further details about the Corteva Climate Positive Leaders Program and the 2021 winners, please visit corteva.com/sustainability/climatepositive/leaders-program.html.

Sustainability key to family's on-farm success

Sharni and Shane Radford made the decision to participate in the online pilot EnviroVeg Program in 2019. Through their participation, they provided valuable feedback ahead of the program's rollout from 2020.

The Radfords are involved in training the next generation who might be working in the farming sector. They are very proactive in being involved in industry programs, including the Australian vegetable industry's environmental sustainability program EnviroVeg, and regularly share what they have learned with others for the betterment of their industry and growing community.

The EnviroVeg program allowed the Radfords to benchmark their practices against other vegetable producers, and guided changes and improvements on-farm.

The decision to participate in the revised EnviroVeg program led to the business successfully undertaking its first Freshcare Code of Practice Environmental audit in March 2021.

The *EnviroVeg Program 2017-2022* (VG16063) is a strategic levy investment under the Hort Innovation Vegetable Fund.

Collaboration key to kicking environmental goals

Andrew Johanson is Mulgowie Farming Company's Sustainable Farming Practices Manager. In this article, AUSVEG EnviroVeg Coordinator Danielle Park catches up with Andrew to learn more about Mulgowie's approach to environmental sustainability, its involvement with the EnviroVeg program and the importance of teamwork and collaboration when it comes to implementing change across five different regions.



Mulgowie Farming Company's Sustainable Farming Practices Manager, Andrew Johanson.

Mulgowie Farming Company oversees vegetable growing operations that span 5,000 hectares of land strategically located down the eastern seaboard of Australia. To ensure continuous year-round supply and mitigate weather events, Mulgowie's farms and packing facilities are spread from as far as Home Hill in north Queensland, down to Boisdale in Victoria's central Gippsland region.

With a long history of adopting and promoting good agricultural practices, Mulgowie chose to include four properties in the EnviroVeg Program's pilot phase in 2019.

The EnviroVeg program allowed each of the Mulgowie farms participating to review current practices against best practice, as well as use the benchmarking capability to visualise each of its farms.

Many of the EnviroVeg components aligned and supported the farm plans that Mulgowie was working with its team to develop, including improving water efficiency, reducing pollution risk and pesticide use, preventing soil erosion, and increasing soil carbon to leverage plant health.

EnviroVeg training was held on Mulgowie farms in Queensland and Victoria, allowing farm teams to work together, review current practices and identify opportunities to collaborate and continue to improve in key areas.

Following the pilot phase, additional farms have elected to join the EnviroVeg program.

Operational focus

Sustainable Farming Practices Manager Andrew Johanson says farmers at Mulgowie are continually learning about the land and how to protect it.

"Mulgowie farmers keep the environment at the forefront of decision-making," he says.

In his role, Andrew's key focus is to prevent soil degradation and the loss of microbiology and organic matter. He does this by working with the Mulgowie team across the different farms and regions.

"The goal is to farm sustainably, while reducing inputs. We have been able to achieve this by improving soil condition, microbial activity, worm populations, composting, controlled traffic, minimum or no-till, and cover cropping," Andrew explains.

Mulgowie has invested in environmental practices that have led to further improved operational efficiencies and economic benefits. These have been a result of reductions in fuel and electricity use, fewer irrigation and fertiliser requirements, less soil loss and reduced labour costs.

"The team at Mulgowie takes great pride in developing new methods that improve water use, soil, plant quality and reduces water pollution, which have resulted in improvements to our fresh vegetable produce, including increased shelf-life, improved taste, and better nutritional levels," Andrew says.

Mulgowie also has a soil health strategy rolled out across all farms. The operation's commitment to soil fertility has seen the

farms engage in a composting initiative, with organic matter mixed in with mill mud applied to the soil. Additional green waste is used in other composting and waste utilisation initiatives.

"As one of Australia's larger vegetable farmers, we're vertically integrated to ensure quality control from the soil to the plant, to the product and shelf," Andrew says.

"Our farmers have a deep commitment to sustainably managing the environment and producing nutritionally rich plant-based food to support our community's health and wellbeing."

Sustainability, productivity and carbon goals

At Mulgowie, the stated focus is 'Healthy Soils, Healthy Plants, Healthy People'.

"Growing great nutritious vegetables and preserving that nutritional benefit through to the consumer is our goal. The fact that improving our soil also results in carbon sequestration and 'net negative' at the farmgate is a very welcome side benefit," Andrew says.

The team approach and collaboration across Mulgowie farms and regions includes the implementation of cover cropping, controlled traffic farming, and

minimum tillage.

"The move to zero or strip tillage has shown an immediate result in plant vigour, yield and resilience," Andrew explains.

"We've also observed improved soil water infiltration and water holding capacity, while soil has become more friable."

To understand the impact of these practices beyond their production benefits, Mulgowie has begun working with Carbon Friendly® – an international accounting methodology that is based on the Greenhouse Gas Protocol guidelines and directives.

"We track our carbon sequestration using a certified Carbon Friendly® farming operations method to show a reduction in greenhouse gas emissions for the same agricultural crop or product over the same period of time," Andrew says.

"Retaining carbon in soil, building organic matter and improving water holding capacity are further challenges of modern agriculture."

Plants have also been seen to be more resilient to increased occurrence and severity of weather extremes.

Mulgowie has been better able to maintain supply to customers during the last severe drought when others could not as a result.

Participating in EnviroVeg

For vegetable growers looking to assess their current practices on-farm, the EnviroVeg Program is one way of identifying opportunities for improvement, as well as benchmarking against others in the industry.

The program was established to improve the longevity of vegetable growing regions; benchmark industry data; and develop industry recognition for environmentally responsible, sustainable production methods.

EnviroVeg is industry-led and promotes best management techniques by providing resources, support, engagement, and a pathway to recognition for vegetable producers.

Find out more R&D

For help with accessing the EnviroVeg self-assessment, please contact AUSVEG EnviroVeg Coordinator Danielle Park on 0432 324 822 or email danielle.park@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

Project Number: VG16063

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Vegetable Crop Nutrition Masterclass reaps online rewards

Due to the changing levels of COVID-19 restrictions around the country, the Vegetable Crop Nutrition Masterclass made the move online in 2020.

The change to online resulted in an oversubscription to the program, with vegetable growers, agronomists, and other industry representatives attending from every state in Australia for sessions held on 12 and 13 August. The highlight was the breakout sessions on day two, with six groups developing and presenting nutrient management plans.

Mastering crop nutrition

Digging into the detail of vegetable crop nutrition, the training covered the knowledge and principles necessary to develop and manage crop nutrition programs on vegetable farms.

Beginning with a deeper understanding of soil functions and underlying soil conditions, the program also outlined the importance of soil structure for vegetable crop growth. It highlighted the role organic matter plays in this, and in nutrient cycling and soil biology. Opportunities for more efficient use of crop nutrition and the role that cover crops can play in both storing and releasing nutrients were also flagged.

Leading the Vegetable Crop Nutrition Masterclass was Doris Blaesing from RM Consulting Group (RMCG).

"The presenters were impressed with participants' overall contribution and how they tackled the nutrient management planning, given all groups had to work on a vegetable crop that was not familiar to them," Dr Blaesing said.

"It was also great to see people from all corners of the country getting involved."

In this edition, two Masterclass participants share what they learnt from across the two days. *Vegetables Australia* spoke to agronomists Bhargav Rayeni from Mulgowie Farming Company and Joel Davis-Ward from Bejo Australia about their experience.



Bhargav Rayeni

You have an agronomy/farm manager role at Mulgowie Farming Company. What does this involve?

I'm involved in season planning and agronomy. This includes working with growers to conduct crop checks, quality/yield forecasting and soil health management.

You attended the Vegetable Crop Nutrition Masterclass in 2020. What were the reasons behind your participation?

I participated in last year's Masterclass and found it quite useful to reaffirm the approach to soil test interpretation. I was also interested to see if anything new had happened since last year's event.

Was there anything new from last year's event? If so, what?

I felt this time it was much better. Sap testing versus leaf testing, and phosphorous conversations.

What did you take away from the Masterclass that you can apply to your role at Mulgowie?

A holistic approach to soil test interpretation and including cover crops to nurture the soil biology.

