

# **Horticulture Innovation Australia**

## **Final Report**

### **Review of current irrigation technologies**

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Irrigation Australia Ltd

Project Number: VG14048

## **VG14048**

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## Summary

This project was developed to give Australian vegetable growers an understanding of available and emerging irrigation practices and technologies that could improve profitability and encourage the uptake of more efficient water practices.

The project was conducted in two phases. The first was a desktop review and extension planning phase, and the second, was the extension of the desktop review findings to the vegetable industry using a combination of farmer workshops, media such as YouTube videos, reports, articles, one-on-one interviews and a conference presentation.

The key outputs of this project include the document, *Review of current vegetable irrigation technologies - Desktop Review and Project Extension*. This document contains the results of the desktop review and the workshop evaluations along with other supporting documents. Three YouTube videos, to support the extension activities, were produced. These videos highlight current and progressive technologies and were produced on vegetable farms in Tasmania, Queensland and New South Wales. They are available on YouTube at <https://www.youtube.com/watch?v=y2rzh7vznIA> as well as Irrigation Australia's website at [www.irrigationaustralia.com.au](http://www.irrigationaustralia.com.au).

Another key output was the 19 workshops used to extend the findings of the desktop review. 226 growers and allied industry people attended the workshops which were conducted across Australia. In addition to the workshops, another key extension activity was the 32 one-on-one interviews conducted with key growers, researchers and service providers.

Other outputs included a conference presentation at the International Irrigation Conference held in May 2016 at the Melbourne Convention and Exhibition Centre; an article in the Irrigation Australia Journal; a generic PowerPoint presentation for use at the extension workshops; and several promotional flyers.

The four key outcomes from this project include:

1. The identification of nine 'themes' or adoption gaps that if addressed will assist vegetable growers improve both resource management and their profitability. The themes were:
  - adoption of soil moisture monitoring,
  - variable rate irrigation,
  - drip irrigation,
  - automation,
  - energy efficiency and costs reduction,
  - technical support,
  - nutrient tracking
  - an understanding of the impediments to adoption and
  - a holistic approach to precision technology adoption and management.

The themes identified can now be utilized for more in-depth gap analysis and strategic planning. Initiatives which address these gaps over the next five to ten years will be critical in ensuring the vegetable industry can not only become more profitable and productive but also maintain its social and environmental license to operate.

2. Heightened grower awareness of current and emerging vegetable irrigation technologies as evidenced in the workshop evaluations and interviews and through ongoing exposure to web based videos.
3. The identified “themes” or gaps in industry adoption which, if addressed, will assist vegetable growers to meet the project objectives of technology adoption to improve both resource management and the profitability of growers.
4. The scoping process carried out in this project has not only identified the gaps in adoption but also detailed specific actions which the Australian vegetable industry can undertake. If acted upon these will lead to outcomes including:
  - a. Increased adoption of irrigation technology and best management practice; scheduling and monitoring in particular.
  - b. Increased water and nutrient use efficiency
  - c. Freedom to operate via improved environmental management via benchmarked water and nutrient tracking
  - d. Increased capacity and knowledge levels amongst irrigation designers as well as vegetable growers around irrigation management A holistic model of technology adoption and integration which acknowledges the specific drivers behind the Australian vegetable industry.

The key recommendations for future R&D include the need for a comprehensive social research program to be undertaken to identify the specific barriers to adoption of irrigation technologies and management practices in the Australian vegetable industry. In addition, renewed applied research into drip irrigation applicability, costs and benefits in a wider range of vegetable crops is warranted. In terms of recommendations which have a practical application to industry, consideration should be given to capacity building in the area of irrigation design. Further, the learnings from this project are transferable across other industry sectors not just vegetables. It is felt that HIA should extend the results of this project through the National Vegetable Industry Extension Network and the proposed forum for industry development officers to help ensure these learnings are captured and new irrigation projects benefit from this project’s results.

## **Keywords**

irrigation; irrigation technologies; vegetables; adoption; extension; capacity building; precision irrigation; irrigation design.

