Evaluation of quality assurance software for the vegetable industry

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Purpose of the Report:
This project report provides information for the vegetable industry. The purpose of this project is to investigate the range of tools available for use by vegetable growers related to traceability or compliance with quality assurance systems. It will compare costs, specifications and features and aims to provide vegetable growers with the ability to review and assess tools for their individual use.

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Project Summary

A practical checklist, funded by Horticulture Innovation Australia Ltd (HIA Ltd) formerly known as Horticulture Australia (HAL) has been developed to assist vegetable growers on the selection and purchase of tools to assist in managing their quality assurance (QA) systems, including traceability.

Managing quality assurance systems is a time consuming and costly exercise for Australian vegetable growers. It is however, necessary for many vegetable growers, particularly those supplying into the fresh, retail and export markets. A common concern raised by industry is the overwhelming amount of paperwork and time that is required to prove compliance to one or more quality assurance (QA) systems essential to meet customer and/or market requirements.

Many vegetable growers are moving away from traditional paper-based QA tools and turning to innovative technology such as Applications or 'apps' and options such as cloud-based and web-based platforms to reduce their QA operating costs and improve reporting processes. However, deciding on the right tool and whether it covers the functionality required by the individual business can be challenging. Research undertaken with vegetable growers reveals that there does not appear to be a one size fits all approach to purchasing and using QA tools. The capital cost of QA tools is dependent on the scale of the business, which is also likely to be impacted by the number of crops grown, and customer and market requirements for food safety and quality for specific crops.

No recommendation is made on a specific QA tool. A necessary starting point when contemplating investment in QA tools is defining the business requirement and to differentiate between the functionality they 'must have', 'nice to have' and 'don't need'. As a result of this project, two tables have been developed to show the QA tools identified and the ease of use; and show the functionality that each tool provides. These tables can be used by vegetable growers to assist them consider the suitability of the QA tool for their individual use.

As the project focus was on the evaluation of quality assurance software for the vegetable industry, tools described as predominantly focussing on farm management were excluded. The HIA Ltd funded *Project VG13106 Evaluation of commercially available farm management software programs for the vegetable industry* will focus on farm management software tools in more detail.

QA systems provide a critical benefit of enabling vegetable growers to obtain market access for their product. If any vegetable grower is unable to sell their crop then the future business options can be challenging. As such the benefit of market access is critical and therefore QA systems and/or tool implementation are an imperative requirement. However, there are a significant range of other benefits that can be achieved by the implementation of QA tools such as improved farm performance (such as yield and cost saving), traceability and improved risk management. These benefits are likely to bring tangible additional revenue, cost control and potential profit for those vegetable growers able to select the tools suited to their needs and leverage from these advantages.

Project Summary - Tables and Practical Checklist

The following Tables and Practical Checklist can be used by vegetable growers to assist them consider the suitability of the QA tool for their individual use:

- Table 1 – QA tools identified and the ease of use;
- Table 2 – QA tools and functionality provided; and
- Checklist – A practical checklist to use when purchasing ‘complex’ QA tools.

Table 1: QA Tools and ease of use

QA Tool Name	Company	Website	Easy	Complex	Paper-Based	Software Package / Customised	App / Cloud or Web Based Platform
ABC Software	ABC Software Ltd	http://www.abcsoftware.co.nz		x		x	
Agtrix	Agtrix Pty Ltd	http://www.agtrix.com		x		x	x
Agworld (farm management app)	AgWorld Pty Ltd	http://www.agworld.com.au/	x				x
Canvas Forms	Canvas Solutions Inc	http://www.gocanvas.com	x				x
CMO Compliance (app)	CMO Compliance	http://www.cmo-compliance.com		x		x	x
CompliantPro	Siemens	http://www.ibs-us.com		x		x	
Dropbox	Dropbox	http://www.dropbox.com	x				x
Farm Minder	AgTech Pty Ltd	http://www.farmminder.com.au	x				x
Food Safety Manager	N2N Global	http://www.n2nglobal.com		x		x	x
FoodLogiQ (Labels/ItemTrace)	FoodLogiQ	http://www.foodlogiq.com	x				x
Formatta	Access Enterprise Forms	http://www.formatta.com	x				x
Freshcare	Freshcare Limited	http://www.freshcare.com.au			x		
FreshTemp	FreshTemp	http://www.freshtemp.com	x				x
FreshTrack Systems	Freshtrack Systems	http://www.freshtrack.com.au		x		x	x
Google Docs	Google	http://www.google.com	x				x
Gorriladox	GFSC Group	http://www.gfscgroup.com	x				x
GrowData (orchard / vineyard / packing)	GrowData Developments	http://www.growdata.com.au		x		x	
HarvestMark	YottaMark	http://www.harvestmark.com	x				x
Hastings Data Loggers	HDL Pty Ltd	http://www.hdl.com.au	x			x	
HACCP Manager Software	South Coast Business Solutions	http://www.haccpmanagersoftware.com		x			x
HACCP Now	HACCP Now	http://www.haccpnow.com		x		x	x
I Auditor	Safety Culture	http://www.safetyculture.com.au					x

Icon Global Link	Integrated Standards Enf. Systems	http://www.iglink.com.au		x		x	x
Icicle	Burton Software	http://www.icicle.burtonsoftware.com		x			x
Intelex (QSQA)	Intelex Technologies Inc	http://www.intelex.com/		x		x	
IronBark (Fresh Produce)	Ironbark Software Pty Ltd	http://www.ironbark.com.au/		x		x	x
ISO Tracker	LennoxHill	http://www.isotracker.com		x			x
Lean & Mean Business Systems	Lean Machine Business Systems Inc	http://www.theleanmachine.com		x		x	
Lettus Software (Supplier focus)	Fresh Computer Systems Pty Ltd	http://www.freshcomp.com.au		x			x
Live Farmer	Marpak Pty Ltd	http://www.livefarmer.com/		x			x
Mango	Mango Ltd	http://www.mangolive.com/		x			x
MasterControl	Mastercontrol Global Ltd	http://www.mastercontrol.com/		x		x	x
MetricStream	Metricstream Inc	http://www.metricstream.com		x		x	x
Muddyboots	Muddy Boots Software Ltd	http://en.muddyboots.com/		x		x	x
PackTrack (also offer PackMaster & Pick2Market which are more complex)	GV Custom Software	http://www.gvcustomsoftware.com.au	x			x	x
PAM Ultracrop	Fairport Farm Software	http://www.fairport.com.au		x		x	x
Paradigm3	Paradigm Software Pty Ltd	http://www.paradigm3.com.au/		x		x	x
Phoenix Cropping	Agdata Australia	http://www.agdata.com.au		x		x	x
Quality Systems Toolbox	Maus	http://www.maus.com.au/product/quality-assurance-software/		x			x
Safe Food 360	Safe Food 360	http://www.safefood360.com/		x		x	x
SafetyChain (for food)	SafetyChain Software Inc	http://www.safetychain.com/		x		x	x
Sharepoint	Microsoft	http://www.office.microsoft.com/	x				x
Smart-Trace Online Monitor	Ceebron Pty Ltd	http://www.smartrace.com	x				x
TraceTracker	TraceTracker Innovation ASA	http://www.tracetracker.com	x				x
TracMap Horticulture		http://www.tracmap.com	x				x
TruQC	TruQC LLC	http://www.truqcapp.com	x				x
Unipoint	Unipoint Software Inc	http://www.unipointsoftware.com		x			x
Verify Traceability (eQTrace)	Verify Traceability	http://www.verifytraceability.com		x		x	x
ZenDoc	ZenDoc	http://www.getzendoc.com/	x				x

Table 2: QA tools and functionality provided

QA Tool	ELEMENT	QA Principles	Calibration	CAPA Management	Chemical & Fertiliser Management	Cleaning & Sanitation Management	Control of Non-conforming Product	Control of Facilities, Plant & Equipment	Control of Storage	Complaints & Feedback Management	Document & Record Management	Good Agricultural Practices (GAP)	Good Manufacturing Practices (GMP)	HACCP (Risk) Management	Identification & Traceability	Pest Prevention & Management	Control of Product (Quality Control)	Recipe Management & Ingredient Control	Regulatory Requirements	Incident Management	Supplier Management (Inputs)	Staff Training	Dispatch & Transport
ABC Software															X								
Agtrix					x		x								X	x	x				x		x
Agworld			x		x						x	x				x							
Canvas Forms											x												
CMO Compliance		X									x			x					x		x	x	
CompliantPro		X	x	x				x		x	x			x					x		x	x	
Dropbox											x												
Farm Minder					x											x			x	x			
Food Safety Manager		X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
FoodLogiQ (Labels)															x								
Formatta											x												
Freshcare		X	x	x	x	x	x	x	x	x	x	x		x	x	x		x		x	x	x	x
FreshTrack Systems			x		x	x	x	x	x			x			x	x	x	x			x		x
Google Docs											x												
Freshtemp																	x						
Gorriladox		X		x		x		x			x										x		
GrowData			x		x										x								
HarvestMark										x					x								
Hastings Data Loggers																	x						
HACCP Manager Software		x	x	x		x	x				x		x	x	x	x	x			x	x	x	
HACCP Now		x		x		x					x			x			x				x	x	
I Auditor		x																					
Icicle		x		x				x			x			x						x	x	x	

Icon Global Link		X		x			x			x	x			x	x		x			x	x	x	
Intelex (QSQA)		X	x	x			x	x	x	x	x						x		x	x	x	x	x
IronBark			x	x	x	x	x	x	x	x	x		x		X		x	x		x	x	x	x
ISO Tracker		x		x			x			x	x						x				x	x	
Lean & Mean Business Systems		x	x	x			x			x	x			x	X		x				x	x	
Lettus Software															X								
Live Farmer			x	x	x		x	x	x	x	x	x			X	x	x			x	x	x	x
Mango		X	x	x			x	x		x	x			x			x		x	x	x	x	
MasterControl		X	x	x			x	x		x	x			x	X		x		x	x	x	x	
MetricStream		x	x	x			x	X		x	x			x	X		x		x	x	x	x	
Muddyboots		x	x	x	x		x	x	x	x	x	x	x		x		x			x	x	x	x
PackTrack / PackMaster & Pick2Market															x		x						
PAM Ultracrop			x		x	x	x	x	x		x	x			x	x	x				x	x	x
Paradigm3		x	x	x			x	x	x	x	x			x	x		x		x	x	x	x	
Phoenix Cropping			x		x	x	x	x	x		x	x			x	x	x				x	x	x
Safe Food 360		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x
SafetyChain (for food)		x	x	x	x	x	x	x	x	x	x			x	x	x	x	x		x	x	x	x
Sharepoint											x												
Smart-Trace Online Monitor															x								
TraceTracker										x					x					x			
TracMap Horticulture					x			x							x								
TruQC											x												
Unipoint		x	x	x			x	x		x	x						x				x		
Verify Traceability (eQTrace)														x	x		x	x					
ZenDoc											x											x	

A Practical Checklist to use when purchasing 'complex' QA Tools

Check	
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 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?	☐

Definition of Terms

For the purposes of this document, the following definitions are used:

Term	Definition[1]
App	App is short for "Application" which is the same thing as a software program. Where an app may refer to a program for any hardware platform, it is most often used to describe programs for mobile devices, such as smartphones and tablets.
Cloud	The term "Cloud" comes from early network programs, in which the image of a cloud was used to indicate a large network. The cloud eventually became associated with the entire internet. Examples of popular cloud-based services include web applications, SaaS, online backup and other types of on-line storage.
Desktop Application	An application that runs stands alone in a desktop or laptop computer. It means any software that can be installed on a single computer and is used to perform specific tasks. Desktop applications generally stored on a single computer and are confined to a physical location.
Devices Supported	Devices that can be used (i.e. Android, iPhone-iPad, Linux, Mac, Mobile Web App, web-based, Windows etc.)
Farm Management	Farm management is the making and implementing of the decisions involved in organizing and operating a farm for maximum production and profit.
Food Safety	The conditions and practices from paddock to plate, and from prevention and surveillance to detection and control that preserve the quality and safety of food to prevent contamination and foodborne illnesses. A scientific discipline describing handling, preparation and storage of food in ways that prevent foodborne illness.
Graphics Card	A Graphic card interfaces a display to a computer so that you can see what you are doing on the computer.
HACCP-based system	HACCP stands for Hazard Analysis Critical Control Point. A HACCP-based system is a system that is consistent with the seven principles of HACCP: 1) conduct a hazard analysis; 2) determine the critical control points (CCPs); 3) establish critical limits; 4) establish monitoring procedures; 5) establish corrective actions; 6) establish verification procedures; 7) establish record-keeping and documentation procedures
Hard Disk Space	The Hard Disk records and stores information. The hard disk is housed inside the hard drive which reads and writes data to the disk. Information recorded to the hard disk remains intact after the computer is turned off. An important distinction between the hard disk and RAM, or memory, is reset when the computer's power is turned off.
I/O Ports	Stands for "Input/Output". The ports on the outside of a computer are commonly referred to as "I/O" ports because they are what connect input and output devices to the computer.
Memory	While memory can refer to any medium of data storage, it usually refers to RAM (Random Access Memory) which is a very high-speed type of memory which makes it ideal for storing active programs and system processes. It is different from Hard Disk Space.

[1] Technology definitions are referenced from TechTerms.com

Organic	Organic is a labelling term that denotes products that have been produced in accordance with organic production standards and certified by a duly constituted certification body or authority.
Operating System	An operating system or "OS" is software that communicates with the hardware and allows other programs to run. It is comprised of computer software or the fundamental files a computer needs to boot up and function. Every desktop computer, tablet and smartphone includes an operating system that provides basic functionality for the device.
Platforms	Refers to a computer's operating system. The term platform is often used when referring to what kind of computer systems a certain software program will run on. For example, a Dell computer running Windows XP would be considered running on a Windows platform. An iMac, runs on a Macintosh platform.
Processor Speed	A processor is a small chip that resides in computers and other electronic devices. Its basic job is to receive input and provide the appropriate output. Most computers show the computer processor speed as the computer boots. Processor speed is how fast the processor operates.
Quality Assurance (QA)	The maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production[2]. Quality Assurance is being able to assure customers that you can produce a quality product to meet their specifications the same way every time. It is the customer who defines quality.
Quality Assurance (QA) System	A Quality Assurance (QA) system is the organisational structure, responsibilities, processes, procedures and resources for implementing quality management. QA systems for fresh produce (incorporating the vegetable industry) are designed to enable producers to demonstrate that their on-farm practices allow them to produce safe food products that meet Australian food safety standards under the Food Standards Australia New Zealand Code (FSANZ).
Quality Assurance (QA) Tools	Tools that can be used to develop, test, analyse, or maintain a QA system or its documentation. They can include paper-based manuals, software programs and/or apps, cloud-based or web-based programs.
Risk Management	The culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects. The systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk are risk management processes.
SaaS	Stands for "Software as a Service". SaaS is software that is deployed over the internet rather than installed on a computer. It is often used for enterprise applications that are distributed to multiple users. SaaS applications typically run within a web browser, which means users only need a compatible browser in order to access the software. It is considered part of cloud computing since the software is hosted on the internet.
Software	General term that describes computer programs.
Vegetable Growers	Within the scope of this report, vegetable growers include packing.

[2] http://www.oxforddictionaries.com/definition/english/quality-assurance

1 Introduction

1.1 Background

Managing quality assurance (QA) systems is a time consuming and costly exercise for Australian vegetable growers. It is however, necessary for many vegetable growers, particularly those supplying into the fresh, retail and export markets. Several industry or retailer specified standards are in operation to address food safety and quality across Australia, providing growers with a range of options to select the QA system that best suits their business requirements. A key element of these systems and an essential issue for all producers is traceability.

Vegetable production, like other primary production industries, is becoming an information-intensive enterprise. A common concern raised by industry is the overwhelming amount of paperwork and time that is required to prove compliance to one or more QA systems essential to meet customer and/or market requirements. Many vegetable growers are moving away from traditional paper-based QA tools and turning to innovative technology such as software, Applications or 'apps' and options such as cloud-based and web-based platforms to reduce their QA operating costs and improve reporting processes.

The use of QA tools in primary production is continuously growing. However the range and complexity of the tools available on the market can make it a difficult space to navigate and there does not appear to be a universal industry solution to purchasing and using QA tools to meet business needs. Furthermore, there are a number of vegetable growers that have not been able to find a shelf-ready tool that meets all their requirements. In these cases, vegetable growers have either developed their own tool, or worked with a software developer to tailor programs to their individual operation. This can be an expensive task, but is often the only way to ensure software meets their needs.

This project provides information for the vegetable industry. The purpose of this project is to identify a range of QA tools that can assist vegetable growers (including packers) in deciding on the selection and purchase of tools to assist in managing their quality assurance (QA) systems, including traceability. As the project focus was on the evaluation of quality assurance software for the vegetable industry, tools described as predominantly focussing on farm management were excluded. The HIA Ltd funded *Project VG13106 Evaluation of commercially available farm management software programs for the vegetable industry* will focus on farm management software tools in more detail. However, a number of farm management tools identified during the interview process have been reflected in this report.

QA tools, Investigation of the myriad of tools available, contextualisation of the data gathered from the benchmarking and desktop study exercise, and details captured from grower interviews for a cost: benefit analysis, provides key information to develop beneficial outputs for vegetable growers. Local contextualisation of information makes the use of Information Technology (IT) valuable to vegetable growers. Regardless of the technology, vegetable growers need good access, training and mentorship to make the best use of on-line services[3].

The outcome of this project is a vegetable industry that is aware of the tools available, and that has the ability and confidence to make informed decisions on the suitability of each tool for their business.

[3] http://www.regional.org.au/au/asa/2004/symposia/4/3/238_easdownwj.htm

2 Methodology

This project was undertaken by TQA Australia (TQA) on behalf of Horticulture Innovation Australia Limited (HIA Ltd) formally known as Horticulture Australia Limited (HAL). The purpose of this project is to investigate the range of tools available for use by vegetable growers related to traceability or compliance with quality assurance systems with a view to improving the ability of vegetable growers to review and assess these tools for their individual use.

2.1 Desktop study

The first stage was to identify and benchmark requirements of the respective QA systems identified as being significant to the sector. Using our extensive knowledge of QA in the vegetable industry and consideration of data from project reports listed in the tender brief, a range of systems most commonly implemented in the Australian vegetable industry was identified. Using the benchmarking activities of QA systems previously completed by TQA as a component of the Project *AH12009 Partnering Fresh Produce with Retail – Quality Assurance Harmonisation*, documentation and reporting requirements of each system was categorised to ascertain the commonality and differences between the identified systems.

The second stage involved a desktop review of 'tools' available to assist with traceability and maintenance of QA systems. This activity included ascertaining the range of tools currently 'on the market' and promoted as being available to assist vegetable growers in the implementation of QA systems. Such 'tools' included software packages, apps for mobile devices and manual / paper-based systems. The review comprised scanning the internet, industry journals, industry feedback (word of mouth) and accessing industry based networks. The focus was primarily on tools used in managing QA systems and excluded those tools described as predominantly focussing on farm management. The HIA Ltd Project *VG13106 Evaluation of commercially available farm management software programs for the vegetable industry* will focus on farm management software tools in more detail. Once the range of relevant QA 'tools' were singled out, the features of each tool were reviewed for mapping purposes.

2.2 Vegetable grower interviews

Interviews with vegetable levy payers were conducted in stage three. Voluntary engagement in the interview stage was difficult to achieve despite using a variety of media and industry activities to highlight the project objectives. As a result, TQA networks were heavily relied upon for the interview stage. Two levels of interviews were conducted, with in-depth face-to-face interviews with 10 vegetable growers and/or packers and shorter phone interviews with 21 vegetable growers and/or packers. The purpose of the interviews was to understand the tools currently being used, including 'off the shelf' models and tailor-made solutions that vegetable growers have developed themselves. TQA investigated the motivations behind the use of the tools, the reasons particular tools were being used, direct and indirect cost savings, and the limitations of tools currently on the market.

2.3 Cost: benefit analysis

Stage four focussed on a cost/benefit analysis of tools to determine the value of each tool for vegetable growers. Information on cost savings, both direct and indirect, was sourced during vegetable grower interviews. This stage four process allowed for specific quantitative data to be captured in addition to qualitative data, which provided the opportunity for each interview to explore 'why' the business chose the tools, which elements they used, and the potential application(s) across their business management activities.

2.4 Mapping the QA tools and developing a checklist

The final stage involved 'mapping' the QA tools available and developing a simple checklist which vegetable growers can use to identify the most appropriate tool to purchase for their business application. Using the information gathered from the benchmarking process and interviews with vegetable growers, a 'map' of the elements and capabilities of the QA tools was compiled to indicate the main categories that each QA tool offered for vegetable growers to consider relevant to their business needs.

3 Desktop study findings

3.1 Quality Assurance systems most commonly implemented in the Australian vegetable industry

Several industry or retailer specified standards are in operation to address food safety across Australia, providing vegetable growers with a range of options to select the QA system that best suits their business requirements. Economic survey data produced by the Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES) who survey Australian vegetable growers on behalf of HIA Ltd finds that an estimated 65 per cent of Australian vegetable farms had a food safety program in place in 2010–2011[4].