A holistic approach involves feeding the soil rather than the plants alone, while keeping the nutrient interactions in mind. Cover crops are included as part of improving soil health and maximising nutrient availability. E.g. We are using buckwheat as a cover crop, which can make phosphorous more available to the next crop.

Were there any key learnings that you have been able to – or will be able to – pass on to the growers who you work with?

Cover cropping and soil amendments. I can discuss the importance of lime and gypsum to counter act pH and high magnesium issues, as well as outline how compost and cover crops can be used to improve soil's nutrient/water holding capacities.

What were the highlights of the Masterclass?

Highlights included interaction with other participants and solving real-world soil testing and cropping problems.

The Masterclass helped to bring our internal agronomy onto the same page as our approach to soil test interpretation.

Do you have any suggestions for the Soil Wealth team should another Masterclass be offered in 2021? What topics would you like to see on the agenda?

I would like to see more emphasis on soil health and trace elements such as silicon. Also, a focus on pathogen and nutrient interactions.

There has been an ongoing emphasis on sustainability – it may not be a choice anymore as customers are looking to buy sustainably-grown produce.

Calcium silicates counteracting powdery mildew in an organic situation is a great example.

It will be great to see the pest and nutrient interaction, so we may be able to expand the scope of nutrition for growing and protecting the crop. Also, it reduces the dependency on chemical and cultural controls.



Joel Davis-Ward

Hi Joel, can you please give me a brief introduction of yourself and how you became involved in the vegetable industry?

I'm 32, married, and have a 10-month-old son. I became passionate about the vegetable industry in my early teens when I started cooking, which I later turned into a profession. As a professional cook, I became even more passionate about good food and starting with the best produce, so I started growing my own. I didn't particularly like working in kitchens, and dreamed of being the one producing the ingredients I was cooking with, which led to my wife and I studying Agricultural Sciences at The University of Adelaide, moving to Tasmania (where the soil is great and the land relatively cheap), and working in agriculture while we save for our own farm.

You're a Research Technician at Bejo Australia. What does this involve?

Bejo Australia produces a reasonably wide range of vegetable and herb seed, and we're constantly trialing new ways to improve productivity, efficiency, safety, reliability, and quality, while reducing our environmental impact. My role is to help maintain and manage those trials – everything from planning, planting, spraying, weeding, and applying treatments to assessing the effects of

those treatments and extending those results to our field officers.

You attended the Vegetable Crop Nutrition Masterclass in 2020. Why did you decide to participate? Have you been involved before?

It was recommended to me by my supervisor (who also attended) as a way to improve my agronomic knowledge in regards to crop nutrition. I hadn't been involved in training like this before (other than at uni), so the idea was that at the very least it would be a good refresher.

What did you take away from the Masterclass? Was there anything new that you learnt?

I realised that my understanding of crop nutrition was far less than I had anticipated and that I had a lot more to learn, especially in terms of all the different products available. During the Masterclass, we worked on a case study involving carrot nutrition, which gave me a heap of information about nutrient removal rates, fertiliser timing, and nutrition management practices for a crop that I'm heavily involved in. Some of the products that were brought up in the group discussion I had never even heard of before, so I learned quite a bit!

What was the most useful information, and was there anything that you learnt that you could apply to your day-to-day work?

The most useful information for me definitely came from the group task, which was developing a crop nutrition plan for a carrot crop in Penola, South Australia. We were lucky enough to have Doris Blaesing supervising our group, and she has an enormous amount of knowledge that we only just scratched the surface of. While I can say that the discussions around calcium cyanamide, the nutrient concentration of composts, or mycorrhiza were particularly useful to me, it was

actually being exposed to Doris and her work with the Soil Wealth and Integrated Crop Protection (SWICP) project that provided *the most* useful information that's applicable to my day-to-day work. I've since downloaded and printed every SWICP report that is applicable to the crops we grow, so I ended up with a *lot* more relevant information than I expected!

Would you recommend the Masterclass to other members of the vegetable industry, and why?

Absolutely! There's always something to learn from training that encourages peer-to-peer learning, no matter what your experience level is.

Would you consider undertaking any similar Masterclasses and if so, what would you like to see it focused on in terms of vegetable production?

I'm always keen to undertake more training. I'd be especially keen to learn more about soil microbiology and how to manage it; soil microscopy; developing disease-suppressive soils; factors that promote weed growth (i.e. what the present weeds tell you about the current conditions and how to manage them); and how different fertilisers and the timing of their application affects the growth, nutrient density, and health of various vegetable crops.

Find out more 

Please contact Doris Blaesing at dorisb@rmcg.com.au.

The Vegetable Crop Nutrition Masterclass has been made possible by Soil Wealth and Integrated Crop Protection – Phase 2 (VG16078), delivered by RM Consulting Group and Applied Horticultural Research.

This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

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Piloting digital remote monitoring to improve environmental performance



AustChilli Managing Director David De Paoli.

With an increasing range of real-time sensors and monitoring used in vegetable production, several real-time sensing options will be piloted in a new project to investigate whether these digital tools might be able to both support agronomic decision making as well as guide and record improved environmental stewardship. AUSVEG EnviroVeg Coordinator Danielle Park reports.

AUSVEG and the EnviroVeg Program – along with several horticulture industry partners – are participating in a new project to raise the horticulture sector's environmental performance.

Part of EnviroVeg's role will be investigating the use of remote monitoring to support vegetable producers automate the collection of real-time data to support management decisions, as well as allow for digital reporting of environmental performance.

The challenges of record keeping and collecting evidence to support production decisions, as well as tracking environmental performance, has been evidenced over many years through the AUSVEG-facilitated EnviroVeg Program, which is a strategic levy investment under the Hort Innovation Vegetable Fund.

Funded through the Australian Government's Landcare Smart Farming Partnerships program, the *Digital remote monitoring to improve horticulture's environmental performance* (ST19024) project is managed by Hort Innovation.

Other project collaborators include Applied Horticultural Research, Hitachi, Freshcare, Growcom, Greenlife Industry Australia, the Australian Banana Growers Council, Avocados Australia and the Australian Macadamia Society.

Current technology developments already provide a range of sensors and tools that can continuously monitor key components of farm production and performance. This could be done through identifying inefficiencies, filling in the gaps and having more efficient operations with optimised use of inputs.

Supporting improved environmental practices is a key objective of the three-year project.

Establishing a pilot farm

With a focus on protecting ecosystems in horticulture growing regions, the project is establishing pilot or demonstration smart farms in the Great Barrier Reef catchment area.

AustChilli is one of the pilot farms that will participate in the investigation and use of various digital monitoring methods. The operation's Managing Director, David De Paoli, outlined why he chose to be part of the project and pilot the automated monitoring approach.

"If you do not change, you will be roadkill as your competitor will run over you to get the market first," David said.

"We want to prevent run-off into the reef and potential contamination of waterways. The bonus is the higher productivity, better quality, lower cost of production and greater reliability of supply."

When it comes to managing crops with more frequency of extreme weather events experienced globally, David said that his staff wanted to be able to tap into weather patterns and models to be able to predict and reduce its effect on production by being proactive – and not reactive.

"Automation can improve crop efficiency and reduce leachate by reducing and adjusting inputs at critical times," he said.

Another potential benefit flagged was a future potential for automation to address gaps in the availability of experienced or appropriately skilled team members. This will take the guess work out of actions and decisions will be able to be made based on scientific information.

David said that he hoped the project would make it easier to show

that AustChilli is a good steward of the environment.

The piloting of these technologies aims to test whether these methods might provide a feasible way for vegetable producers to collect and use farm data for production decisions, as well as for automated collection of evidence of their environmental performance.

Evidence of environmental stewardship

Throughout the project, remote technology will be used in the continuous monitoring of environmental indicators such as nutrient leaching, sediment run-off, water, and energy use efficiency and more.

The sensors and tools can monitor and measure vegetable production environmental indicators to quantify baseline performance; inform decision making; drive good environmental stewardship; and natural resource use resulting in evidence to help build and support strong markets.

A digital dashboard will integrate sensors and other data to remotely monitor environmental performance and support adoption of Best Management Practice (BMP) programs, including the EnviroVeg Program.

Find out more

Please contact AUSVEG National Manager – Engagement and Extension Zarmeen Hassan at zarmeen.hassan@ausveg.com.au or phone 03 9882 0277.

This project is funded by Hort Innovation using the nursery research and development levy and contributions from the Australian Government.