## Introduction

Horticulture Innovation Australia (HIA) sought a service provider to *give Vegetable growers an understanding of available and emerging practice and technologies that if adopted could reduce water use/costs.*

This project, *Review of current irrigation technologies*, was developed from a concept devised by the previous HAL FPRUM Design Team (DT) in August 2014. The DT noted that one area of research which had not received much funding was water use efficiency and irrigation. The DT observed that for many members of the vegetable industry, the risks involved in trialing irrigation options often outweigh the potential benefits. It was suggested that the proliferation of low-cost remote sensing technologies may reduce the risks over time and that drainage and variable-rate watering should not be forgotten when discussing water efficiency and irrigation practices. It was agreed that a review was needed of water irrigation technologies and techniques. Reducing water use would quickly lead to financial benefits for growers, encouraging uptake of more efficient water practices.

This project was subsequently developed to give Australian vegetable growers an understanding of available and emerging irrigation practices and technologies that could improve profitability and encourage the uptake of more efficient water practices.

The project was conducted in two phases. The first was a desktop review and extension development planning phase, and the second, was the extension of the desktop review findings to the vegetable growing industry utilising a combination of farmer workshops, media such as YouTube videos, reports, articles, one-on-one interviews and a conference presentation.

The Australian vegetable industry is a composite of numerous crop types, production systems, and human demographics of a very diverse nature, involved in producing some of the most high value and high risk fresh and processed produce in the world. The GVP of vegetable crops (including the non-vegetable levy sector) was AUD\$3.3 billion in 2012 with over 6,000 growers around the country in diverse climates and soils dealing with various environmental and political challenges and regulation.

It is also worth noting that the industry has a high proportion of growers from culturally and linguistically diverse backgrounds ('CALD'), with NSW for example having up to 80% of growers representing a multitude of nationalities, languages and cultures.

The purpose of this document and the Appendix is to provide industry with a summary of the most relevant and practicable irrigation technologies and management practices which vegetable growers across Australia could adopt, and to scope and identify the key areas in which further research and development could be undertaken. The outcome of adopting any of these technologies and practices should be both improved water use efficiency and long term economic sustainability.

# Methodology

Irrigation Australia Limited (IAL) partnered with NSW Department of Primary Industries (NSW DPI) and Greater Sydney Local Land Services (GS LLS) to deliver this project nationally. IAL operated as the lead partner and held responsibility for the delivery of the project to agreed parameters.

The project was conducted in two phases. The first was a desktop review, consultation process and extension development planning phase, and the second was the extension of the desktop review findings to the vegetable growing industry utilising a combination of farmer workshops, media such as YouTube videos, reports, articles, one-on-one interviews and a conference presentation.

NSW DPI took the lead role in reviewing existing technologies and practices utilising a desktop review and consultation process, and GS LLS led the design of extension services. IAL engaged suitably experienced workshop facilitators, who were regionally-based to deliver the extension component across Australia. IAL also used its networks to bring irrigation manufacturers, irrigation retailers and international irrigation bodies into the review process and managed the delivery of extension services across the country. A listing of facilitators and partners may be found in the Acknowledgement section of this report.

As the project team were based across Australia it was imperative that frequent and regular contact be maintained within the team. Consequently, regular teleconferences, email communications and phone discussions were held.

The desktop review focused on current and emerging irrigation technologies as well as key management practices that had potential to maximise productive water use. The principal tool of the review process was interviews with those involved in the vegetable industry including growers, researchers, consultants and manufacturers. The interviewee feedback identified 9 "themes" around technology and management practice which, if adopted, will assist vegetable growers to meet the project objectives of technology adoption to improve both resource management and profitability. These themes were soil moisture monitoring adoption; variable rate irrigation; drip irrigation; automation; energy efficiency and cost reduction; a need for more technical support; nutrient tracking; a more sophisticated understanding of the impediments to adoption of technologies and management practices; and a holistic approach to precision technology adoption and management.

In the second part of the project, the extension services were delivered nationally using local, respected facilitators with a substantive and credible background in extension. Initially 26 workshops were planned; however during the project it became obvious to the team that some jurisdictions would not support the number of planned workshops. In consultation with HIA it was agreed to substitute one-on-one interviews with key growers and stakeholders in those areas which would not support further workshops. Where appropriate, key allied industry representatives and researchers were also interviewed. The one-on-one primary contact with key growers will be multiplied through their networks and also via allied industry networks.