Using the benchmarking activities of QA systems previously completed by TQA as a component of the Project *AH12009 Partnering Fresh Produce with Retail – Quality Assurance Harmonisation*, documentation and reporting requirements of each system was categorised to ascertain the commonality and differences between the identified systems. The most commonly accepted third party certified systems in Australia relevant to vegetable growers (including packers) are BRC, Codex HACCP, Coles Supplier Requirements, Freshcare, GlobalG.A.P., the SQF Code, and Woolworths Quality Assured (WQA). The table below provides a description of common acceptable quality assurance systems:

Table 3.1 Description of common acceptable quality assurance systems

System	**BRC Global Standard for Food Safety (Issue 6, July 2011)**
Description	The British Retail Consortium (BRC) developed and introduced the BRC Technical Standard as a tool for evaluating the manufacturers of various retailers' own brand food products. BRC is designed for packers and processors only. As the BRC Standard is not applicable on-farm, there are a limited number of businesses certified to it in Australia.
Critical areas covered in system	HACCP Quality Management (including internal audit, corrective action) Site Standards Product Control (including traceability, allergen management) Process Control (including layout, product flow and segregation, housekeeping, control of operations) Personnel (including training and hygiene)

[4] Source: ABARES Australian vegetable growing farms; An economic survey 2010-11 and 2011-12, page 38

System	Codex HACCP (CAC/RCP 1-1969) – last amended in 2003
Description	HACCP (Hazard Analysis Critical Control Point) is a systematic, preventive approach to food safety. HACCP is commonly used in food production as a tool to identify and control potential risks to product safety, quality and regulatory compliance. HACCP has seven principles that guide the development of any HACCP Plan. HACCP is also supported by a range of pre-requisite programs. A number of Australian certification bodies offer HACCP certification, underpinned by the Codex guideline document. While the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) provides a mechanism for accreditation of HACCP food safety systems, not all HACCP certification systems are currently accredited with JAS-ANZ. Therefore the particular elements of HACCP certification and in particular the detail of support or pre-requisite programs may vary between certification bodies.
Critical areas covered in system	HACCP Primary production Establishment (including design and facilities, maintenance and sanitation, Personal hygiene) Control of operation Transportation Product information and consumer awareness Training

System	Coles Supplier Requirements – Food (CSR-FV3May 2011)
Description	Coles (Australia) developed the "Coles Supplier Requirements - Food", as they believed that external food safety standards were too generic to address some areas specific to Coles. The Coles Supplier Requirements are audited at the same time as the external standard that the supplier is certified to. "Coles Supplier Requirements – Food" is developed for suppliers of Coles Brands Suppliers. A Coles Brands Supplier is defined as "any supplier who provides a product which is manufactured and packed with a brand owned by Coles, including but not limited to, SmartBuy, Coles Finest, Coles Butcher, and Coles Market Place. This also includes supply of bulk products which are sold loose or unbranded in a display case or open carton, bulk produce which is packed into Returnable Plastic Crates; and bulk product which is packaged at store…"
Critical areas covered in system	Use of subcontractors and indirect suppliers Product specifications and finished product assessment Retention samples and shelf-life validation HACCP training Metal detectors Soil additives

System	Freshcare Food Safety and Quality – 3rd Edition (July 2009)
Description	Freshcare Code of Practice - Food Safety and Quality has been designed to cover all activities occurring on farm, including growing, storage, packing and dispatch of produce. It cannot be used for standalone pack-houses or processors. Freshcare has a number of documents – the Code of Practice, Compliance Criteria, Forms and Resource Manual. While the Code of Practice is the document that defines the elements that growers must comply with, some additional guidance is provided in the Compliance Criteria document.
Critical areas covered in system	Management Commitment Quality Management (including internal audit, corrective action) Site Standards Product Control (including traceability, allergen management) Process Control (including housekeeping, control of operations) Personnel (including training and hygiene)

System	GlobalG.A.P. 18 Integrated Farm Assurance Version 4.0 (March 2011)
Description	GlobalG.A.P is an integrated farm assurance system that defines Good Agricultural Practices (GAP) as agreed by European Retailers and associated organisations. The GlobalG.A.P standard is primarily focussed on primary production activities. Standalone pack-houses or processors cannot be certified to this standard. GlobalG.A.P has five standards – for horticultural producers, the applicable standard is Integrated Farm Assurance. Within this standard there are a series of 'modules' covering many farm activities including livestock, aquaculture, and cropping. For vegetable production the module "Fruit and Vegetables" would apply.
Critical areas covered in system	Site history and management Quality Management (including internal audit, corrective action) Subcontractors Product Control (including traceability) Process Control (including housekeeping, control of operations) Personnel (including training and hygiene)

System	SQF Code – Edition 7.2 (July 2014)
Description	First developed in Australia in 1994, the Safe Quality Food (SQF) program has been owned and managed by the Food Marketing Institute (FMI) since 2003. The SQF Code incorporates HACCP with a number of additional requirements. The SQF programme focuses on quality and safety. Vegetable growers are categorised under Food Safety Category 3: Growing and Production of Fresh Produce and apply Module 2: System elements and Module 7: GAP for farming of plant products (fruit and vegetables) to their operation. To supply major retailers, vegetable growers are required to be certified to Level 3 Comprehensive Food Safety and Quality Management System – which incorporates all Level 1 and Level 2 system elements and indicates that a food quality risk analysis of the product and its associated process has been completed, that the actions taken to prevent the incidence of poor quality have been implemented. System elements in Module 2 at level 3 are required.

Critical areas covered in system	HACCP Quality Management (including internal audit, corrective action) Product Control (including traceability and allergens) Process Control (including housekeeping, control of operations) Personnel (including training and hygiene)

System	**WQA: Primary Production – Produce – Version 8 (March 2013)**
Description	Originally launched as Woolworths Vendor Quality Management System (WQVMS), WQA Primary Production – Produce is mandatory to all Woolworths' direct suppliers (and indirect suppliers packing Woolworths branded produce). Pre packed product includes bulk products. WQA is a HACCP based system focussing on product safety and legality. The WQA Standard applies to businesses which have been nominated by the respective Woolworths Business Teams as part of their contractual requirements for supply. Participation in the program is by Woolworths' invitation only. WQA certification is site and product specific as nominated by Woolworths.
Critical areas covered in system	HACCP Quality Management (including internal audit, corrective action) Product Control (including traceability and allergens) Process Control (including housekeeping, control of operations) Personnel (including training and hygiene)

Other standards such as the Spotless Food Safety Standard for Suppliers (which covers receiving, storage, handling, production and distribution of food related products) and the McDonalds Good Agricultural Practices Food Safety Standards are examples of Approved Supplier programs for vegetable growers supplying products in the Quick Service Restaurant (QSR) space. The McDonalds GAP Food Safety Standard is included in the benchmarking process as an example for those vegetable growers supplying the Quick Serve Restaurant (QSR) supply chain. It is noted that this Standard is not the only supplier program present in this sector.

System	**McDonalds Good Agricultural Practices (GAP) Food Safety Standards - Version 8.3 (March 2011)**
Description	The intent of McDonald's Global Framework for GAP – Food Safety Standards is to establish standardized requirements for every grower involved in the fresh produce supply to McDonald's Corporation. McDonald's does not maintain direct relationships with growers, but it's their expectation that McDonald's suppliers will adhere assure all their growers comply with the standards and specific expectations contained in their Standard and detailed checklist. There are nine specific topics and assigned specific quality system requirements.
Critical areas covered in system	Management Commitment Food Safety Program (Growing, Harvesting and Transportation) Risk Assessment Land Use Assessment Irrigation and Water Management Fertiliser, Soil Additives and Pesticide Use Personnel Hygiene, Field Sanitation and Working Conditions (Social Accountability) Field Foreign Material Control Traceability

Examples of systems that are less common but relevant to vegetable growers include the International Standard ISO 22000, Australian Certified Organic Standard (ACOS) and the National Association for Sustainable Agriculture, Australia Limited (NASAA) Organic Standard. ISO 22000 specifies requirements for a food safety management system and is used by a small number of integrated businesses within the supply chain including grower/processors. ACOS and the NASAA Organic Standard are systems available to vegetable growers who are converting to organic production or who are certified as having an organic production system. The Australian Organic Market Report (2012) reveals that average organic farms in Australia are growing in size, but are still smaller than conventional farms; further that supply chains for organic produce are likely to involve direct sales to the public, with leading organic consumers buying from organic and wholefood stores and other specialty format such as farmers markets and online / direct resulting in growers having a lower participation in food safety schemes[5]. The table below provides a description of quality assurance systems less common but relevant to vegetable growers:

Table 3.2 Description of Quality Assurance systems less common but relevant to vegetable growers

System	**ISO 22000 - First Edition (2005-09-01)**
Description	ISO 22000 specifies the requirements for a food safety management system that combines the following generally recognised key elements to ensure food safety along the food chain (including primary production), up to the point of final consumption: interactive communication, system management, prerequisite programs (PRPs) and HACCP principles. During hazard analysis, the organization determines the strategy to be used to ensure hazard control by combining the PRP(s), operational PRP(s) and the HACCP plan. ISO 22000 is intended to address aspects of food safety concerns only.
Critical areas covered in system	Food safety management system Management responsibility Resource management Planning and realisation of safe products Validation, verification and improvement

System	**Australian Certified Organic Standard (2013)**
Description	The Australian Certified Organic Standard (ACOS) 2013 outlines the requirements for marketing produce as certified organic in Australia. The ACOS covers the basic requirements outlined in the Standards Australia *AS 6000-2009 Organic and biodynamic products*, as well as the Department of Agriculture, Forestry and Fisheries (DAFF) National Standard for Organic and Bio-dynamic Produce, while being a linking document to key international organic standards. ACOS outlines the minimum requirements for certification of organic or biodynamic produce under the ACOS and use of the Australian Organic Bud logo.
Critical areas covered in system	Certification requirements General production standard – Primary production Miscellaneous production systems (includes greenhouse production) Marketing and handling (incudes transport and farmers markets)

[5] Monk, A. 2013: Organic Foods: Food safety incl. Market Overview 2012, Biological Farmers Australia (BFA) Ltd, page 8, page 77

System	NASAA – December 2004 (Amended 06/02/2012)
Description	In December 2004, the National Association for Sustainable Agriculture, Australia Limited (NASAA) first introduced an integrated Organic Standard, incorporating the previously separate primary production and processing Standards. Since then, the Standard has undergone several revisions in response to, and in recognition of, continuing research and development in the Australian and wider international organic industry. The Standard comprises 4 sections: 1. General Principles - behind the architecture of organic agriculture and include a range of 2. Recommendations –should be put into place where appropriate. 3. Standards – are the minimum requirements which must be met. 4. Derogations – represent possible exceptions to a standard and the specific conditions under which they may be authorised. Note: Sections 1 and 2 are not subject to inspection and compliance.
Critical areas covered in system	Precautions and general requirements General standards for crop production Additional requirements for individual categories (including vegetables) NASAA Standards for biodynamic agriculture

3.2 Benchmarking requirements of QA Systems

The seven systems identified above have been selected for benchmarking as they are commonly applicable to vegetables growers. The McDonalds GAP Food Safety Standard and the NASAA Standard have also been included to relate the QSR and organic sectors in the benchmarking scope.

One of the primary aims of the benchmarking process was to identify common requirements across the nine QA systems to act as a basis for comparison across QA tools (including paper and software based tools). Upon review of the nine selected QA systems, over 430 individual requirements were identified (i.e. chemicals and fertilisers; ground, water and crop management; HACCP; quality requirements and Good Agricultural Practices and Good Manufacturing Practices) which were then grouped into common elements. Whilst all elements rate highly and/or are covered in all the QA systems described in this report, no judgement has been made as to the adequacy or depth to which a particular QA system addressed the individual elements. The table below reflects the nine systems and common elements by system.