Project Number: ST19024

**Hort
Innovation**

Engagement and Communications Plan

VG16063 – The EnviroVeg Program 2017 - 2022

Document Control

Final Versions will be stored within the S: Drive at AUSVEG

Document Number	Date Modified	Revisions
1.0	21 April 2017	First Draft
1.1	31 April 2017	AUSVEG feedback – minor changes, rules for external communication added
2.0	June 2018	Minor adjustments for milestone reporting

Contents

Glossary.....	2
Overview	2
Project Details	2
Project Background:.....	2
Purpose:	2
Scope:.....	3
Assumptions.....	3
Constraints:	3
Communication management:	3
Stakeholder management.....	4
Key stakeholder groups	4
Stakeholder groups requirements:	4
Communications strategy	4
Aims of the Communication Strategy:.....	4
Stakeholder groups objectives and key messages:.....	5
Key communication platforms and resources:	6
Measures of success	7
Communications Plan	9
Activity Plan	9
Communication mechanisms.....	11
Rules for external project communication	11

Glossary

BMP	Best Management Practice
ENV	Freshcare Environmental
Hort Innovation	Horticulture Innovation Australia
M&E	Monitoring and Evaluation
The Project	VG16063 - The EnviroVeg Program 2017 – 2022
The Program	The EnviroVeg Program
The Committee	VG16063 Stakeholder Committee
The Panel	VG16063 Technical Panel
R&D	Research and Development
RD&E	Research Development and Education

Overview

Project Details:

Project code and name	VG16063 - The EnviroVeg program 2017 – 2022
Project description	Environmental Assurance program for vegetable growers
Communications contact	Andrew Shaw, AUSVEG - Environment Coordinator
Project Duration	March 2017 - February 2022
Service providers	AUSVEG, Growcom, Freshcare
Email	andrew.shaw@ausveg.com.au or info@ausveg.com.au
Telephone	03 9882 0277 or 0448 963 548
Industry funding	Vegetable R&D Levy
Priority	Farm Productivity, resource use & management

Project Background:

The EnviroVeg Program 2017-22 is a, levy-funded project jointly managed by AUSVEG, Growcom and Freshcare. This project aligns components from previous EnviroVeg programs along with Hort360 and Freshcare Environmental programs, to deliver a clear pathway to environmental assurance for Australian vegetable growers.

The EnviroVeg Program is the vegetable industry's own environmental program and previous EnviroVeg projects have provided resources to growers to develop and quantify their environmental practices. This new version of EnviroVeg aims to support and improve environmental management on-farm and develop environmental recognition for growers as well as help direct future R&D funding by capturing quality data.

EnviroVeg has three tiers of membership, with the new program structure to include alignment with Freshcare Environmental, as well as grower support and report delivery through Hort360 and updated program resources.

Purpose:

The Communication Plan outlines the strategy and methodologies to be used for project communications, information distribution, feedback and stakeholder management, and how these will be managed during 2017 – 2022.

The Communication Plan builds on previous work undertaken by the Program and should be read in conjunction with the following documents:

- Hort Innovation Research Agreement for The Project
- Monitoring and Evaluation Plan for The Project
- Risk Assessment for The Project

The purpose of the Engagement and Communications Plan is to facilitate effective communications to ensure that the Project:

- Maximises opportunities for the Program to attain Project objectives as outlined in the Research Agreement.
- Collaborates with all stakeholders and;
- Assists in achieving vegetable industry strategic objectives.

Scope:

This document will cover:

- Stakeholder Management – identification of project stakeholders, analysis of their requirements, and planning for their needs.
- Communication Planning - the communication and information needs of project stakeholders. Who needs what information, when, in what format, by what means and how to receive input and feedback and to create buy-in and ownership.
- Information Distribution - how information will be distributed to all stakeholders.

Assumptions

The assumptions on which this the Communication Plan are based are:

- Communication activity has already commenced with the early phases of the project.
- Overall project outcomes and plans have been endorsed by project partners, Hort Innovation and the stakeholder committee.
- This document is available to all project partners and Hort Innovation.

Constraints:

The constraints on which this Communication Plan is based are:

- Lack of time from stakeholders to effectively assist in the communication process.
- Less project resources devoted to communication earlier in the project, more project resources devoted to communication later in the life of the project.
- Current perceptions of the EnviroVeg program are based on previous research projects.

Communication management:

The Project Coordinator will be primarily responsible for implementation of the Engagement and Communications Plan, with assistance from project partners as required. The Project Coordinator has media training and experience in stakeholder communication.

Project Coordinator: Andrew Shaw, AUSVEG - Environment Coordinator

The Communications Plan (page 8) will be updated annually and submitted to Hort Innovation with the appropriate subsequent milestone reports. This will provide progress reporting and updates against planned activities and may include; progress against plans, future activities, new issues arising and changes required.

Stakeholder management

Key stakeholder groups

- Project Partners
- Project Committee and Technical Panel
- Australian vegetable growers
- Program members
- Australian fresh produce supply chain
- R&D projects and service providers
- Industry engagement networks
- Consumers and the public
- Regional communities
- Government bodies
- Hort Innovation
- Media

Stakeholder groups requirements:

Each stakeholder group has different engagement and communication requirements; these are listed as needs in the table below. Needs may include; engagement, understanding, marketing, support, training or consultancy.

Stakeholder group	Needs
Project Partners	Engagement and understanding
Committee and Technical Panel	Engagement and understanding
Australian vegetable growers	Engagement, and consultancy
Program members	Engagement, support, marketing, training and consultancy
Fresh produce supply chain	Awareness, engagement and support
R&D projects and project service providers	Awareness and engagement
Industry engagement networks	Engagement, support and understanding
Consumers and the public	Increased understanding
Regional communities	Support, recognition and understanding
Government bodies	Understanding and engagement
Hort Innovation	Reporting, understanding and engagement
Media	Understanding and engagement

Communications strategy

Aims of the Communication Strategy:

The main aims of the project's Communication Strategy are to ensure that:

- Key stakeholders and the vegetable industry are aware of the project; understand how it currently operates and what benefits it will deliver.
- Broader stakeholders such as the consumers, the general public and government are aware and supportive of the project as a means of developing the environmental performance of growers.

- There is support for the project within appropriate key stakeholder groups, especially growers and project members.
- Australian vegetable growers with the opportunity to be recognised for best practice techniques.
- Timely and accurate information is provided to key stakeholders
- A plan to inform key stakeholders is identified and developed

Stakeholder groups objectives and key messages:

The objectives and key messages for each stakeholder group should be small, simple, jargon-free, positive and focused on benefits. When defining key messages, focus on *What is it that you want to change?*, *What do you want the stakeholders to know?*, *What do you want them to feel - what perception do you want to create?* *What do you want them to do - what action do you want as a result?*

Stakeholder group	Objectives	Key messages
Project Partners	Efficiently complete and manage the project	How the project is tracking with regard to timelines, what actions need to be organised.
Committee and Technical Panel	Provide support and strategic direction for the project	How the project is progressing and what the issues are so that we can address issues and challenges
Australian vegetable growers	To know about, understand and engage with the project	EnviroVeg supports growers to improve on farm performance, achieve environmental assurance and recognition through connection to R&D and appropriate programs. It has been developed by industry and growers.
Program members	To benefit from using and keep updated with the project	EnviroVeg has resources to benefit growers, supports progress through program tiers and incorporates feedback and support mechanisms to keep growers engaged.
Fresh produce supply chain	Support growers that use the project and use it themselves	EnviroVeg is a quality, robust, pre-existing, industry owned mechanism to ensure growers are performing environmentally.
R&D projects and project service providers	Connect related R&D to the project, also engage additional growers with the project	EnviroVeg connects growers to R&D and increases R&D uptake and engagement. It is beneficial to growers and service providers alike.
Industry engagement networks	Able to engage growers with the project and its resources	EnviroVeg benefits growers and is supported by industry. It has a number of resources.
Consumers and the public	Increased understanding of the project and what it means for Australian vegetable growers/program members	Australian vegetables are produced under very high environmental standards. EnviroVeg members especially work hard to be sustainable and environmentally responsible. Associated project branding is recognisable.
Regional communities	To understand and support vegetable growers and their good practices within their community	Australian vegetables are produced under very high environmental standards. EnviroVeg members especially work hard to be sustainable and environmentally responsible. Associated project branding is recognisable.