The areas affected were South Australia, New South Wales, Tasmania and Western Australia. The reasons for the reduction of the number of workshops in some jurisdictions included:

- the unprecedented wet weather in Tasmania which devastated the northern vegetable growing regions through flooding and then prolonged wet periods. The local facilitator felt it was inappropriate to engage with the growers through workshops as many were in "survival" mode.
- There was very little interest in an irrigation workshop at Carnarvon as DAFWA had recently run a series of irrigation workshops there and in addition, an extensive 'More Dollars per Drop' program

looked at the irrigation practices of many growers across WA (including Carnarvon) in the last two years. <https://www.agric.wa.gov.au/r4r/more-dollars-drop-water-efficiency>

- In NSW the Riverina and Mildura (Sunraysia) growing areas proved to be problematic to engage industry and in consultation with key people in these regions, some reasons included the distance between growers, the biosecurity issues (Green Cucumber Mosaic Virus) of having farm walks, in particular for Riverina Growers

Consequently only 19 of the proposed 26 workshops were conducted attracting a total of 226 people. The workshop locations, facilitators and other details are tabulated in the Appendix.

In lieu of workshops and as part of the extension process 32 one-on-one interviews (additional to the 50 plus interviews completed as part of the desktop review) were also conducted and the transcripts of these interviews may be found in the Appendix.

Due to the nationwide extent of the workshops and recognising that local issues may vary from location to location, the project team developed generic promotional flyers and generic workshop evaluation sheets. The local facilitator then modified the generic material to suit the local audience. Copies of the generic material may be found in the Appendix. The evaluation sheets also allowed some flexibility for the workshop facilitator to highlight those local issues during the workshop presentation and the subsequent evaluation.

In addition, a generic PowerPoint presentation was developed by the project team to allow each local facilitator the opportunity of including the local issues without losing the main thrust of the project. The generic workshop PowerPoint may be found in the Appendix.

The results of the feedback from the workshops are presented on a State by State basis in graphical format in the Appendix along with an analysis of the evaluations. In addition, an analysis of several issues was prepared to reflect a national perspective, compiled from the State data.

Three YouTube videos were developed to showcase the candid thoughts and efforts of growers who had adopted and/or aspired to adopt best technology and management practices. This in turn will be an ongoing web based tool to enhance the potential for vegetable producers adopting emerging irrigation technologies. One video was produced in each of NSW, Tasmania and Queensland. The video details, including scripts may be found in the Appendix. Each video featured interviews with vegetable growers and highlighted an aspect of vegetable irrigation technologies such as VRI, drones, scheduling, energy audits and pumps.

The project was also promoted through IAL's electronic newsletter, Backwash as well as an article in the Irrigation Australia magazine. A formal presentation was also made at the International Irrigation Conference held in May 2016 in Melbourne, Australia.

The Sydney Field Vegetable Demonstration Farm, located at Richmond NSW, was the venue of two workshops. The farm had installed several soil moisture monitoring devices and utilizes VSD pumping. These were used to highlight emerging irrigation technology discussion during the farm walk component of the workshop.

## Outputs

- The document, *Review of current vegetable irrigation technologies - Desktop Review and Project Extension, (supporting milestone report number 190)*. This document contains the results of the desktop review and the workshop evaluations along with other supporting documents. The document is the Appendix attached to this Milestone Report.
- Three YouTube videos highlighting current and progressive technologies were produced on vegetable farms in Tasmania, Queensland and New South Wales. They are available on YouTube at the following link; <https://www.youtube.com/watch?v=y2rzh7vnzIA> as well as Irrigation Australia's website at [www.irrigationaustralia.com.au](http://www.irrigationaustralia.com.au). The videos were used as part of the extension strategy and the scripts for each video can be found in the Appendix and in summary were:

*Video 1:* Subject: Will Bignell, vegetable grower Bothwell Tasmania.

Will is using VRI and drones. An articulate grower and consultant who promotes a holistic approach to soils, scheduling and drainage. He is comfortable with technology and he provides a realistic assessment of the pros and cons of emerging technologies such as drones.

*Video 2:* Subject: Andrew Fyffe, vegetable grower Bundaberg Queensland.

Andrew is using irrigation scheduling in an innovative and sustainable manner which suits a typical small to medium enterprise. He is proposing to link his scheduling tool with his irrigation system. This example is applicable across Australia.

*Video 3:* Subject: Jeff McSpedden, vegetable grower Bathurst NSW.

Jeff is a widely respected grower and former long term Chair of the National Vegetable Industry Advisory Committee. He has been involved with energy audits, pump upgrades and centre pivot installations. His message emphasises the benefits of getting the basics right before embarking on high cost high tech irrigation investments.