Table 3.3 Benchmarked systems and common elements by systems

Compiled Elements by System	BRC	Codex HACCP	Coles	Freshcare	GlobalG.A.P	McDonalds	NAASA	SQF	WQA
Allergens	✓	✓	✗	✓	✗	✗	✗	✓	✓
Approved suppliers	✓	✓	✓	✓	✓	✗	✓	✓	✓
Approved suppliers - produce	✗	✓	✓	✓	✗	✓	✗	✗	✓
Business continuity / Food defence	✓	✗	✗	✗	✓	✓	✗	✓	✓
Calibration	✓	✓	✓	✓	✓	✓	✗	✓	✓
Chemicals / Fertilisers	✗	✓	✗	✓	✓	✓	✓	✓	✓
Cleaning	✓	✓	✗	✓	✓	✓	✓	✓	✓
Complaint handling	✓	✓	✗	✓	✓	✗	✓	✓	✓
Control of inputs	✓	✓	✗	✓	✓	✗	✓	✓	✓
Control of non-conforming product	✓	✓	✗	✗	✗	✗	✗	✓	✓
Control of processing / handling	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control of storage	✓	✓	✗	✓	✓	✗	✗	✓	✓
Corrective action	✓	✓	✗	✓	✓	✓	✓	✓	✓
Dispatch and transport	✓	✓	✗	✓	✗	✗	✓	✓	✓
Documents and records	✓	✓	✓	✓	✓	✓	✓	✓	✓
Environment	✗	✗	✗	✗	✓	✗	✓	✗	✗
Equipment	✓	✓	✗	✓	✓	✓	✗	✓	✓
External audit	✓	✓	✓	✓	✓	✓	✗	✓	✓
External site standards	✓	✓	✗	✓	✗	✗	✗	✓	✓
Food fraud	✗	✗	✗	✗	✗	✗	✗	✗	✓
Foreign body detection	✓	✓	✗	✗	✗	✓	✗	✓	✓
Glass, brittle plastic control	✓	✓	✗	✓	✓	✓	✗	✓	✓
Ground, water and crop management	✗	✗	✗	✓	✓	✓	✓	✓	✓
HACCP	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health and safety	✗	✗	✗	✗	✓	✓	✓	✓	✓
Internal audit	✓	✓	✗	✓	✓	✓	✗	✓	✓
Maintenance	✓	✓	✗	✓	✗	✗	✗	✓	✓
Management Review	✓	✓	✗	✓	✓	✗	✗	✓	✓

Medical screening	✓	✓	✗	✓	✗	✓	✗	✓	✓
Metal control	✓	✓	✗	✓	✗	✓	✗	✓	✓
Organisational structure and responsibilities	✓	✓	✗	✓	✗	✓	✗	✓	✓
Other meetings	✓	✓	✗	✗	✓	✗	✗	✗	✗
Outsourced processing	✓	✓	✓	✗	✗	✗	✗	✓	✓
Personnel hygiene	✓	✓	✗	✓	✓	✓	✗	✓	✓
Pest control	✓	✓	✗	✓	✓	✓	✓	✓	✓
Premises construction / layout	✓	✓	✗	✓	✓	✓	✗	✓	✓
Product claims	✓	✓	✗	✗	✗	✓	✓	✓	✓
Product design / development	✓	✓	✓	✗	✗	✓	✗	✓	✓
Product Id, Trace and Recall	✓	✓	✗	✓	✓	✓	✓	✓	✓
Product release	✓	✗	✗	✗	✗	✗	✗	✓	✓
Protective clothing	✓	✓	✓	✗	✓	✓	✗	✓	✓
QA training	✓	✓	✓	✓	✗	✓	✗	✓	✓
Quality objectives	✓	✓	✗	✗	✗	✗	✗	✓	✓
Quality Policy	✓	✓	✗	✓	✗	✓	✗	✓	✓
Quantity checking	✓	✓	✗	✗	✗	✗	✗	✗	✗
Resourcing	✓	✗	✗	✗	✗	✓	✗	✓	✓
Site flow / plan	✓	✓	✗	✓	✓	✗	✓	✓	✓
Site security	✓	✓	✗	✗	✗	✗	✗	✗	✓
Specifications	✓	✗	✓	✓	✗	✗	✗	✓	✓
Staff facilities / amenities	✓	✓	✗	✓	✓	✓	✓	✓	✓
Training	✓	✓	✗	✓	✓	✓	✗	✓	✓
Utilities	✓	✓	✗	✓	✓	✓	✗	✓	✓
Visitors	✓	✓	✗	✗	✓	✗	✗	✓	✓
Waste / waste disposal	✓	✓	✗	✓	✓	✗	✓	✓	✓
Wood	✓	✓	✗	✗	✗	✓	✗	✓	✓

The final step in the benchmarking exercise was to categorise the identified common elements to provide a summary to be used for the QA tool mapping exercise. In almost all cases the nine QA systems require either a policy or procedure to address the common elements. Examples of policies and/or procedures required include Approved Suppliers, Business Continuity / Food Defence, Calibration, Chemical and Fertiliser Management, Cleaning and Sanitation Management, Complaint Handling, Documents and Records, Foreign Object Management, Internal Audits, Identification Traceability, Recall, Personal Hygiene and Training. Categorisation of the elements is reflected in the table below.

Table 3.4 Common Elements and Category for Mapping

Common Element	Category (for mapping purposes)
Business continuity / Food defence External audit Food fraud Health and safety Internal audit Management Review Organisational structure and responsibilities Quality objectives Quality Policy Resourcing Site security Visitors	Quality Assurance Principles
Calibration	Calibration (includes Control of Monitoring and Measuring Equipment)
Corrective action	Corrective Action and Preventive Action (CAPA) Management
Chemicals / Fertilisers	Chemical and Fertiliser Management
Cleaning Waste / waste disposal	Cleaning and Sanitation Management
Control of non-conforming product	Control of Non-Conforming Product
Equipment Maintenance Premises construction / layout Staff facilities / amenities Utilities	Control of Facilities, Plant and Equipment
Control of storage	Control of Storage
Complaint Handling	Complaints and Feedback Management
Documents and Records	Document and Record Management
Environment External site standards Ground, water and crop management	Good Agricultural Practices (GAP)
Allergens Foreign body detection Glass, brittle plastic control Medical screening Metal control Personal Hygiene Protective clothing Wood	Good Manufacturing Practices (GMP)
HACCP Plan Control of Processing (Product) Site flow / plan	HACCP (Risk) Management
Product Identification and Traceability	Identification and Traceability
Pest control	Pest Prevention and Management

Product design / development Product release Quantity checking Specifications	Control of Product (Quality Control)
Allergens Specifications	Recipe Management and Ingredient Control
Product claims	Regulatory Requirements
Business Continuity / Food defence Product Withdrawal / Recall	Incident Management
Approved suppliers Control of Inputs Outsourced processing	Supplier Management (Inputs)
QA training Training	Staff Training
Dispatch and transport	Transport (Includes Dispatch)

4 Cost: Benefit Analysis Findings

This project has sought to understand specific costs and benefits to vegetable growers that implement and manage QA systems.

The approach adopted was:

- Develop specific questions to be used during an interview with vegetable growers.
- Conduct face-to-face and telephone interviews with vegetable growers. This process provided the opportunity to capture quantitative and qualitative data, with an additional benefit of enabling interviews to explore 'why' specific QA tools were chosen for their enterprise.
- Undertake analysis on the data and report on findings.

4.1 Vegetable grower interviews

As there was a limited response by vegetable growers to participate in project interviews from promotion in industry newsletters, TQA utilised its own network to personally contact and coordinate participants. Project interviews were conducted over 10 site visits and 21 telephone interviews with vegetable growers from New South Wales, Queensland, Tasmania and Victoria. To ease into the interview process and to gain an overview of operations, the initial phase of the questionnaire included general information about the business, crops and volumes handled. Subsequent questions included a review of QA systems and QA tools utilised, improvements and impediments, costs and benefits achieved.

The survey questionnaire *Evaluation of Quality Assurance Software for the Vegetable Industry* outlines the specific questions or information required for capture during this phase and is included in Appendix 1. Due to business sensitive information such as costs savings and costs (such as system operation and use of QA tools) obtained during the interview process, some growers expressed the need for information to remain confidential and, as such, a contact list of vegetable growers interviewed will be provided to HIA Ltd as a separate confidential attachment to this report.

4.2 Data obtained from vegetable grower interviews

Information captured from the vegetable grower interviews was influenced by a number of factors including:

- Some vegetable growers were reluctant to disclose tonnage or crop specifics due to fears of competitors being able to utilize this information to their advantage. Lack of visibility in this area has influenced the project team's ability to perform a comprehensive cost comparison on applicable QA tools.
- Many vegetable growers were unable to accurately report tonnes produced, as they simply did not know. Where this occurred we requested growers to provide the crop area and average yield per hectare to calculate likely annual production.
- Some vegetable growers were unable to accurately identify operating and labour costs associated with their QA systems as this was included in their overall operational costs. In addition where a specific QA tool had been purchased the capital expenditure investment was not always fully identified. As noted above, the lack of complete visibility in this area has influenced the project team's ability to perform a comprehensive cost comparison.
- From the range of vegetable growers interviewed, it is apparent that the industry continues to be diverse with many business models in place. Some businesses grow tens of thousands of tonnes of hard vegetables for specific markets with specific management systems. Other businesses grow tens of tonnes of niche vegetables without structured management systems. The information obtained through interview with this range of businesses varies in depth and scope, as the information was reliant on the point in time information recall of the person interviewed.
- It is the project team's assessment that the insights obtained in the interviews are one of the most valuable components in the study when forming a view on cost.

As a result of these factors, the project team's cost analysis and findings should be seen as basis for comparison rather than a specific dollar value of the cost of quality assurance. It provides a useful benchmark for vegetable growers who are evaluating tools for their QA system.

4.3 Vegetable business profiles and QA systems

The following overview is helpful to understand the businesses reviewed and the application of QA systems. The businesses have been split into three categories based on their scale of production. It should be noted that the project team found that the scale of production also correlated strongly to the uptake of QA systems and QA tools.

Small production volumes (up to 1,000 tonnes)

The key features of this group were:

- 14 growers produced less than 1,000 tonnes of crop each.
- Apart from one enterprise, all businesses had a single QA system and/or tool in use. The QA tools utilized were either paper based or required only basic spreadsheet or computing functions.
- On average, this group produced 2.1 different types of vegetable crops, most producing 1 or 2 vegetable crop types.
- On average these businesses spent $2,000 on starting (capital cost) their QA system, had an annual operating cost of $1,400, and spent 0.75 days per month using their QA system.
- The average cost for these businesses is estimated at $4,800 per annum or $23 per tonne of vegetable produced.

Medium production volumes (1,000 to 5,000 tonnes)

The key features of this group were:

- 7 growers produced between 1,000 and 5,000 tonnes of produce each year, however some of these businesses were producing large volumes of high value leafy and soft vegetables (eg hydroponics), making them quite large in terms of turnover and staffing levels.
- These businesses had on average 2.5 QA systems in place; each QA system was required for a different market and/or customer. The QA tools used by these businesses were either off the shelf specific QA software packages or custom designed software packages.
- On average, this group produced 3.7 different types of vegetable crops.
- On average these businesses spent $46,000 on starting (capital cost) their QA system including their QA tool; had an annual operating cost of $20,000, and spent 12 labour days per month using their QA system and/or tool.
- The average cost for these businesses is estimated at $87,400 per annum or $27 per tonne of vegetable produced. This value is distorted by the hydroponic producers and high value herb crops which typically have high value crops and higher QA costs than bulk vegetable crops.

Large production volumes (10,000 to 50,000 tonnes)

The key features of this group were:

- 4 growers reported producing between 10,000 and 50,000 tonnes of produce.
- These businesses had on average 3.75 QA systems in place; each QA system was required for a different market and/or customer. The QA systems and/or tools used by these businesses were either off the shelf specific QA software packages or custom designed in house software packages.
- On average, this group produced 5.5 different types of vegetable crops.
- On average these businesses spent $270,000 on starting (capital cost) on their QA system and QA tools, had an annual operating cost of $60,000, and spent 18 labour days per month using their QA system and/or tool.
- The average cost for these businesses is estimated at $194,400 per annum or $9 per tonne of vegetable produced.

Key features of businesses surveyed

The key features of the QA system adopted by the businesses interviewed are:

- Small production volumes (up to 1,000t) of one or two crops types require a small capital investment and ongoing management cost, typically in a single, simple QA system. However, this does provide a high cost per tonne produced, at $23/tonne.
- Medium production volumes (1,000 to 5,000t) of a few crops require investment in staff and QA software. This provides an annual cost of QA of $27 per tonne, however this does include high value, lower volume hydroponic crops, and these crops will have a higher cost per tonne compared to bulk vegetables.
- Large production volumes (10,000 to 50,000t) of numerous crops into a range of markets require multiple QA systems, with higher staffing requirements, at a higher total cost. However, due to scale efficiency the cost per tonne of product sold is only $9 per tonne.