Government bodies	Provide support for the project and understand its benefits	EnviroVeg is a quality, robust, pre-existing, industry owned mechanism to ensure growers are performing environmentally. It improves R&D uptake and benefits grower's bottom line.
Hort Innovation	Knowledge of project developments, outputs and outcomes	How the project is tracking, what actions need to be organised and what the issues are.
Media	Increased understanding of the project and what it means for Australian vegetable growers/program members	Australian vegetables are produced under very high environmental standards. EnviroVeg members especially work hard to be sustainable and environmentally responsible. Associated project branding is recognisable.

Key communication platforms and resources:

How key stakeholders will utilise different platforms to demonstrate key resources.

Platforms refers to journal/conference papers, Intranet, printed media, meetings, seminars, Internet, national/sector press.

Key resources refers to case studies, posters, discussion groups, expert system/decision support tools, multimedia exemplars, pod-casting, video, newsletters, e-mails, articles, core materials.

Stakeholder group	Key platforms	Key resources
Project Partners	One-on-one and group meetings/teleconferences, project timelines	Email, phone, gnatt chart, discussion groups
Committee and Technical Panel	Group meetings/teleconferences and associated papers	Email, Phone, meeting minutes, agendas and papers, core materials
Australian vegetable growers	Internet, meetings, stakeholder groups, program updates	EnviroVeg website, email, phone, core project materials, articles and newsletters, supporting materials, branding and logo
Program members	Internet, meetings, stakeholder groups, program updates, regular updates during the 'update' period of the project, training,	EnviroVeg website, Hort360, Freshcare Online, email, phone, core project materials, articles and newsletters, supporting materials, feedback forms
Fresh produce supply chain	Internet, meetings, stakeholder groups, program updates, press	EnviroVeg website, email, phone, core project materials, articles and newsletters, supporting materials, interviews, branding
R&D projects and project service providers	Internet, supporting articles, stakeholder groups, program updates, meetings	EnviroVeg website, email, phone, core project materials, articles and newsletters, supporting materials, committee and project networks
Industry engagement networks	Internet, supporting articles, stakeholder groups, program updates, meetings	EnviroVeg website, email, phone, core project materials, articles and newsletters, supporting materials, committee and project networks

Consumers and the public	Internet, Media, marketing, produce, supply chain	Website, interviews, articles, branding and logo, members
Regional communities	Meetings, branding and logo, grower and member engagement, marketing	Website, branding/logo, member communication, produce
Government bodies	Meetings, program updates, branding and logo, stakeholder groups	Phone, email, meetings, network engagement, articles, core project materials.
Hort Innovation	Reports, updates, meetings	Milestone reports, emails, phone, core project materials
Media	Media releases, program updates, internet, project networks	Interviews, articles, updates, marketing, branding, members

Measures of success

What you want to achieve (prioritised and by when) and what success will look like.

‘Action’ refers to what we want to achieve. ‘Time of completion’ refers to the date by which the action will be finished. ‘Measures of success’ refers to how the action has been proven to be successful. For example: Action – Use the outputs of the project to support the sector more widely. Measures of success – project outputs referenced/used in future activities.

Note: This project has a separate monitoring and evaluation plan, the below table refers only to communication outputs and not project outputs.

Stakeholder group	Action	Time of completion	Measures of success
Project Partners, Committee and Technical Panel	A successful, efficient program	Over the life of the project	EnviroVeg is well regarded and used
Australian vegetable growers	Engagement with the project	Over the life of the project	Growers use the project
Program members	Project outputs and resources are useful	Over the life of the project	Project outputs and resources are widely referenced
Fresh produce supply chain	Recognition for the project and its members	At the end of the project	Branding and resources are used and recognised
R&D projects and project service providers	Up-to-date R&D is connected to the project	Mid way through the project	Service providers approach the project with R&D, resources receive positive feedback
Industry engagement networks	Engagement with the project	Over the life of the project	Networks promote the project to growers
Consumers and the public	Recognition for the project and its members	Towards the end of the project	Project branding is visible to consumers
Regional communities	Recognition for the project and its members	Towards the end of the project	Regional communities recognise program members
Government bodies	Support for the project	Towards the end of the project	Government bodies reference the program
Hort Innovation	Milestone and final reports	Every 6 months over the project	Project partners receive payment

Media	Project attention	Mid – late in the project	The program is mentioned in Media
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Communications Plan

Activity Plan

Event/item	Stakeholders	Phase	Responsibility	Date	Duration	Status
Milestones	Hort Innovation	Continuous	Project Coordinator	Every 6 months	Whole project	No track
Update through vegetable communications program	Growers, members, service providers	Continuous	Project Coordinator	As program developments proceed, every 6 months minimum	Whole project	On track
Project partner teleconference	Project partners	Continuous	Project Coordinator	Quarterly	Whole project	On track
Committee meetings	Committee members	Continuous	Project Coordinator	6 monthly, (teleconference and face-to-face)	Whole Project	On track
Technical Panel meeting	Technical Panel	Three meetings in year 1-2, one meeting in year 3	Project Coordinator	June 2017 – February 2017 and one day in 2019 (before 20 Feb 2020)	Whole Project	On track
Program fact sheet distribution	All (apart from Media)	1 during the development of project resources and structures, 1 after development	Project Coordinator	First year, and by February 2018	Whole Project	On track
Program updates and resources given to VegNET	Industry engagement networks	Continuous	Project Coordinator	Ongoing from 2018	Whole Project	On track
Develop and implement Program	All	After initial update/redevelopment phase	Project Coordinator	Development commenced by 20 Feb 2018, Finalised and	2018 – 2022	On track

recognition strategy				commenced implementation by 20 August 2018		
Develop Program sustainability strategy	Partners, committee, growers, members	After initial update/redevelopment phase	Project partners	Draft by 20 August 2019	2019 – 2022	On track
Review alignment of project with M&E plan and adjust	Project partners	Mid way through project	Project Coordinator	By 20 Feb 2018	2018	On track
Engage, vet and select growers for program pilot	Vegetable growers, project partners	End of 2017/2018	Project partners	Commenced by Feb 2018, completed by August 2018	About one year	completed
Engage growers and members to move through the program	Growers, members, project partners	After initial update/redevelopment phase	Project Coordinator and Growcom	Ongoing	Whole project	On track
Training for growers in tier two of the program	Growers, members, project partners	After initial update/redevelopment phase, especially during the roll out of program pilot	Growcom	Ongoing	Whole Project	On track
Regular communication during the project update period	Members, growers, project partners	Initial update/redevelopment phase	Project Coordinator	Ongoing	2017/2018	On track
Publicising the project to the broader community	Media	As needs basis	Project Coordinator	As needs basis	Whole project	On track

Communication mechanisms

Includes; publications, emails, websites, portals, blogs etc.

Form of communication	Stakeholders	Responsibility	Date	Notes
Media releases and engagement with Media	Media	Project Coordinator	As per project recognition strategy (to be developed)	On track
Speak with and/or present to groups of growers at events	Growers, project members	Project Coordinator	As per project recognition strategy (to be developed)	On track
Update on project through Vegetable communication program	Growers, project members	Project Coordinator	6 monthly (minimum)	On track
Emails, phone calls and meetings with supply chain members	Supply chain members	Project Coordinator	After initial update/redevelopment phase	Pending project recognition strategy
Utilise the VegNET program to engage growers	VegNet program, growers	Project Coordinator	After initial update/redevelopment phase	Pending project recognition strategy

Rules for external project communication

1. All project related media is delivered through the Project Coordinator
2. All Communications to project members comes through the Project Coordinator
3. Feedback forms are used at any EnviroVeg events (see appendix)
4. Feedback is collected for any Tier 3 project member and collated
5. External communications featuring project partner logos are run past all project partners

Appendices

Attachment 1: Event questionnaire

Name of event:	
Date:	
Location:	

Please mark the following to rate your choice

1. How would you rate the quality of this EnviroVeg event/training?

- ☐ Poor quality
- ☐ Low quality
- ☐ Good quality
- ☐ Excellent quality

<i>Why?</i>

2. How relevant was the EnviroVeg event/training?

- ☐ Poor quality
- ☐ Low quality
- ☐ Good quality
- ☐ Excellent quality

<i>Why?</i>

3. What did you like best about the training/event?

4. What do you think could have been improved? How?

5. What more would you like to learn about and why? (Please give specific examples of how you would want to use this new information of skills).

