



Traceability  
**Solution Providers**  
Special Interest Group



## Forensic proof of origin

How can trace element and isotope testing help enhance traceability and trust in food and beverage supply chains?

Tuesday 5 September, 2023, 10.30am to 12pm



**Nathan Hancock**  
CEO  
Citrus Australia



**Caroline Barrett**  
Program Manager  
- Traceability  
Biosecurity  
and Agriculture  
Services  
Agriculture Victoria



**Karyne Rogers**  
Senior  
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**Stacey Barlow**  
Senior Project  
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**Cameron Scadding**  
Founder & Managing  
Director  
Source Certain



**John Keogh**  
Managing Principal  
Shantalla Inc.  
Professor of Practice  
McGill Center for  
the Convergence  
of Health and  
Economics (MCCHE)

# Acknowledgement of Country



National GS1 Traceability  
**Advisory Group**  
**Solution Provider Group**

We acknowledge the Traditional Custodians of the various lands on which we meet and work today and any First Nations people that may be participating in this meeting.

Specifically, we acknowledge the people of the Kulin and Eora nations, where GS1 offices are located, and pay our respects to elders past, present and emerging.

We recognise and celebrate the diversity of First Nations people, and their ongoing cultures and connections to the lands and waters across Australia.



Credit:  
Barry Rainman Boland. Rivers and Waterholes Bilyan Bagay

# Our agenda and host



National GS1 Traceability  
**Advisory Group**  
**Solution Provider Group**

Time	Item	Who
10.30am	Welcome and Housekeeping	<b>Caterina Slade</b> Manager – Alliances <b>GS1 Australia</b>
10.35am	Opening Remarks and official welcome	<b>Greg Calvert</b> Founder & CEO <b>FreshChain Systems</b> Co-Chair TSP-SIG
10.40am	Key-note Speakers	<b>Nathan Hancock</b> CEO – Citrus Australia  <b>Caroline Barrett</b> Program Manager – Traceability, Biosecurity and Agriculture Services Agriculture Victoria  <b>Karyne Rogers</b> Senior Environmental Scientist GNS Science
11.20am	Introduction to Panel	<b>Greg Calvert</b>
11.25 am	Panel Session with Q&A	<b>Moderator:</b> Peter Carter <b>Panel:</b> Cameron, Scadding, John Keogh, Stacey Barlow, Caroline Barrett, Karyne Rogers, Nathan Hancock
11.50 am	Summary and Close	<b>Greg Calvert</b> Founder & CEO <b>FreshChain Systems</b> Co-Chair TSP-SIG



**Greg Calvert**

Co-Founder & Director  
FreshChain Systems

# National Isotope and Trace Element NITE Profile for Australian Citrus

Caroline Barrett  
Stacey Barlow  
Nathan Hancock  
Karyne Rogers





“Creating the National Isotope and Trace Element (NITE) Profile has demonstrated the use of science for citrus traceability.

Isotope and Trace Element testing has proved how Australian fruit can be differentiated from the fruit of other nations, when it’s in market.

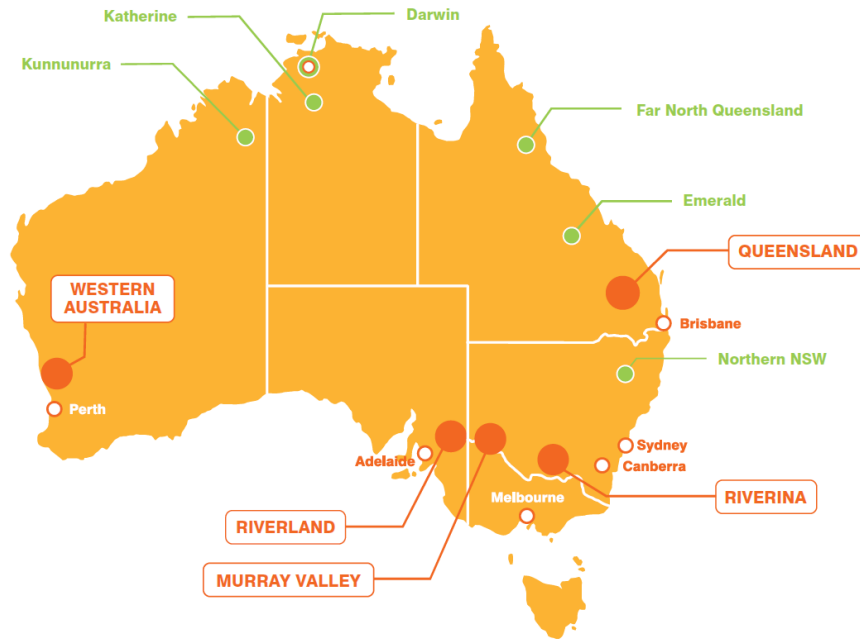
What’s more, we can also characterise fruit from our five Australian growing regions. This gives us more certainty in the face of a food recall, or when protecting Australian brands from food fraud.”