4.4 Cost of QA tools

The businesses interviewed were asked about the costs of establishing and operating the QA tools (systems) they had in place, plus the amount of time taken for staff to use the QA tools. These costs are described in the following sections.

QA tools

The QA tools identified in the interviews, ranged in complexity, price and level of customisation. Each QA tool was adopted with consideration of the purchaser or crop market in mind. Some of the QA tools identified in the interviews were:

1. Paper based manual system - filling in documents and storing them appropriately.
2. Basic computer system - these systems used spreadsheets, electronic documents, file sharing and basic reporting.
3. Off-the-shelf QA software - examples of this were Agworld, GrowTrak, Livefarmer, PAM, and Freshtrack.
4. Custom QA software - this is where a package or suit of products is developed for a specific business.

The simpler QA tools were typically adopted by the smaller businesses, whereas the off-the-shelf software and custom software packages were adopted by large businesses with complex production systems selling into multiple markets.

The cost of implementing and managing these tools is described in the following sections.

Capital cost

The capital cost is the upfront payment associated with hardware, software, materials and initial training of staff to implement a QA system (including tools). The capital costs are reported for each category of business based upon scale of production.

Table 4.1 Capital cost of QA system (tools) by scale of business

Capital cost of QA tools	Businesses producing up to 1,000 tonnes	Businesses producing 1,000 to 5,000 tonnes	Businesses producing 10,000 to 50,000 tonne
Lowest capital cost ($)	0	1,000	15,000
Highest capital cost ($)	5,000	125,000	1,000,000
Capital cost (average $)	2,000	46,000	270,000
Life expected of hardware & software (no of years)	4.8	4.0	4.8
Average annual capital cost ($/annum)	**475**	**21,000**	**66,000**

In consideration of the table above, it has been identified that:

- Smaller vegetable growers (up to 1,000 tonnes) do not tend to spend much money on their QA tools, ranging from zero dollars (for a simple paper based system) through to $5,000 for a basic off the shelf system.
- The larger the business, the more that is typically invested in QA systems and tools.

- There is significant range in investment - for example in the large producer category, one business invested $15,000 in their particular QA system (including tools), whereas another business invested $1m.
- Most businesses, on average expected to get 4-5 years out of their QA tool before requiring a major upgrade or additional capital expenditure.

Finally, there does not appear to be a one size fits all approach - the capital cost is dependent on the scale of business, which is also likely to be impacted by the number of crops grown (see section 4.3) and market requirements for QA.

Operating cost

Operating costs are identified as those expected to be expended annually to use and maintain the QA tool and/or system. These costs typically include auditing, training, software upgrades, licensing fees and any consumables. During the interview process, each business identified the estimated their operating costs with the results aggregated in the table below.

Table 4.2 Annual operating costs of QA tools (system) by scale of business

Operating cost of QA tools	**Businesses producing up to 1,000 tonnes**	**Businesses producing 1,000 to 5,000 tonnes**	**Businesses producing 10,000 to 50,000 tonne**
Lowest cost ($/annum)	0	1,000	10,000
Highest cost ($/annum)	10,000	70,000	220,000
Average operating cost ($/annum)	**1,400**	**20,000**	**60,000**

The table comparison identifies that:

- Smaller vegetable producers (up to 1,000 tonnes) have an average annual cost of $1,400 per annum, medium scale businesses at $20,000 per annum and large at $60,000 per annum.
- The lowest cost annual operating cost for each business level can to be modest at either 0, $1,000 or $10,000 for a large scale business. However the highest cost reported in each category is significantly higher compared to the average.

The annual operating costs for each business can be small or very large; this suggests that a business choosing a new QA tool and/or system should carefully consider the annual costs of the QA tool and/or system as in many cases the annual operating cost exceeds the upfront capital cost.

Labour cost

The third cost captured in the interviews with vegetable growers was that of labour. Each business was asked to estimate the hours spent on quality assurance (tools and/or system) and the results are reported in the table below.

Table 4.3 Labour cost of QA tools (system) by scale of business

Labour cost of QA tools	Businesses producing up to 1,000 tonnes	Businesses producing 1,000 to 5,000 tonnes	Businesses producing 10,000 to 50,000 tonne
Lowest days spent on QA (no. days/annum)	1	3	135
Highest days spent on QA (no. days/annum)	48	702	300
Average days/annum spent on QA	9	145	214
Average labour cost ($/annum at $40/hour)	**2,925**	**46,400**	**68,400**

The table comparison identifies that:

- For both the small and medium scale of production businesses, the lowest number of days spent on QA per annum at either 1 day per year or 3 days per year is a very small labour commitment.
- In the case of small and medium scale business, each had examples of large labour requirements to implement and manage the QA tools and/or systems. This could be either 48 days per year or 702 days per year (multiple people). The high number of days for the 1,000 to 5,000 tonne business was associated with intensive horticulture production and protected cropping systems.
- The larger the business in scale of production, the larger the annual labour component required. The total labour cost has been based on $40 per hour for labour. This shows that large businesses with significant capital investment, can achieve modest labour costs with the equivalent of one full time staff on average required to manage the QA system (including associated tools) i.e. 214 days per annum is approx. full time for one staff member.

Similar to the previous section on operating costs, the labour required to manage a QA system (including tools) is variable. Some businesses achieve a modest labour cost and some of the larger and more intensive vegetable growers have a high labour cost. On average, the additional capital cost expended by the larger businesses allows them to maintain a reasonable labour cost of around one full time equivalent on average.

Total cost of QA tools

The values recorded from grower interviews in the previous sections are aggregated in the following table to show the total annual cost of using QA tools.

Table 4.4 Total cost of QA system (tools) by scale of business

Total cost of QA tools	up to 1,000 tonnes	1,000 to 5,000 tonnes	10,000 to 50,000 tonne
Average annual capital cost ($/annum)	475	21,000	66,000
Average operating cost ($/annum)	1,400	20,000	60,000
Average labour cost ($/annum at $40/hour)	2,925	46,400	68,400
Total cost per business (average $ /annum)	**4,800**	**87,400**	**194,400**
Average annual production of crop (tonnes/annum)	208	3,253	22,554
Total cost per tonne of produce ($/tonne)	**$23**	**$27****	**$9**

**Note: this category does include protected cropping (greenhouse) businesses with high value crops being produced. For example, the workload, quality assurance requirements and profit margins are likely to be substantially different between producing 10 tonnes of bulk carrots v's 10 tonnes of baby spinach. This is essentially due to the low food safety risk associated with producing carrots to the high food safety risk category associated with baby leaf spinach and the resulting compliance elements.

The table above has identified that:

- The capital cost, operating cost and labour cost of QA all increase with the scale of production.
- Small producers of up to 1,000 tonnes have an average cost of QA at $4,800 per annum or $23 per tonne of vegetable produced.
- Medium producers of 1,000 to 5,000 tonnes have an average cost of QA at $87,400 per annum or $27 per tonne of vegetable produced. However, this does include two businesses with intensive protected cropping systems producing a higher value product with increased QA requirements.
- Large producers of 10,000 to 50,000 tonnes have an average cost of QA at $194,400 per annum or $9 per tonne of vegetable produced.

The impact of scale on a business and their requirement for QA tools is significant. Larger vegetable growers have higher capital, operating and labour costs. However, those larger businesses also can achieve a lower cost per tonne of product, as they are able to achieve economies of scale, or spread the costs of their QA system and/or tools over a larger crop volume. In a competitive marketplace it is likely that a larger vegetable grower can achieve a lower cost of production per tonne of product due to their cheaper QA costs on a per unit basis.

4.5 Benefit of QA tools

The previous section examined the costs of implementing and managing the QA system and/or tools, it is anticipated that for that cost, each business would achieve a benefit. This section examines the benefits described in the grower interviews from having a QA system and/or tool in place.

Primary benefits

The majority of growers interviewed mentioned market access as the primary benefit of implementing a QA system.

Market access

The purchasers of the vegetable crop typically dictate the QA system to be adopted by the grower. Without that QA system in place the grower is unable to sell into that particular market. In some situations, growers reported that their QA system enabled them to sell into new markets, or they received a marketing advantage as customers took them seriously due to their focus on quality and food safety.

Market access is a critical benefit, or a 'stop / go' point. If any vegetable grower is unable to sell their crop then they will not be in business for long. As such the benefit of market access is critical to businesses, and therefore QA system and/or tool implementation are an imperative requirement.

Secondary benefits

The benefits listed below were only identified by a small number of businesses and those businesses were typically larger producers. These benefits were identified in the interviews with growers as tangible and significant for those businesses that were able to achieve the benefit.

Improved farm performance (increased yield and cost saving)

A few of the larger businesses were very positive about the benefits of a QA system, believing that the system was able to provide a significant dollar benefit to the business. The benefit was achieved through a process of 'measuring to manage.' This occurs when performance data is captured, the data is analysed to understand performance and then changes are made to production to improve performance. Without collection of good data, it is difficult to monitor performance and the QA systems and/or tools have helped capture this information. Examples of benefits achieved were:

- **Cost control.** While not likely to be a direct function of a QA system, it is likely that the QA system and tools are closely aligned and capturing cost of production data for each paddock, crop type, market, packer or machine. This process of activity based costing (ABC) allows cost data to be captured so that decisions can be made to control costs of production and improve efficiency.
- **Systematic approach to management.** A further impact and benefit of QA systems and tools is a systematic approach to decision-making and tasks. A systematic approach to management allows repeatable and reliable results to be achieved, this can provide benefit such as consistent quality, timely harvesting, and reduced decision making time and improved engagement with customers.
- **Improved acceptance percentages with customers.** Where quality specifications exist in supply contracts, purchasers of vegetable crops have the option of rejecting crop that doesn't meet specification. A QA system that focuses on key contractual requirements allows monitoring of despatched vegetables to ensure only those that meet specification are sent, plus it forces a focus on the farm to produce vegetables that meet specification. This improved acceptance percentage is likely to be associated with higher yield per hectare of marketable produce.

  Reduced transport and repackaging costs. In additional to the above point, when product is rejected by customers there are additional costs of transport due to rejected crop being returned to the farm plus repackaging, resorting or waste disposal costs that are avoided. This is a double benefit with more product sold and costs saved on the product rejected.
- **Change of enterprise focus.** Where a range of crops are produced or sold into different markets at different times, the data captured by the QA system and/or tool can show which crops are sold in various volumes at specification so that profit for each crop or market can be calculated. This

calculation enables businesses to focus towards markets and crop types that are more profitable and do less production of less profitable lines.

In summary, there are a significant range of benefits that can be achieved by businesses through the implementation of QA systems and/or tools. These benefits are likely to bring tangible and substantial additional revenue, cost control and ultimately profit for those businesses able to leverage from these advantages. It is also probable that a business will need to make a reasonable financial commitment and time investment to their QA system and/or tool in order to achieve these benefits.