- A proposal to present the (progress) findings of this project was accepted by the organising committee of the International Irrigation Conference held in May 2016 at the Melbourne Convention and Exhibition Centre.  
  
Luke Jewell, NSW Department of Primary Industries, made the presentation on behalf of the project team on Thursday 26 May 2016. The presentation, in pdf format is in the Appendix.
- One journal article was published (Yiasoumi, W, 2016. IAL and NSW DPI Review of vegetable irrigation technologies. Irrigation Australia Journal Autumn 2016, 22) to raise awareness of the project.
- A generic PowerPoint presentation for use at the extension workshops was developed by the team and approved by HIA on 21 April 2016 via an email from Kathryn Young. A pdf of the generic PowerPoint is in the Appendix.
- A two page generic evaluation document was also produced and can be found in the Appendix. This generic feedback document was used by presenters across Australia and modified to suit the local audience by the presenters.

- A number of other documents were developed during the course of this project. These included flyers and information sheets to promote the project to the vegetable growing community.

One flyer was produced and used to promote project awareness and seek participation in the desktop review whilst two flyers were produced to promote project awareness and seek participation in extension workshops. The flyers are reproduced in the Appendix.

- 19 workshops, attended by 226 people, were conducted across Australia. Location, numbers and other details are tabulated in the Appendix.
- In lieu of scheduled workshops, and as part of the extension process, 32 one-on-one interviews were conducted. The transcripts of these interviews may be found in the Appendix.

## Outcomes

This project has identified current vegetable irrigation technologies and management practices through a desktop review and consultation process and brought this information together in the one paper which is attached to this document as an Appendix.

The themes identified can now be utilized by HIA, AUSVEG and the industry overall for more in-depth gap analysis and strategic planning. Initiatives which address these gaps over the next five to ten years will be critical in ensuring the vegetable industry can not only become more profitable and productive but also maintain its social and environmental license to operate.

The results of the feedback from the workshops are presented on a State by State basis in graphical format in the Appendix along with an analysis of the evaluations.

In addition, an analysis of several issues was prepared to reflect a national perspective, compiled from the State data. For example, the question *"Do you think you will change your irrigation management as a result of attending this workshop?"* prompted a strong positive response across Australia. Nearly two thirds said they would change their irrigation management practices as a result of attending the workshop. The presentations and discussions have demonstrated to the growers the benefits of the technologies discussed during the workshop. It is not clear if the motivation for change was based on profit, crop yield/quality or environmental concerns. However it is clear that the workshops have prompted a desire for improvement through irrigation practice change. This is most noticeable in WA.

In summary, the outcomes of this project include:

- The themes identified can now be utilized for more in-depth gap analysis and strategic planning. Initiatives which address these gaps over the next five to ten years will be critical in ensuring the vegetable industry can not only become more profitable and productive but also maintain its social and environmental license to operate.
- Heightened grower awareness of current and emerging vegetable irrigation technologies as evidenced in the workshop evaluations and interviews and through ongoing exposure to web based videos.

- The nine eight “themes” or gaps in industry adoption identified which, if addressed, will assist vegetable growers to meet the project objectives of technology adoption to improve both resource management and the profitability of growers.
- The scoping process carried out in this project has not only identified the gaps in adoption but also detailed specific actions which the Australian vegetable industry can undertake in the Recommendation Section. If acted upon these will lead to outcomes including:
  - increased adoption of irrigation technology and best management practice; scheduling and monitoring in particular.
  - Increased water and nutrient use efficiency
  - Freedom to operate via improved environmental management via benchmarked water and nutrient tracking
  - Increased capacity and knowledge levels amongst irrigation designers as well as vegetable growers around irrigation management
- A holistic model of technology adoption and integration which acknowledges the specific drivers behind the Australian vegetable industry .

## Evaluation and Discussion

The overwhelming majority of interviewees were of the opinion that vegetable growers were generally low adopters of irrigation technology. Many reasons for this low adoption were given ranging from perceptions of the economic value of adoption through to the practicality of adoption. Grower support featured very strongly from all interviewed groups with a consistent theme being the need for ongoing agronomic and technical support to maximise the potential of technology adoption. This appears to be true of all agricultural technology, but seems to be magnified with irrigation technology, and especially so for vegetable production. Consultation feedback suggests the lack of technological management support has led to either “dis-adoption” of irrigation technologies or increased resistance to wider industry uptake. The themes are explored in detail in the Appendix.