Monitoring and Evaluation Plan

VG16063 - The EnviroVeg Program 2017 – 2022

Document Control

Document Number	Date Modified	Revisions
1.0	13 April 2017	First document
1.1	28 June 2017	Feedback incorporated – minor revisions
2.1	31 Jan. 18	Minor adjustments for milestone reporting

Contents

Document Control.....	1
Glossary.....	1
Overview	2
Summary	2
Background	2
Purpose	2
Scope.....	2
Key Evaluation Questions:	3
Program Logic	4
Performance expectations.....	5
Monitoring data collection and analysis arrangements including methods	5
Data monitoring and Reporting Arrangements	6
Evaluation data collection and analysis	Error! Bookmark not defined.
Data storage and Evaluation	8
Appendices.....	9
Appendix 1) Event questionnaire.....	9
Appendix 2) Hort360 data gathering framework	10
Appendix 3) Freshcare Environmental data gathering framework	10

Glossary

EMP	Environmental Management Practice
ENV	Freshcare Environmental
Hort Innovation	Horticulture Innovation Australia
M&E	Monitoring and Evaluation
The Project	VG16063 - The EnviroVeg Program 2017 – 2022
The Program	The EnviroVeg Program
The Committee	VG16063 Stakeholder Committee

The Panel	VG16063 Technical Panel
R&D	Research and Development
RD&E	Research Development and Education

Overview

Summary

Title	VG16063 - The EnviroVeg Program 2017 – 2022
Starting Date	01 March 2017
Duration	5 years
Project Partners	AUSVEG, Growcom, Freshcare
Report Audience	Hort Innovation
Project Lead	Jessica Lye
Project Administrator	Andrew Shaw
Cost	Total Project Amount: \$1,261,262
Funding Source	Vegetable R&D Levy

Background

VG16011 - The EnviroVeg Program 2017 – 2022 (The Project) is a five year vegetable levy funded project that builds on a long running vegetable levy funded program, EnviroVeg (The Program), an environmental management program containing a series of resources and structures over three tiers of grower membership.

The project has three partner organisations; AUSVEG, Growcom and Freshcare which will collaborate to align the complementary components of three programs; EnviroVeg, Hort360 and Freshcare Environmental. The Program will update its resources to increase effectiveness, efficiency and gather quality data.

AUSVEG has managed previous iterations of The Program with oversight from a Stakeholder Committee (The Committee) and will act in a coordination and leadership role for The Project. This includes leading reporting to Hort Innovation. The Committee will remain to give oversight and support the Project and a Technical Panel (The Panel) will ensure that updated program resources are connected to up-to-date Research and Development (R&D).

Purpose

The M&E plan for the EnviroVeg program 2017 – 2022 has been developed by project partners to address the requirements of the project research agreement and meet a number of key criteria including a particular focus on project outcomes through monitoring of project outputs, based on logic with links to Hort Innovation and industry objectives.

Scope

The M&E plan will encompass information gathered at all tiers of the program through defined data gathering systems and at predetermined intervals. The M&E plan has been developed with the intent of tracking:

- Progress of project partners in completing key activities
- Achievement of program objectives:
 1. To support and improve environmental management on farm
 2. To facilitate program recognition of and competitive advantage from EnviroVeg branding

Key Evaluation Questions:

These questions are to be used to guide the M&E plan as it is re-visited over the life of The Project.

Effectiveness	• To what extent have the industry funds achieved their objectives in delivering benefits to growers? • How well has the Project delivered intended outcomes and benefits to growers?
Relevance	• How relevant is the Project to the needs of intended beneficiaries including targeted growers, advisors and industry stakeholders?
Process appropriateness	• How well have intended beneficiaries including targeted growers, advisors and industry stakeholders been engaged in the research process? • To what extent were engagement processes appropriate to the target audience/s of RD&E including targeted growers, advisors and industry stakeholders?
Efficiency	• What is the benefit-cost ratio of the Project?

Program Logic

Broader Goals	- Increased global competitiveness, profitability and productivity of the Australian Vegetable Industry. - Delivery of the Australian vegetable industry strategic investment plan's key priority categories; consumer alignment, market and value chain development, farm productivity, resource use and management	
Long Term, end of program Outcomes	- Greater sustainability of Australian vegetable production regions - Australian vegetable growers can use their track record of good environmental management practices to seek opportunities with consumers and retailers - A clear pathway for levy-funded R&D outputs to be incorporated into EMPs - Direction for future vegetable industry (and horticulture) R&D through the delivery of quality data - Increased numbers of EnviroVeg certified Australian vegetable growers	
Intermediate Outcomes	- Assessment of vegetable industry performance - A cost effective program - Industry led development of accepted and holistic EMPs for vegetable production in Australia - Increased awareness of the EnviroVeg brand among growers, communities, consumers, and retailers	- A clearly defined pathway for achieving environmental certification for vegetable production businesses - A pathway for long-term sustainability of the program - Increased understanding of vegetable industry uptake of sustainable production practices - On-farm implementation of recognised and scientifically robust EMPs
Outputs	- A Three tiered pathway for Environmental Assurance with logical flow and housing of key elements on appropriate platforms - EnviroVeg Factsheet for NVEN use - Program sustainability scoping study and strategy	- Program recognition strategy and implementation of the strategy - Facilitated movement through the program (grower pilots) - Updated program resources (manual and self-assessment) - Six Monthly milestone reports and a final report, inclusive of data gathered through Freshcare and Hort360 and pilot results
Influence Activities	- Collaboration between project partners, stakeholder committee, technical panel and Hort Innovation - Updated self-assessment, manual, EnviroVeg website and other program resources reflecting program changes - Updated Freshcare Online, Hort360 platforms	- Alignment of EnviroVeg certification with Freshcare Environmental - Integration of self-assessment with Hort360 - Development of tier 2 facilitated assessment requirements - Communication with growers, industry and program participants
Foundational Activities	- Research agreement signed - M&E Plan developed - Risk Assessment updated	- Communications plan developed - Stakeholder Committee formed - Technical Panel formed

Performance expectations

Monitoring data collection and analysis arrangements including methods

Program logic	What to monitor	How to monitor (suggested methods)	Who to monitor (target audience)	When
Activities	- Integration between EnviroVeg Hort360 and Freshcare Environmental and related platforms - Coordination of panel and committee meetings - Development of program outputs., eg M&E plan, C&E plan, recognition strategy - Program communications to growers and stakeholders	- Milestone reporting - Committee meeting minutes - Technical Panel meeting minutes - Consistent feedback form for EnviroVeg meetings - Event questionnaire (appendix 1)	- Growers - Advisors	- Ongoing over the life of the project - Six monthly milestone reports
Outputs	- Three tiered environmental assurance pathway, inclusive of resources from EnviroVeg, Freshcare Environmental and Hort360. - Facilitated movement through program tiers 2 and 3 (grower pilot) - Milestone and final reports - Program Factsheet - Program sustainability strategy - Program recognition strategy - updated resources (Manual, self-assessment, website, Hort360, Freshcare Online)	- Quality data delivered to Hort Innovation from Hort360 and Freshcare Environmental - Record keeping and reporting - Records of growers moving through the program	- Growers - Advisors - Supply chain - Project Partners - Levy funded RD&E projects	- Ongoing over the life of the project - Six monthly milestone reports
Intermediate outcomes	- Cost effective program - Assessment of vegetable industry environmental performance	Quality data delivered to Hort Innovation from	- Growers - Advisors - Supply chain	Intermittent; Annually

	• Program data will inform further R&D investments • Increased awareness of the program and the EnviroVeg brand. • Recognised and scientifically robust EMPs implemented on farm • Increased numbers of environmentally certified growers	Hort360 and Freshcare Environmental • Independent, Mid-term review • Record keeping and reporting • Grower member feedback • Technical Panel feedback • EnviroVeg event questionnaire (appendix 1)	• Project partners • Hort Innovation	• Six monthly milestone reports • As required for evaluation
End-of-program outcomes	• Increased sustainability and productivity of Australian vegetable production regions • A clear pathway for R&D to be included in EMPs • A source of quality data that directs future vegetable industry R&D work • Competitive advantages for vegetable growers	• Quality data delivered to Hort Innovation from Hort360 and Freshcare Environmental • Record Keeping and Reporting • Independent Mid-term review • EnviroVeg event questionnaire	• Growers • Consumers • Advisors • Supply chain • Project partners • Hort Innovation	• Six monthly milestone reports • Mid way through the project • As required for evaluation