Labour efficiency

Labour efficiency was identified by some businesses as a benefit from their QA system and/or tool. These labour efficiencies were captured from three activities:

- **Measuring and monitoring labour.** Some systems and/or tools measured data such as labour used for specific tasks (also for traceability). This data was then analysed and could assist in identifying where staff and processes that were inefficient. Making changes to the production system then helped achieve labour efficiency.
- **Capital investment to save labour.** Section 4.4 Cost of QA tools (refer to Capital costs and Operating Costs) identified that some businesses had spent significant amounts on QA hardware, software and annual operating costs. Where this had occurred, businesses were confident that the capital expenditure had also resulted in labour cost savings. For example where manual recording was replaced with barcodes, this had reduced the labour requirement and there was a net cost saving to the business.
- **Use of electronic devices.** One business noted that a benefit of a QA system with iPad type devices was that staff liked using the devices and could enter data more quickly into the system than previously occurred with pen and paper. This use of electronic device had also improved the discipline of staff to ensure that all the necessary data was captured.

Traceability

Some of the businesses interviewed had specific examples of product recall activity where immediate traceability was required. The QA systems and/or use of tools enabled the rapid location of product to be recalled and further exposure to unidentified stock and/or customer concerns over recall management were avoided.

Some businesses may never require a product recall; however when it is required, it is critically important and can provide the benefit of saving lives, risks to consumer health, maintaining markets and reputational damage. Thus the benefit of traceability is likely to be ongoing but significantly valuable when required. One common challenge that businesses face in implementing traceability is the incremental time and costs involved, particularly establishing trace relationships and to configure relevant and needed reports. QA tools provide a consistent process (particularly those including identification and traceability functionality) with structured templates that can automate and/or streamline processes.

Improved yield forecasting

Some businesses reported a benefit of improved yield forecasting. This occurred with accurate data collected in real time relating production areas to crop produced and pack-out percentages. The real time data can then improve management of transport, customers and staff.

This benefit is difficult to measure in dollars and cents, however it does bring tangible benefits to harvest and transport operations and improves decision-making.

Improved risk management

As a result of implementing or upgrading QA tools, some businesses had identified real risks to food safety that required mitigation. These businesses did not recognise the risks prior to the risk assessment implemented during introduction of the tool. This is deemed to be because the risk was not perceived until the question or element needed to be reviewed. As such, the business now has a decreased risk profile and improved confidence in their ability to produce crops to quality and food safety specifications.

Views expressed on the implementation of QA systems by Vegetable growers interviewed:

The interviews provided an ability to obtain a wide range of opinions from vegetable growers on the implementation of QA systems and the utilization of QA tools. In addition to the benefits already highlighted above (see section 4.5) some of the impacts on the implementation and management of QA systems showed that the benefits also come at a 'cost' to businesses or individuals. The negative views expressed were:

- **Increased paperwork.** The impact of the QA system was perceived as negative due to the additional paperwork required that did not appear to bring about any other benefit to the grower.
- **Stress at audit time.** As most QA systems require an external audit to ensure the integrity of the system, this process bought stress to growers who were worried about the outcome of the audit. This impact does not have a dollar value but can add to the reluctance to adopt and use QA systems.
- **Moving to new technology.** The change from paper based recording to electronic communication and data recording and reporting can be difficult for many people. Where a QA system and/or tool assume a base level of technology skills there can be frustration and reluctance to change practice. Again, this does not have a dollar value but can add to the reluctance to adopt and use QA systems.
- **Compliance over risk management.** Two users identified their concern that a systems approach can focus an enterprise on compliance and reporting, rather than adequately addressing food safety risks. Essentially they were focussed on dealing with paperwork rather than reducing a perceived food safety hazard.

These perspectives have been captured but no dollar value is attributed to them.

Total benefit of QA tools

A key primary benefit of QA is market access. QA is not an optional extra for many businesses, rather it becomes an essential element and without it many businesses are unable to trade. Fundamentally the identified benefit can be any profit achieved by that business from selling into that particular marketplace.

The secondary benefits that were achieved by some of the larger vegetable growers include:

- Improved farm performance (yield and cost saving)
- Labour efficiency
- Traceability
- Improved yield forecasting
- Improved risk management

These benefits are difficult to quantify on a dollar term, and they vary depending on the individual business and QA tools used. It is likely that the QA tools are being integrated with QA management systems to achieve some of these additional benefits. Thus, it is likely that substantial benefits can be achieved for businesses that implement QA tools and then monitor and manage those tools to extract the maximum value for them.

5 Mapping the Ideal System

5.1 QA Tools available to Vegetable Growers – An overview

Australian vegetable growers (including packers) are able to adopt a number of strategies and tools to assure the quality and food safety of their products. However, growing business demands are driving vegetable growers to look for ways to reduce their QA operating costs and improve the time taken to meet system requirements. A well-documented, flexible and fit-for-purpose system is essential for maintaining operational control, meeting chosen system requirements and providing support for continuous business improvement and ongoing quality assurance.

Conversely, fragmented processes and disconnected systems, each with their own specific data and collection method, are problems that can be faced by many businesses within the supply chain. Such circumstances result in congested resources invested in attempting to track food safety and quality parameters. Unconnected data sources and manually tracked (i.e. paper based) processes can lead to a lack of real-time and/or inconsistent information where issues may not be adequately addressed. In addition critical production decisions could be based on assumptions rather than accurate and reliable information.

As noted above, there are a wide range of QA tools from simple paper based systems, basic desktop software programs (often called “desktop applications”) such as word documents and spreadsheets, through to apps and complex customised software. QA tools need to be flexible to monitor performance and to cater for the varying and changing needs of vegetable growers and packers who are suppling markets with increasing expectations. The QA tools should ensure that employees involved in business processes are able to locate access and retrieve information quickly and easily. It is essential that the QA tools are able to provide information in meaningful report formats to provide the business with the full picture of where it stands with its quality related processes.

A major factor that differentiates large and small enterprises can be the availability and allocation of resources to underpin their QA tools. Purchasing costs vary significantly ranging from free app downloads and use at entry level to large and multi-faceted programs that are priced and tailored to suit business needs. Desktop applications are purchased one time and there are not continually occurring charges. However, in certain cases, maintenance fees may be charged. Mobile apps can only be obtained by downloading them from an online app store. Some apps are free, while others must be purchased. Mobile apps are typically much cheaper than desktop applications and are intended to be used on-the-go and are developed to integrate with a small touchscreen interface (such as iPad). Part of the reason mobile apps are cheaper than desktop applications is because they are often less advanced, have limited functionality and take less resources to develop. The larger multi-faceted programs are more complex to operate, require training support, ongoing maintenance and data validation efforts which may pose a barrier to some vegetable growers in accessing and using the QA tool.

Increasingly QA tools offer cloud-based and web-based options. Cloud based platforms allow software vendors to develop software that is independent of the user computer hardware and that can be accessed from multiple device types (e.g. smartphones, tablets, laptop, desktop PC etc.). The cloud based platform

allows software to be developed that runs on single (or groups) of remote computers, called servers, that are accessed over the internet by the user.

There are two main types of cloud services:-

- Software as a Service (SaaS): This is where the user either uses a web browser or a very simple piece of software installed on their device (called a 'client' programme) to use a software application that runs on a computer located remotely (within the internet) rather than on the user's own device. User data is also typically stored on remote servers rather than on their own machine. Software as a Service will often allow the user to switch between different access devices seamlessly as they move from office (e.g. desktop/laptop) to travelling (tablet, smartphone) to on-site operations (smartphone).

- Attached services: This is where the user's own device typically has some software installed that provides functionality in its own right, but when connected to the internet can provide access to additional functionality through software provided on a server. Examples of additional functionality include enhanced or premium services, shared data storage (across many users), real time information updates (e.g. weather data, market data etc.) or real time interaction with other users (information sharing, support groups, social media). Attached services will often allow users to access their data from different devices allowing switching between devices but unlike 'Software as a Service' each device needs to have device specific software installed to provide the local application.

With both service models it is usual for the user data to be stored on the remote server in the 'cloud'. This has the benefit that the data is usually backed up more frequently than it would be if it was only stored on the user device and requires less maintenance activity from the user to manage the process. Cloud based services are usually provided on a subscription basis rather than outright purchase. The end result is a more efficient and less costly way of conducting business.

Web based platforms allow software vendors to develop software that is independent of the user computer hardware that can be accessed from multiple device types (e.g. smartphones, tablets, desktop pc etc.). The web based services provided by such platforms can usually be considered to be 'Software as a Service' solutions as described previously under 'Cloud based platforms', the distinction being more a subtlety of technology rather than services provided to the user. Many companies now offer both desktop and web versions of their most common programs.

Popular QA tools are those that come at minimal cost and can be integrated into existing business processes without causing much disruption. The most cost effective tools are those that allow users to gather information from multiple applications and transform the data into performance action. This data should be readily transferable to other software structures and platforms and be simple to use and control by all users – including those with limited IT knowledge or experience. Marsh (1998)[6] points out that for innovations to be readily adopted, they must demonstrate a need (or respond to an expressed need), demonstrate an observable difference (in on-farm situations) especially for practices that have slow and indirect effects, and demonstrate a measurable benefit (in line with individual objectives). In investigating new experiences in working with horticultural farmers to improve productivity, the Productivity Commission Report (2003) points out that farmers are not a homogeneous group, with the same skills, values, preferences and resources[7]. Regardless of the technology, vegetable growers need good access,

[6] Marsh SP (1998). What can agricultural researchers do to encourage the adoption of sustainable farming systems? Sustainability and Economics in Agriculture Working Paper 98/05, (University of Western Australia).
[7] www.regional.org.au/au/apen/2003/refereed/110heisswolfs.htm

training and mentorship to maximise the investment in QA tools and make the best use of it relevant to individual needs.

5.2 QA tools and ease of use

Software, app, cloud-based and/or web-based options all require the user to have basic computer skills to gain the most benefit. English is the chosen language but some offer use in other languages. All QA tools have been designed to solve user problems with a range of technology, language and platforms available. Where presented at the time of research, cloud-based and web-based options are depicted in Table 5.1. The identified QA tools in this project have been rated as 'Easy' or 'Complex' as noted below:

- Easy – tools that are manual, paper-based, off the shelf QA software, apps and/or can be cloud-based or web-based that offer simple, user friendly functions for a basic system solution.

- Complex – tools that have a range of multifaceted modules that offer comprehensive and integrated solutions. These tools may also have apps that capture data to feed into the main system and can be cloud-based or web-based. They can include custom QA software, where a package or suite of products is developed for a specific business. These tools may need users to be more 'tech savvy'.

5.3 Range of QA tools identified

Broadly across the vegetable sector there are systems such as Freshcare (on-farm food safety and quality system) that are used by a large number of vegetable growers and provide an easy paper-based tool for management system implementation and information collection. This type of paper-based tool provides the vegetable grower with forms and documents necessary to maintain compliance. Generally these types of manual paper-based tools are offered as part of a training package but are losing favour over electronic systems.

Off the shelf desktop software programs offer a range of easy to complex QA tools depending on the need. However, to operate these QA tools basic entry level computer literacy is required. A popular off the shelf desktop software suite used by small to medium vegetable growers at minimal cost is Office 365 which provides a range of basic programs (such as Word, Excel and Access) for operators to develop procedures, forms and/or data collection for a paper-based and/or basic computer system approach. The majority of vegetable growers interviewed used these basic programs within their operation for easy data capture and traceability of information. Software programs such as Access provide the ability to create databases that provide functionality for data management such as document and record control, traceability and quality control.

In conjunction with software, app tools such as Canvas forms, Agworld, Farm Minder, FoodLogiQ, GrowTrak, IAuditor, MSDS.com and TruQC are gaining in popularity with vegetable growers. They are relatively inexpensive (depending on scope), easy to use and offer portability but may have some limitation in the range of system features. The *Project VG13106 Evaluation of commercially available farm management software programs for the vegetable industry* aims to identify farm management software specific to the needs of the vegetable industry. However, a limited number have been reflected in this report.