There are many drivers unique to the vegetable industry which strongly influence management practices and technology adoption. These drivers (described more fully in Section 3.1.1 of the Appendix) make the adoption of some technologies a challenge, and in the view of many growers, irrelevant to their industry. Briefly these issues included the availability of water, the relatively low cost of water compared with other production costs, the perceived lack of benefit of soil moisture monitoring, poor language and literacy skills (particularly within the large culturally and linguistically diverse background group of growers) as well as security of tenure and the reluctance of growers who lease their land to invest in infrastructure. However, energy costs along with water quality and quantity issues may become surrogate drivers for growers to adopt water saving technologies in the future.

Vegetable growers are also very time poor. They often have limited time to be able to analyse soil moisture monitoring data. Time efficient and flexible tools are the only ones relevant to the vegetable industry, unless significant benefits can be demonstrated which make the time investment worthwhile. Comments such as *'We are busy as growers, making water decisions with a click of the finger'*, and

*'Vegetable growers wake each morning with millions of decisions to make, irrigation is just one of them, and it's a small part of the operation'*, were common in stakeholder interviews.

Irrigation technology adoption leading to greater efficiencies in the vegetable industry is lower than that of other horticultural commodities. The value and practicality of adoption of irrigation technologies by vegetable growers was regularly questioned in interviews conducted with advisors, consultants and growers throughout Australia. 'What has a grower got to gain by being efficient? Better insurance to just apply more' said one grower interviewed. 'It is easier to just overwater' said another grower, 'Our scheduling could be better but why risk sacrificing yield?'

One consultant interviewed recognised that in Tasmania, two types of vegetable producers existed; those in traditional areas with small margins who can't expand, and 'already know everything'. The other is those growers who are bigger, expanding, and are in an investment phase. These vegetable growers are readily adopting technology.

The adoption of irrigation scheduling by way of accurate soil moisture monitoring by irrigators across agriculture in Australia is low, and more recently has declined to only 14% (ABS 2014). Feedback from this review reinforces this trend for the vegetable industry. An otherwise successful agronomist from southern Victoria commented 'we have zero uptake (in soil moisture monitoring) in the vegetable industry'

For irrigation scheduling technology to be successful for the vegetable industry the tools must be simple to install, adopt, interpret, (see section 3.1.3.3) or made simple to irrigators through initial and ongoing support.

'The industry needs something to make real time decisions on a daily basis' said one researcher. 'They need rapid response decision making'.

Manufacturers are responding to these requirements (e.g. simple to interpret Tain Electronics sensor, easy to install 'Drill and Drop' sensors from Sentek). The development of smartphone based Apps are often integral to this. 'All my monitoring gear is smartphone based' said one grower.

Dis-adoption was a concept readily and repeatedly used during the review and the workshops, particularly in relation to soil moisture monitoring and variable rate/precision irrigation (VRI). Opinions regarding dis-adoption were not always negative, 'We used soil probes as a learning tool, not constant use for daily irrigations', commented one irrigator.

If adoption of new technology is to occur, appropriate support needs to be available to ensure adoption is sustainable. Traditionally this was a role carried out by government extension programs. As government continues to withdraw from this area private consultants will be required to fill the gap.

Without appropriate support irrigation scheduling tools and services will fail. The initial failure of the Scheduling Irrigation Diary (see Section 3.2.8 in the Appendix) due to a lack of technical support, followed by its successful adoption once a local agronomist was able to provide appropriate technical support, is a good example.

Research and development in broadacre industries has shown that introducing 'game changing' precision technologies requires a carefully staged and holistic approach. Throughout the project there were numerous examples of how a more holistic approach is needed to achieve adoption. Recognition that changing an irrigation system (particularly to drip) can involve significant modification and/or complete redesign of the production system (see Section 3.1.1 in the Appendix). Some examples include VRI technology which is changing production systems, such as bed layouts and spray rig design; drones and

their use in developing simpler VRI programs, which are currently considered too complex as well as linking VRI to Variable Speed Drive (VSD) pump systems to save energy costs.

The vegetable industry must consider carefully how this integrated, holistic approach can be extended to irrigators. There have been numerous instances where growers have unsuccessfully sought to overcome other farm system flaws such as poorly drained soils or poor irrigation layouts, with precision irrigation. These lessons need to be passed on to the wider industry and carefully considered approaches taken to boost adoption.