Data monitoring and Reporting Arrangements

Monitoring method	Delivery Method	Data delivered	Timeframe	Analysis and delivery of information
Milestone reporting and final report	Formal written report	See individual milestone requirements (appendix x)	Six monthly	Feedback from Hort Innovation upon delivery of milestone reports will encompass and modifications required before approval of funding.
Committee meeting minutes	Written summation	Written documentation of	Within milestones, through email after meetings and as	Meeting minutes will be distributed to attendees including Hort Innovation representative for comment after meetings, so that

		meetings including actions	requested by Hort Innovation	minutes can be approved or amended. Minutes will be provided within two weeks of the meeting date.
Technical panel meeting minutes	Written summation	Written documentation of meetings including actions	Within milestones, through email after meetings and as requested by Hort Innovation	Meeting minutes will be distributed to attendees including Hort Innovation representative for comment after meetings, so that minutes can be approved or amended.
Feedback from EnviroVeg meetings	Compiled Report	Compiled information from appendix 1	Within milestones	Information will be compiled and correlated into a report, through feedback collected in EnviroVeg meetings (not including Committee or Technical Panel meetings)
Data from Hort360	Compiled Reports in milestones, Separate reports	Responses to self-assessments, reports with this data collaborated	Within milestones, upon request from Hort Innovation	Data will be delivered to cover a number of areas as per appendix 2. The information will be used to assess the environmental performance of vegetable growers. Hort Innovation will be consulted on the type and format of information that is delivered.
Data from Freshcare Environmental	Compiled Reports in milestones, Separate reports	Feedback on the environmental performance of certified growers	Within milestones, upon request from Hort Innovation	Data will be delivered to cover a number of areas as per appendix 3. The information will be used to assess the environmental performance of vegetable growers. Hort Innovation will be consulted on the type and format of information that is delivered.
Record Keeping and Reporting	Summation reports, Verbal communication,	Documentation of work carried out on the project	Within milestones	Delivery will be facilitated through milestone reports where feedback can evaluate the processes involved in project delivery.
Growers moving through the program	Numerical values	Number of growers at each level of the program	Within milestones	Within milestone reports, as per milestone reporting analysis.
Mid-term review	Independent report	Tracked progress and assessment of the project	Halfway through the project	Independent review to be organised by project partners, in consultation with Hort Innovation. The findings from this report will evaluate the effectiveness and efficiency of the project.

Data storage and Evaluation

Data	Storage location and frequency	Evaluation method
Self-assessment data (individual scores, individual feedback reports, correlated group reports)	Within Hort360, constant Within AUSVEG/S drive, 3 monthly	Embedded within milestones and reporting mechanisms to Hort Innovation
Feedback on the program (meeting minutes, EnviroVeg event questionnaire feedback)	Within AUSVEG/S drive, 3 monthly	
Freshcare Online data	Within Hort360, constant Within AUSVEG/S drive, 3 monthly	
Membership numbers	Within AUSVEG/S drive, 3 monthly	
Milestones	Within AUSVEG/S drive, 6 monthly	

Appendices

Appendix 1) Event questionnaire

Name of event:	
Date:	
Location:	

Please mark the following to rate your choice

1. How would you rate the quality of this EnviroVeg event/training?

- ☐ Poor quality
- ☐ Low quality
- ☐ Good quality
- ☐ Excellent quality

Why?

2. How relevant was the EnviroVeg event/training?

- ☐ Poor quality
- ☐ Low quality
- ☐ Good quality
- ☐ Excellent quality

Why?

3. What did you like best about the training/event?

4. What do you think could have been improved? How?

5. What more would you like to learn about and why? (Please give specific examples of how you would want to use this new information of skills).

Appendix 2) Hort360 data gathering framework

Hort360 can provide outputs to growers including; action plan reports, business progress charts, peer to peer progress charts, various charts and data based on queries relating to modules, locations, crops and statistics relating to area and grower program coverage. Information gathered through Hort360 can be compiled into reports and represented graphically by interrogating the raw data at multiple scales: nationally, state-by-state, catchment region, postcode and commodity grown.

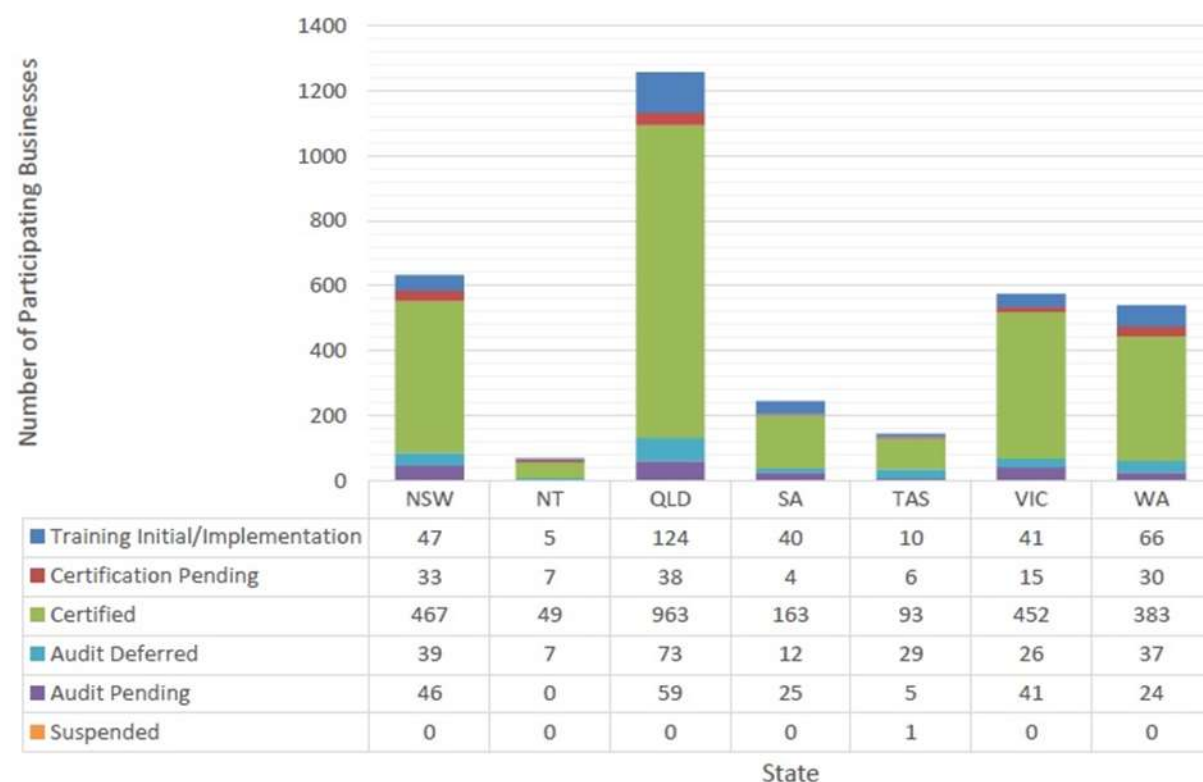
Appendix 3) Freshcare Environmental data gathering framework

Freshcare has capacity to deliver membership statistic such as the below data - drawn from records for the Food Safety & Quality program. This can also be generated in relation to Environmental participants and once established those linked for co-badging purposes to EnviroVeg. Freshcare can also run reports via region and commodity grown.

Freshcare Food Safety & Quality Facts and Figures – June 2017

There are a total of 3460 Freshcare Food Safety & Quality participating businesses as at June 2017, of these 287 also participate in the Environmental Program.

National Distribution of Freshcare Food Safety & Quality Participating Businesses



Status definitions:

- **Training/Implementation stage** – those who completed Freshcare training and are currently implementing the Freshcare program on their property.
- **Certification Pending** – those who completed an audit within the last 12 months but have outstanding Corrective Action Records (CARs).
- **Certified** – those who completed an audit within the last 12 months and is currently certified.
- **Audit Pending** – those who have not completed an audit within the last 12 months and therefore do not qualify for an annual certificate.
- **Audit Deferred** – those who have requested to defer their audit, usually due to crop loss.
- **Suspended** – those who are not compliant with the Freshcare Rules (e.g. outstanding audit payments).