Examples of simple and easy to use cloud and/or web-based options include Dropbox (which is a file hosting service that offer options such as cloud storage and file synchronisation), SharePoint (which integrate intranet, content management and document management), TraceTracker (tracks products through complex supply chains), Formatta (a web-based platform that enables form creation), Google Docs (allows users to create and share documents online), Gorriladox (offering document management) and ZenDoc

(allows users to manage their quality management procedures and training). Where on demand cloud-based and/or web-based options are available these are identified in the mapping exercise.

More complex tools such as FreshTrak, IronBark, Muddyboots, Pack2Market, Safe Food 360, IronBark, Paddock Action Manager (PAM) and Food Safety Manager offer vegetable growers a range of modules and options (such as apps and cloud-based platforms) depending on need which are mostly configured and priced to suit. These tools are designed to be user friendly but because of the comprehensive functionality require ongoing training, maintenance and support to fully capitalise on the investment.

A large range of QA tools on the market (such as CompliantPRO, Entropy, Mango, ISO Tracker, Paradigm3, QA Hub, Quality System Toolbox and TQIM) offer integrated solutions with other standards such as ISO 14001 (Environmental) and ISO 18001 (Workplace Health and Safety). These standards require hazard identification and risk management as well as compliance to legal and other requirements (such as customers). Where there is a heavy emphasis on quality elements specific to the food sector, these have been included in the mapping exercise.

5.4 Examples of QA tools excluded

A number of QA tools had a broad cross section of quality system management elements (including traceability) that could be applied to vegetable production in the future but are primarily focussed on food and beverage manufacturing or only available in specific regions such as USA / Canada and have therefore been excluded from the final analysis. Examples of these manufacturing programs include (but not limited to) Plex On-Line, Qedge, Quality Link, Q5Aims (which covers quality elements with a main focus on workplace health and safety), SQF-Sentinal (applicable to baking), TrackWise and Unipoint (scope covers food and beverage from warehouse level) and Unipoint (focusses on meat traceability and only available in the USA/Canada). Examples of region specific programs excluded include PICS (Product Inventory Control System) software which is specifically designed for buying, selling and effectively tracking, tracing, inventorying and reporting on produce for USA/Canada only.

Tools that have synergies to QA systems on-farm with an environmental emphasis, such as EnviroVeg (which provides vegetable growers with guidelines and information on how to manage their business in an environmentally sustainable manner) and Environmental Knowledge Systems Australia (EKSA), which provides content management and communication services to a range of organisations in the land use planning and natural resource management sectors, are acknowledged but excluded.

A program that may have future application in Australia is the recently launched program NubeTrak, which is a patent pending cloud-based program that utilises mobile technology. NubeTrak offers a suite of tools designed to manage food safety specifically for leafy greens and/or berry production. Its scope includes site based data collection, document management, field-to-table traceability through to order fulfilment. However, NubeTrak is currently only available in the USA. Teklynx Central is a customised barcode and label program that provides users with design print and label functions from a database. Because of the focus on barcode and label printing it has been excluded. Other data capture options that have a clear major business accounting and financial management focus (such as MYOB) have also been excluded.

5.5 Pricing, Specifications and Features

The Cost: benefit analysis noted above discussed specific costs and benefits to vegetable businesses that implement and manage Quality Assurance (QA) systems. A price comparison on individual QA tools has identified difficulties in capturing consistent information. Difficulties observed include:

- QA tools prices varied across a wide range – starting from $0 to over $100,000 plus per program. This does not cover the cost of implementation of a paper-based tool.

- Some systems offer a subscription fee, calendar price per month and/or priced to suit an individual operation and as a result, may it difficult to assess the full cost exposure.

- Company did not respond to a number of requests for product information and/or not willing to provide a quote unless they engaged direct with an actual buyer;

- Prices could be tailored to suit vegetable operations. Some systems required tailoring to the grower's vegetable operation and therefore the scope of comparison could vary according to crop type (s), supply chain scope and physical size.

- Some systems offered options that required multiple users (i.e. 5 users) as a minimum for purchase making it difficult to compare.

- During the information gathering period of the report, pricing of some systems changed and it is expected that further changes could be possible to the pricing models used.

For these reasons an individual QA tool price comparison has been excluded.

The quality management system and/or traceability features that each QA tool(s) offer have been categorised against the benchmarked system elements and incorporated into tables for reference.

5.6 QA tool maps

Using the information gathering from the benchmarking process, two tables have been developed to show the QA tools identified and ease of use (Table 5.1); and show the functionality each tool provides (Table 5.2). These tables which are depicted below can be used by vegetable growers to assist them consider the suitability of the QA tool for their individual use. It should be noted that the information contained within the tables is current at the time of research and, with advances in technology and capacity to meet market demands; QA tool (s) specifications and functionality may change over time.

Table 5.1 QA Tools and ease of use

QA Tool Name	Company	Website	Easy	Complex	Paper-Based	Software Package / Customised	App / Cloud or Web Based Platform
ABC Software	ABC Software Ltd	http://www.abcsoftware.co.nz		x		x	
Agtrix	Agtrix Pty Ltd	http://www.agtrix.com		x		x	x
Agworld (farm management app)	AgWorld Pty Ltd	http://www.agworld.com.au/	x				x
Canvas Forms	Canvas Solutions Inc	http://www.gocanvas.com	x				x
CMO Compliance (app)	CMO Compliance	http://www.cmo-compliance.com		x		x	x
CompliantPro	Siemens	http://www.ibs-us.com		x		x	
Dropbox	Dropbox	http://www.dropbox.com	x				x
Farm Minder	AgTech Pty Ltd	http://www.farmminder.com.au	x				x
Food Safety Manager	N2N Global	http://www.n2nglobal.com		x		x	x
FoodLogiQ (Labels/ItemTrace)	FoodLogiQ	http://www.foodlogiq.com	x				x
Formatta	Access Enterprise Forms	http://www.formatta.com	x				x
Freshcare	Freshcare Limited	http://www.freshcare.com.au			x		
FreshTemp	FreshTemp	http://www.freshtemp.com	x				x
FreshTrack Systems	Freshtrack Systems	http://www.freshtrack.com.au		x		x	x
Google Docs	Google	http://www.google.com	x				x
Gorriladox	GFSC Group	http://www.gfscgroup.com	x				x
GrowData (orchard / vineyard / packing)	GrowData Developments	http://www.growdata.com.au		x		x	
HarvestMark	YottaMark	http://www.harvestmark.com	x				x
Hastings Data Loggers	HDL Pty Ltd	http://www.hdl.com.au	x			x	
HACCP Manager Software	South Coast Business Solutions	http://www.haccpmanagersoftware.com		x			x
HACCP Now	HACCP Now	http://www.haccpnow.com		x		x	x
I Auditor	Safety Culture	http://www.safetyculture.com.au					x

Icon Global Link	Integrated Standards Enf. Systems	http://www.iglink.com.au		x		x	x
Icicle	Burton Software	http://www.icicle.burtonsoftware.com		x			x
Intelex (QSQA)	Intelex Technologies Inc	http://www.intelex.com/		x		x	
IronBark (Fresh Produce)	Ironbark Software Pty Ltd	http://www.ironbark.com.au/		x		x	x
ISO Tracker	LennoxHill	http://www.isotracker.com		x			x
Lean & Mean Business Systems	Lean Machine Business Systems Inc	http://www.theleanmachine.com		x		x	
Lettus Software (Supplier focus)	Fresh Computer Systems Pty Ltd	http://www.freshcomp.com.au		x			x
Live Farmer	Marpak Pty Ltd	http://www.livefarmer.com/		x			x
Mango	Mango Ltd	http://www.mangolive.com/		x			x
MasterControl	Mastercontrol Global Ltd	http://www.mastercontrol.com/		x		x	x
MetricStream	Metricstream Inc	http://www.metricstream.com		x		x	x
Muddyboots	Muddy Boots Software Ltd	http://en.muddyboots.com/		x		x	x
PackTrack (also offer PackMaster & Pick2Market which are more complex)	GV Custom Software	http://www.gvcustomsoftware.com.au	x			x	x
PAM Ultracrop	Fairport Farm Software	http://www.fairport.com.au		x		x	x
Paradigm3	Paradigm Software Pty Ltd	http://www.paradigm3.com.au/		x		x	x
Phoenix Cropping	Agdata Australia	http://www.agdata.com.au		x		x	x
Quality Systems Toolbox	Maus	http://www.maus.com.au/product/quality-assurance-software/		x			x
Safe Food 360	Safe Food 360	http://www.safefood360.com/		x		x	x
SafetyChain (for food)	SafetyChain Software Inc	http://www.safetychain.com/		x		x	x
Sharepoint	Microsoft	http://www.office.microsoft.com/	x				x
Smart-Trace Online Monitor	Ceebron Pty Ltd	http://www.smartrace.com	x				x
TraceTracker	TraceTracker Innovation ASA	http://www.tracetracker.com	x				x
TracMap Horticulture		http://www.tracmap.com	x				x
TruQC	TruQC LLC	http://www.truqcapp.com	x				x
Unipoint	Unipoint Software Inc	http://www.unipointsoftware.com		x			x
Verify Traceability (eQTrace)	Verify Traceability	http://www.verifytraceability.com		x		x	x
ZenDoc	ZenDoc	http://www.getzendoc.com/	x				x

Table 5.2 QA tools and functionality provided

QA Tool	ELEMENT	QA Principles	Calibration	CAPA Management	Chemical & Fertiliser Management	Cleaning & Sanitation Management	Control of Non-conforming Product	Control of Facilities, Plant & Equipment	Control of Storage	Complaints & Feedback Management	Document & Record Management	Good Agricultural Practices (GAP)	Good Manufacturing Practices (GMP)	HACCP (Risk) Management	Identification & Traceability	Pest Prevention & Management	Control of Product (Quality Control)	Recipe Management & Ingredient Control	Regulatory Requirements	Incident Management	Supplier Management (Inputs)	Staff Training	Dispatch & Transport
ABC Software															X								
Agtrix					x		x								X	x	x				x		x
Agworld			x		x						x	x				x							
Canvas Forms											x												
CMO Compliance		X									x			x					x		x	x	
CompliantPro		X	x	x				x		x	x			x					x		x	x	
Dropbox											x												
Farm Minder					x											x			x	x			
Food Safety Manager		X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
FoodLogiQ (Labels)															x								
Formatta											x												
Freshcare		X	x	x	x	x	x	x	x	x	x	x		x	x	x		x		x	x	x	x
FreshTrack Systems			x		x	x	x	x	x			x			x	x	x	x			x		x
Google Docs											x												
Freshtemp																	x						
Gorriladox		X		x		x		x			x										x		
GrowData			x		x										x								
HarvestMark										x					x								
Hastings Data Loggers																	x						
HACCP Manager Software		x	x	x		x	x				x		x	x	x	x	x			x	x	x	
HACCP Now		x		x		x					x			x			x				x	x	
I Auditor		x																					
Icicle		x		x				x			x			x						x	x	x	