The adoption of precision irrigation is also low in the vegetable industry. Technology such as VRI and automated irrigation scheduling would appear to have a high potential for applicability to the vegetable industry, along with irrigation scheduling but currently the opposite is true. Adoption appears to be higher in Tasmania, which is going through a development phase, but is minimal elsewhere.

The loss of nutrients, particularly nitrates from inaccurately scheduled fertigation of shallow rooted crops is a looming issue for the vegetable industry, and could significantly reduce the industry's licence to operate if regulation of fertiliser inputs is introduced (as per the sugar cane industry experience). Tools such as solute samplers and FullStops have been largely dis-adopted because monitoring and installation was considered 'horrendous', and 'the trial and error was too much to ask for most growers'. It was not easy for consultants to use either, particularly for sampling where advisors might travel to a property to collect a sample which may not be available as the equipment did not 'catch' a wetted front.

Capacitance technology would appear more likely to be successful with salinity tracking used as a surrogate for nutrient tracking, as long as the same issues required for soil moisture monitoring are addressed i.e. simple and easy to interpret along with technical support.

Requests for information and participation in the desktop review process were made to Irrigation Australia's counterparts in New Zealand and the United States of America. Unfortunately, only New Zealand responded and participated. However, apart from New Zealand an international perspective was provided to this project via the literature review and interview process. Many companies which have an international presence were approached to provide information through discussion and the survey. Their local representatives also have access to and knowledge of their company's (and competitors) emerging technologies. These companies included NaanDanJain (India), Netafim (Israel), Nelson (USA), Toro (USA), HR Products (Australian importer). In addition, we held discussions with Australian irrigation technology exporters such as Sentek and ICT International as well as leading researchers in the irrigation field.

The project received an extension of time (end of October 2016) to allow one collaborator to complete his workshops. In addition, with the approval of HIA, 32 one-on-one interviews were conducted in lieu of several workshops. Finally, an administrative error by the Tasmanian collaborator resulted in the loss of the evaluations from the one workshop that did proceed.

## Recommendations

- It is strongly recommended that a comprehensive social research program be undertaken to identify the specific barriers to adoption of irrigation technologies and management practices in the Australian vegetable industry.
- The successful adoption of precision irrigation technology requires a holistic re-framing of R, D&E programs to ensure that they take into account the whole farm context into which the innovation needs to be integrated.
- The Australian vegetable industry needs to take a proactive stance on off-farm water and nutrient impacts to ensure it can continue to enjoy a licence to operate and avoid potentially onerous regulation of farm inputs.
- Drip irrigation, if carefully integrated into the crop and farm context, offers the potential for greatly improved control of water and nutrient use efficiency. Renewed applied research into its applicability, costs and benefits in a wider range of vegetable crops is warranted.
- Capacity building in the area of irrigation design is critical to the success of all irrigation technology installation and sustainable use. The Australian irrigation industry needs a suitably resourced centrally recognised Centre of Excellence to drive increased levels of certification of irrigation professionals as well as education of growers.
- The learnings from this project may be transferable across other industry sectors. It is felt that Horticulture Innovation Australia should extend the results of this project through the National Vegetable Industry Extension Network and the proposed forum for industry development officers to help ensure these learnings are captured and new irrigation projects benefit from this project's results.

See section 5 "Recommendations for further work" in the Appendix for more detail.

## Scientific Refereed Publications

None to report.

## Intellectual Property/Commercialisation

No commercial IP generated.

## Acknowledgements

This project was made possible with funding from Horticulture Innovation Australia Limited using the vegetable levy and funds from the Australian Government.

Horticulture Innovation Australia (HIA) engaged Irrigation Australia Limited (IAL) to *give Vegetable growers an understanding of available and emerging practice and technologies that if adopted could reduce water use/costs*. IAL partnered with the NSW Department of Primary Industries (NSW DPI) and the Greater Sydney Local Land Services (LLS) to deliver this project. In addition, collaborators from each State and Territory were engaged to assist with the desktop review and deliver the project's extension component.

The project team thanks everyone who gave their time to participate in the desktop review, the extension workshops and interviews.

In summary, the project team included:

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## **Appendices**

*Review of current vegetable irrigation technologies - VG14048. Desktop Review and Project Extension, Supporting Milestone Report Number 190.*