EnviroVeg recognition strategy



Document Number	Date Modified	Revisions
0.1 (draft)	January 2018	First draft
0.2 (draft)	June 2018	Feedback incorporated, prioritised actions and targets
1.0	August 2018	Projects defined, timeline drafted

Executive summary

Objective	Recognition and advantages facilitated for EnviroVeg members					
	A competitive advantage is experienced by certified members	Members are recognised and respected by consumers	A majority of Australian vegetable producers benefit from recognition	Understanding and support from whole supply chain	Consumer recognition	
Goal	Tell the story of sustainable vegetable production					
	Accessible, meaningful environmental branding	Exporting producers access benefits	Resources are useful & targeted at growers	Widespread, easy understanding of program	Improved industry collaboration and perception in regions	Improved industry perception and support from consumers
Outputs	Demonstration farms around growing regions, certificates for members of the program, engagement outputs and region-specific, targeted resources	Research articles on environmental management, sustainable industry goals, program rules, guidelines, assessment, website	Awards for program members, industry brand, Internationally recognised environmental brand	Program communication channels, extension and communication activities including educational program videos	Tradeshow presence, presentations to overseas buyers and export-focused collateral	Produce traceability, partnerships with ‘education champions’, media appearances and connections with buyers
Projects	End user environmental recognition	Underpin ‘clean and green’ Australia image	Build program credibility	Communicate with stakeholders	Provincial production partnerships	Healthy education champions
Stakeholders	Retailers, marketers and processors, production co-ops and large-scale food outlets	Export programs, producers and companies, Australian branded	Extension representatives, landholder managers, production advisors and individual growers	Industry projects, researchers and media	Regional councils and land services, demonstration managers and localised influencers	Champions of sustainability, health and providence, educators, media and influencers
	Domestic supply chain	Export supply chain	Australian Growers	Boarder Industry	Local communities	Consumers

Contents

<i>Executive summary</i>	1
<i>Overview</i>	2
Why	2
<i>Program summary</i>	2
<i>Vision</i>	3
<i>Mission</i>	3
<i>Objective</i>	3
Who	3
<i>Key Stakeholders</i>	3
How	4
<i>Prioritised targets</i>	4
<i>Initiatives</i>	5
What	5
<i>Operations plan</i>	7
When	8
<i>Timeline</i>	8
<i>Operations plan</i>	9

Overview

The EnviroVeg recognition strategy (the strategy) showcases the logic and reasoning for the use of resources from the vegetable levy funded project VG16063: The EnviroVeg Program (2017 – 2022). The strategy will develop and change as the project progresses, accordingly the strategy will be updated and included with future project milestones.

 	This project has been funded by Hort Innovation using the vegetable research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au
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Why

Program summary

EnviroVeg is an industry-led environmental best-practice management program for vegetable production businesses. It provides resources for sustainable growing techniques and represents vegetable businesses as responsible stewards of land, water and biodiversity.

There are three main objectives to EnviroVeg:

- To support and improve environmental management on farm
- To facilitate program recognition of and competitive advantage from EnviroVeg branding
- Track industry progress regarding sustainable farming practices

This strategy, its vision, mission and actions focus on the second objective; recognition.

Vision

Australian vegetable businesses are renowned and rewarded for practicing world-leading sustainable vegetable production methods, which contribute to improved environmental health and domestic food security

Mission

Enabling the best-practice sustainable production of Australian vegetables through recognition of members

Objective

Facilitate recognition and advantages for EnviroVeg members

Long term (3-5 years)	Medium term (1.5-3 years)	Short term (0 -1.5 years)
A competitive advantage is experienced by certified members	All key stakeholders actively engaged	Establishes broad communication channels
Members are recognised and respected by consumers	Collaboration with programs and projects that have aligned objectives	Consolidation of key resources that enable recognition to develop
A majority of Australian vegetable producers benefit from recognition	Recognition reaches a variety of markets	Key stakeholders identified
Understanding and support from whole supply chain	Active engagement with export promotion	
Consumer recognition		

Who

To achieve the strategy objectives, a targeted approach is needed to clarify who this strategy will aim its resources at. Demographics from the six broad key stakeholders are broken into identifiable groups highlighting major contacts therein.

Key Stakeholders

Stakeholder	Influential demographics	Groups
Domestic supply chain	• Retailers • Marketers and processors • Co-ops • Large-scale food outlets	• Coles, Woolworths, Aldi, Costco, etc. • Wholesale markets, farmers markets • Produce marketing and packing co-ops • Subway, McDonalds, etc.
Export supply chain	• Export programs and companies; • Australian branded companies • Exporting producers	• Taste Australia, Austrade, AUSVEG, etc. • Australian made, • Larger, established growers

Australian Growers	• Extension representatives • Landholder managers • Production advisors • Individual growers	• VegNET, grower groups • NRM & CMA, Landcare, local land services • Agronomists • Freshcare ENV3 members,
Boarder Industry	• Industry projects • Researchers • Media	• Hort Innovation, R&D project facilitators • Australian Universities, CRCs, CSIRO • Rural and production-centred media
Local communities	• Regional councils and land services • Demonstration managers • Localised influencers	• Environmentally important or stressed regions • Innovative producers, Demonstration farms • Grower groups, CWA, Rotary clubs, etc.
Consumers	• Providence champions • Sustainability champions • Health and diet champions • Educators • Media • Influencers	• Local markets, sustainability/climate advocates • Farmers markets, • Dieticians, plant-based food advocates, • Schools and teachers, Universities, health classes • Health and providence focused media • 'Foodies', Chefs, High-profile/reach advocates

How

Key stakeholders will be targeted through initiatives that have been prioritised according to their potential;

- to impact objectives,
- use of project resources, and
- influence on desired stakeholders.

Higher graded priorities will be the focus of this project, in order to use project resources to achieve the best possible outcomes for industry and growers; so that EnviroVeg develops to be beneficial, useful and engaging.

Ideas have been sourced from influences identified during project development, which may change with future progress. Revisiting initiatives and reviewing them against Key Performance Indicators (KPIs) is required to gauge success and feasibility.

It is expected that initiatives will be frequently revised over the project.

Prioritised targets

Priority grading						Recommended actions	
Demand (on resources and time)	Potential impact (on strategy objectives)					Priority Grade	Action (within project timeframe)
		Low	Medium	High	Very high	A	Prioritise these initiatives with EnviroVeg leading, aim to complete and show defined outcomes.
	Very High	N	N	D	C	B	EnviroVeg will lead and develop these initiatives after the 'A' priorities. And aim to deliver the majority of outcomes.
	High	N	D	C	B	C	Seek to collaborate with others to achieve these initiatives, if feasible EnviroVeg will lead and deliver some outcomes.

	Medium	D	C	B	A		D	Attempt only if EnviroVeg is working in collaboration with others, do not take the lead on these initiatives.
	Low	C	B	A	A		N	Do not attempt during this project period, the possible benefits outweigh the effort required. Re-prioritise at completion.

Initiatives

Stakeholder engagement initiatives	Priority
<i>Domestic supply chain</i>	
- Identify and meet with major members - Continual engagement through establishing engagement panel - Incorporate program into supply chain resources - Increase recognition of Logo supply chain marketing	A B B A
<i>Export supply chain</i>	
- Identify, target and meet with those actively exporting vegetables - Seek to collaborate with clean, green Australian reputational players - Seek to link EnviroVeg with meeting market access requirements - Create a recognised certification logo for EnviroVeg members to use - Connect with existing/developing export branding	A B C D B
<i>Australian Growers</i>	
- Deliver a quality program that growers use - Develop mechanisms for program feedback and integrate feedback - Visit and speak with growers and their influencers at major events - Work with agronomists, landholders and grower extension groups - Seek to connect with other agricultural commodities and BMP programs - Promote grower champions within the industry - Establish breadth of communication channels	A B A A C B B
<i>Boarder Industry</i>	
- Identify industry programs and projects, meet with key personnel and collaborate on goals - Develop and maintain quality program resources - National extension of sustainability projects through EnviroVeg - Invite media to events and actively interact with media	B B A B
<i>Local communities</i>	
- Engage and with local regions/councils - Demonstration farms - Region specific EnviroVeg materials - Community engagement roadshow	B A A C
<i>Consumers</i>	
- Use 'Foodie' champions to promote program - Engagement videos to explain and define production methods - Connect to national, cross-commodity environmental brand in the future - Collaborate with environmental programs to deliver consumer awareness	C B A A

What

Identified initiatives are segregated into projects with clearly defined goals, methods and outputs. The methods and outputs will be monitored as the strategy progresses, to determine their

feasibility, appropriateness and effectiveness. Monitoring will be incorporated into future project monitoring and evaluation plan submissions.