Icon Global Link		X		x			x			x	x			x	x		x			x	x	x	
Intelex (QSQA)		X	x	x			x	x	x	x	x						x		x	x	x	x	x
IronBark			x	x	x	x	x	x	x	x	x		x		X		x	x		x	x	x	x
ISO Tracker		x		x			x			x	x						x				x	x	
Lean & Mean Business Systems		x	x	x			x			x	x			x	X		x				x	x	
Lettus Software															X								
Live Farmer			x	x	x		x	x	x	x	x	x			X	x	x			x	x	x	x
Mango		X	x	x			x	x		x	x			x			x		x	x	x	x	
MasterControl		X	x	x			x	x		x	x			x	X		x		x	x	x	x	
MetricStream		x	x	x			x	X		x	x			x	X		x		x	x	x	x	
Muddyboots		x	x	x	x		x	x	x	x	x	x	x		x		x			x	x	x	x
PackTrack / PackMaster & Pick2Market															x		x						
PAM Ultracrop			x		x	x	x	x	x		x	x			x	x	x				x	x	x
Paradigm3		x	x	x			x	x	x	x	x			x	x		x		x	x	x	x	
Phoenix Cropping			x		x	x	x	x	x		x	x			x	x	x				x	x	x
Safe Food 360		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x
SafetyChain (for food)		x	x	x	x	x	x	x	x	x	x			x	x	x	x	x		x	x	x	x
Sharepoint											x												
Smart-Trace Online Monitor															x								
TraceTracker										x					x					x			
TracMap Horticulture					x			x							x								
TruQC											x												
Unipoint		x	x	x			x	x		x	x						x				x		
Verify Traceability (eQTrace)														x	x		x	x					
ZenDoc											x											x	

6 Checklist

6.1 Points to consider when purchasing QA tools

A necessary starting point when considering investment in QA tools is defining the business requirement. Planning is essential, with the impact of a poor decision potentially far-reaching. Criteria should include functional requirements, quality attributes, business needs and constraints. In evaluating and selecting quality management software, Hrgarek (2008)[8] states that the goals to change to a software-based quality management system are focussed on, but not limited to:

- Reduce the existing paper-based quality management system and save time due to reduced paperwork;
- Automate and improve quality management processes;
- Make work more efficient through the better allocation of resources;
- Provide better traceability and accurate information;
- Enhance decision making based on readily accessible data;
- Ensure regulatory compliance and reduce the risk of non-compliance;
- Minimise the preparation for external audits;
- Improve customer satisfaction;
- Short product release cycle by closing corrective and preventive actions faster; and
- Reduce potential for human error due to validated processes.

On the basis of a literature review on evaluating and selecting software packages, Jadhav and Rajendra (2008)[9] propose a generic stage based methodology for selection of any software package which consists of seven stages:

1. Determining the need for purchasing the system and preliminary investigation of the availability of packaged software that might be suitable, including high level investigation of software features and capabilities provided by the vendor.
2. Short listing of candidate packages.
3. Eliminating most candidate packages that do not have the required feature or do not work with the existing hardware, operating system and database management software or network.
4. Using an evaluation technique to evaluate remaining packages and obtain a score or ranking of them.
5. Doing further scrutiny by obtaining a trial copy and conducting an evaluation; pilot test the tool in an appropriate environment.
6. Negotiating a contract specifying software price, number of licenses, payment schedule, functional specification, repair and maintenance responsibilities, time table for delivery and options to terminate any agreement.
7. Purchasing and implementing the most appropriate software package.

Purchasing decisions are anything but simple. Each QA tool marketer professes that their program offers the best solution – however no product or service is quite the same. Trade-offs in purchasing decisions can be based on price, quality, features, customer service, maintenance, life cycle, complexity and durability. Selecting software is no different from selecting a product or service, but it has to meet a real need on which the business will depend. Most software purchases are based on technical features such as required

[8] Hrgarek, N (2008), Evaluation Framework for Quality Management Software*, Journal of Information and Organisational Sciences*, vol. 32, no. 1, pp 30-50

[9] Jadhav, Anil S & Jarendra M Sonar (2009) , Evaluating and selecting software packages: A review, *Information and Technology Journal*, No. 51, pp 555-563

processor, operating system, memory, hard disc space and how many PCs can be operated using the program. These key factors are important but vegetable growers should also consider other criteria such as company history and experience (including testimonials from other users), safety / security of data, features and needs versus price, integration into existing systems (such as ease of use) and ongoing support, maintenance and training. If the operating platform is cloud or web based and/or uses mobile technologies and requires a high connection, a critical factor in making a final purchasing decision is whether services can be accessed and/or downloaded in a timely manner. Network access and speed has often been an impediment for technology engagement and use by vegetable growers in regional and remote areas.

When choosing a product to use, vegetable growers will need to evaluate their current hardware (physical computer resources) technology and future needs to make sure they meet the minimum and recommended operating system requirements. Consideration needs to be given to components such as the computer and processor, Memory (Random Access Memory or RAM), hard disc, display (screen resolution / graphics), operating system, browser and any other specific components. Software may not be compatible with the different versions of operating systems in use so when making purchasing decisions compatibility and devises supported must be studied. Most hardware and software products have the system requirements printed on the product. The important information to note includes (but not limited to):

- Operating system (i.e. Windows, Mac OSX, Linux)
- Processor speed (i.e. Pentium 4, 3.2 GHz or Intel Pentium 1000MHz, Power PC G5, 2.0 GHz)
- Memory (i.e. 512 MB)
- Screen Resolution (i.e. 1024 x 768 pixels minimum) and Colour Quality (i.e. 16bit minimum)
- Hard Disc Space (i.e. 80 GB available)
- I/O Ports (i.e. USB, Firewire, Serial, Parallel, SCSI, VGA, DVI ports).
- Devices supported (i.e. Android, iPhone-iPad, Linux, Mac, Mobile Web App, web-based, Windows etc)
- Supported Platforms (i.e. Microsoft Dynamics, NetSuite etc)

Most market-based software allows a free trial period so it may be beneficial for vegetable growers to use this trial period to download and analyse the operational suitability and useability of the software. It is a good idea to include potential program users to try out the different features so that any issues can be identified. When evaluating software options it is important to differentiate between the functionality you "must have", "nice to have" and "don't need". To mitigate the risk of selecting QA tools that are unsuitable, vegetable growers should weigh up what output they want from the QA tool (i.e. report) and how to retrieve it, avoid non-essential features (bells and whistles) that are not needed or make use more complicated and not purchase a product without doing appropriate research and testing or when it is completely new to the market or at the end of its generation (note that products based upon technology from a declining market have a shrinking customer database and waning technical support and training).

Equally important is to evaluate the vendors, not just the QA tools you are looking to purchase and eliminate the vendors that do not provide the QA tools and/or service that will suit business needs. The vendor chosen will need to be a willing and capable partner to ensure the success of the investment. Background information on the vendor is essential as they are likely to be handling sensitive data and have access to business systems. Vegetable growers should also contemplate how long they have been in business, what is their niche and what the experience of their customers has been – customer testimonials on websites are a good way to see who is using the tool and what their comments are.

6.2 A practical checklist

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:

Table 6.1 - A Practical Checklist to use when purchasing 'complex' QA Tools

Check	
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 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?	☐

7 Summary

The use of QA tools provides vegetable growers with the ability to gain leverage from a range of benefits which can bring tangible and additional revenue, cost control and potential profits for the business.

This research has shown that there are many choices and range of functionality options available to vegetable growers. The challenge for vegetable growers is to consider which one is right for their business needs.

No recommendation is made of a specific QA tool. However from the two tables provided, vegetable growers can ascertain whether a QA tool is deemed easy or more complex to use and whether it covers the functionality they are seeking suitable to their business needs. A practical checklist has also been developed to assist vegetable growers in making confident and informed decisions in the selection and use of QA tools to support managing their QA systems.

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9 Appendices

Appendix 1 QA tools survey questionnaire

Appendix 2 Confidential Attachment (Vegetable Growers Contact List)

Appendix 1: QA tools survey questionnaire
(Note only Survey Section 1 relevant to this project is attached)

HAL Projects: Evaluation of Quality Assurance Software and Farm Management Software for the Vegetable Industry

INTRODUCTION

The following survey is part of two projects being conducted by TQA Australia which have been funded by Horticulture Australia Limited (HAL), to better understand quality management and farm management software specific for the needs of the vegetable industry.

The major outcome of the two projects is to provide vegetable growers with the ability to review and assess traceability or compliance quality assurance tools for their individual use; and capability to individually evaluate computer software, mobile applications and cloud based platforms available.
Participants in the survey will go into a draw to win an iPad Mini. The winner will be contacted by TQA Australia after 26 November 2014.

Survey Section 1: Evaluation of Quality Assurance Software

Begin Data Capture for Cost: Benefit analysis –

Data required

The following table outlines the specific questions or data required for capture in the grower interviews.

Data Capture – Information required	
General information:	
What products do you produce and how much of each product to you produce each year?	*List, eg 450 tonnes of onions, 600 tonnes of beans, 80 tonnes of sweet corn.*
What QA systems do you have in place for the business (including internal production techniques)?	*Provide narrative, list items (eg Freshcare, HACCP, WQA)*

What tools do you use to manage your QA system?	*Find out if they use a paper-based system eg paper-based manual, software, apps, cloud based platforms, tailor made.*
What is their major function?	*Describe the main tasks they are used for eg QA compliance, financial, ID & Trace; chemical & fertiliser management*
What has changed for the better since adopting the QA system?	*Provide narrative, list items.*
What has changed for the worse since adopting the QA system?	*Provide narrative, list items.*
Has the QA system enabled you to sell your product into a different market?	*Find out if they have been able to access a new market with adopting a QA system.*
If you have accessed a different market as a result of the QA system, what is the impact?	*Try to be specific, examples may be: shorter freight, higher price per tonne for 500 tonnes, or better payment terms, or now selling 80% of the crop rather than 70% of the crop. Obtain specific item and value of that item.*
Benefit achieved:	
Have there been any productivity benefits (income) to your business as a result of implementing the QA system? If so, please describe and provide a value.	*For example, has the QA system meant that staff now have received additional training and can streamline their work to achieve greater quality packouts? If yes –provide no. of units and $ per unit benefit – or increased output; less wastage.*
Has there been any cost savings to your business as a result of implementing the QA system? If so, please describe and value.	*For example, has the QA system revealed a poorly calibrated sprayer or spreader that as saved spray or fertiliser saving? Or alternatively, has the QA system improved traceability and prevented the wrong box going to the wrong customer? If yes – no of items and $ per unit cost saved.*
Are there any other positive impacts (see question in green) – what has been the value of those?	*Try to provide specific examples and the specific dollar impact with that event – for example new markets. This is a check to make sure all aspects of the green question are captured.*
Cost incurred:	

What has been the total capital cost of the QA system; include all hardware, software and materials?	*Try to be as accurate as possible, help them add the individual components if required. Provide a total cost of $.*
What is the life expectancy of the system and hardware?	*Eg how long will it last before needing replacement: 1 year, 2 years, 3 years?*
What are the annual costs of the system?	*Help them think through specific items such as licence fees, training costs, materials and consumables. Provide a total cost per annum.*
How much time is spent by the business each month or year (whatever is easier) and who does it?	*E.g. 8 hours per month for the farm manager and 4 hours per month for the packing shed manager.*
Are there any other negative impacts (check question in red) – what has been the cost of those?	*Try to provide specific examples and assessment of hours, dollars per week or per annum. This is a check to make sure all aspects of the red question are captured.*

Thank You

Thank you for your participation. The compiled results of this survey and more detailed interviews will be collated into two reports for Horticulture Australia Limited.

If you have any questions about the survey or the two projects, please do not hesitate to contact Belinda Hazell of TQA Australia on 0419 102 476 or Belinda.hazell@tqaaustralia.com.au.

Appendix 2: Confidential Attachment (Contact List for Vegetable Grower Interviews)

TQA have been advised by HIA Ltd to provide this confidential list as a separate attachment to this report.