Operations plan

The overall goal of these projects is to;

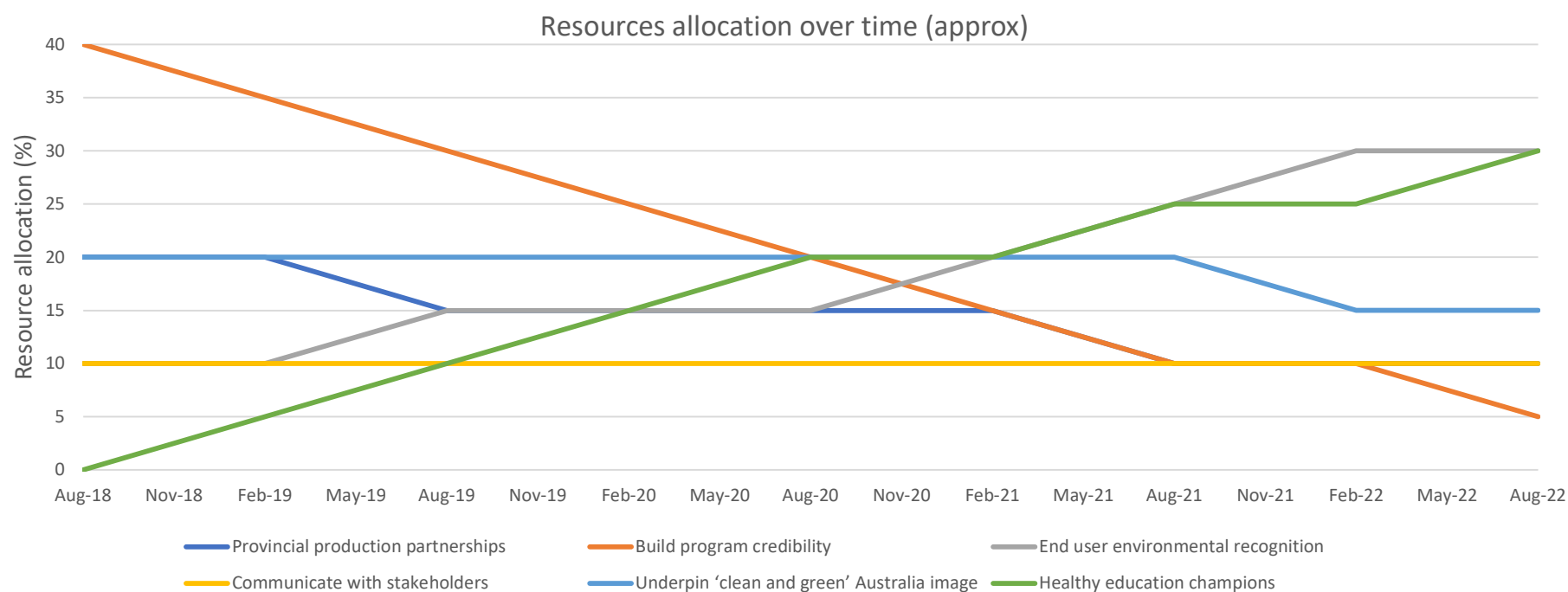
Tell the story of sustainable vegetable production

Project name	Project goal	Methods to achieve goals	Tangible outputs
Provincial production partnerships	Improved industry collaboration and perception in regions	- Identify target communities (those with vegetable production and environmental-issues) - Engage with those involved to understand situation - Develop engagement materials, use different methods flexible on situation and engage at community events - Tour farms with regional community members and media	- Established demonstration farms around growing regions - Certificates for members of the program - Engagement outputs - Region specific, targeted resources developed
Build program credibility	Resources are useful & targeted at growers	- Update resources, defined by how they are used - Engage with growers on resources and useability, include ongoing feedback mechanisms - Promote, and enable continuous improvement through feedback and being open to change - Incorporate research from universities and CRCs	- Research articles and/or literature reviews on EnviroVeg management chapters 'Sustainable farming plan' – vegetable industry goals - Program rules - Program guidelines, assessment, website
End user environmental recognition	Accessible, meaningful environmental branding	- Promote EnviroVeg brand for use within industry - Collaborate across industries, environmental/farm management programs for a consumer-focused brand - Link to 'Brand Australia' and exporting campaigns	- Awards for program members (investigate how this may look) - Domestic environmental brand for industry - Internationally recognised environmental brand
Communicate with stakeholders	Widespread, easy understanding of program	- Desktop review, identify; key contacts, projects, programs and interested parties across all key stakeholders - Meetings, extension and event presentations - Engage/develop supply chain 'committee'; retailers, grower influencers and wholesalers - Organise connection opportunities between members, discuss issues in an online forum	- Educational videos to explain the program to growers/industry and consumers (vox pop style) - Established program communication channels; social media, email updates, blogs, podcasts, videos, webinars, website - Extension/communication activities
Underpin 'clean and green' Australia image	Exporting producers access benefits	- EnviroVeg materials and information communicated to export markets through connections with agri-export programs - Collaborate and seek opportunities to define 'clean and green'	- Tradeshow presence - Presentations to overseas market-focused producers and buyers - Export-focused collateral

Healthy education champions	Improved industry perception and support from consumers	- Identify and understand key sustainability-purchasing motivators through desktop review and meetings - Influential groups identified include; chefs, health advocates, media, farmers markets, providence-focused food networks, 'foodies' and plant-based consumers - Connect with key influencers and collaborate to influence public dialog around the environment and vegetable consumption	- The addition of traceability to the program - Partnerships with 'education champions' - Media appearances - Connections between members and buyers
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When

Timeline



Operations plan

To be revised and further developed given feedback on **Who, What** and **How** as defined above.

Initially, the operations plan involves piloting projects, weighted to focus on *building program credibility*, *provincial production partnerships* and *underpinning Australia's clean and green image*. Over time, more resources are allocated towards *end user environmental recognition* and *healthy education champions*, while *communication with stakeholders* requires consistent effort over time.

Build program credibility

The majority of program resources are being updated at the beginning of the project, which is why this project is weighted heavily towards the start of the timeline. This project will require constant attention, so that; feedback is incorporated, resources are up-to-date, new research is integrated, members find resources engaging and useful and targeted to their production environment.

Provincial production partnerships

This project involves getting to know regions better, and having the program coordinator attending events, meetings and talking with industry members in environmentally-conscious areas. Once the region, its issues and members are understood, focus can shift to delivering outcomes that benefit the community and its grower members.

An initial pilot of this method has begun in the Coffs Harbour region. Time has been spent in the area and now work is progressing on how to achieve beneficial outcomes. The merits of this project will be reassessed after this has progressed. It is worth noting that each region will be different, requiring diverse collaborations with similarly diverse outcomes.

Underpin 'clean and green' Australia

To understand the complexities in export requirements, attendance at major market events and collaboration with existing market-focused programs will be vital to this project. Initially, a pilot has been set up involving attendance at Asia Fruit Logistica, in collaboration with Taste Australia, the Vegetable export program and Freshcare.

Asia Fruit Logistica in September 2018 is a pilot of this project, the outcomes of which will help guide how this project progresses.

Communicate with stakeholders

This project requires constant effort so that members and interested parties are engaged with EnviroVeg, and find value in its communication channels. Some initial effort will be required to set up the communication systems for stakeholders, and thereafter constant use and monitoring of these communication channels to supplement the work of other projects.

Some extension and communication extension to have begun include meetings with groups, event presentations and setting up communication channels (program twitter and Facebook page for members)

Healthy education champions

Finding and working with the right people and areas will define the success of this project. As long-term project, its viability and effectiveness will be underline other efforts to increase awareness in distinct market segments. Overtime, as project stakeholders are identified and communicated with, this project will take up more EnviroVeg resources.

End user environmental recognition

A long-term project that underpins the work involved in other areas, the initiatives defined under this project will ramp-up over time but remain a constant for the recognition work of EnviroVeg.

The goal of this project is difficult, large and complex. So a long-term view will be taken when measuring its success over time.