**NATHAN HANCOCK, CEO,  
CITRUS AUSTRALIA**



## The Value and Diversity of Australian Citrus Exports



30,000 hectares of  
Australian citrus

5 production regions

Exports \$540 million

Premium citrus for overseas  
markets

Increased traceability and  
origin verification needed to  
protect brands and  
ensure consumer  
satisfaction

## **The Challenges of Food Fraud**

**Competitor countries also supply both premium and sub-premium fruit to the same export markets.**

### **Risk of**

- » **food substitution with inferior products**
- » **biosecurity incidents**
- » **food recalls**
- » **mislabeling of origin or variety**

## **The Benefits of Traceability**

- » **food substitution / food fraud protection**
- » **accurate product selection in food recalls**
- » **biosecurity incident responses**
- » **providing verified scientific data to support claims or litigation**
- » **brand protection for Australian growers**
- » **consumer trust in the safety**

# Options for Traceability

## Mapping



Supply Management  
[National Citrus Map](#)

## Digital



Everyday & Crises  
[Traceability Project](#)

## Laboratory



Claims & Crises  
[NITE Profile](#)



Farm



Packing House



Freight



Wholesaler



Retailer



Consumer



## What is laboratory traceability?

Unique profiles of isotope ratios and trace elements

are found in products such as fruit

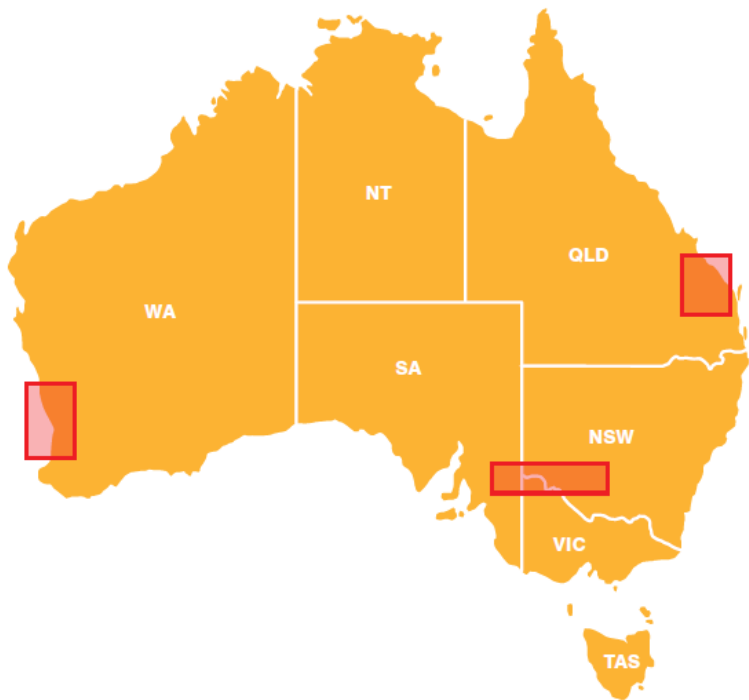
from soil and water uptake

caused by unique local geology, environmental conditions, and agricultural practices

giving an effective means of tracing foods to their origin



B, Ca, Ce, Co, Cs, Cu, Fe, K, La, Mg, Mn,  
Na, Ni, P, Pb, Rb, Sn, Sr, Zn,  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$



26 Australian samples from 5 Australian growing regions: WA, QLD, SA, VIC, NSW

13 samples from 4 other nations:  
New Zealand, China, USA, Egypt

## The National Isotope and Trace Element (NITE) Profile for Australian Citrus

Project goal: 2 key questions:

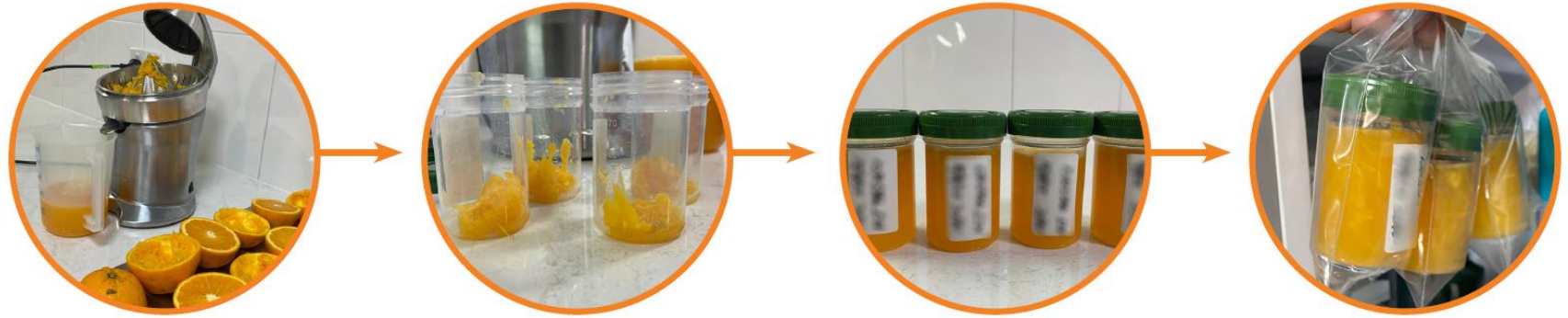
- 1. Can we determine if an orange is from Australia?**
- 2. Can we differentiate Australian oranges into one of the 5 Australian growing regions?**

Project result: 'yes' to both

With further data, a 3rd question could be answered in future:

- 3. Can we differentiate Australian oranges from separate orchards?**

## Sampling and Testing



Each 'sample' consisted of 6 oranges for pulp and juice extraction

All samples were measured in New Zealand at the Stable Isotope Laboratory at GNS Science and at University of Otago

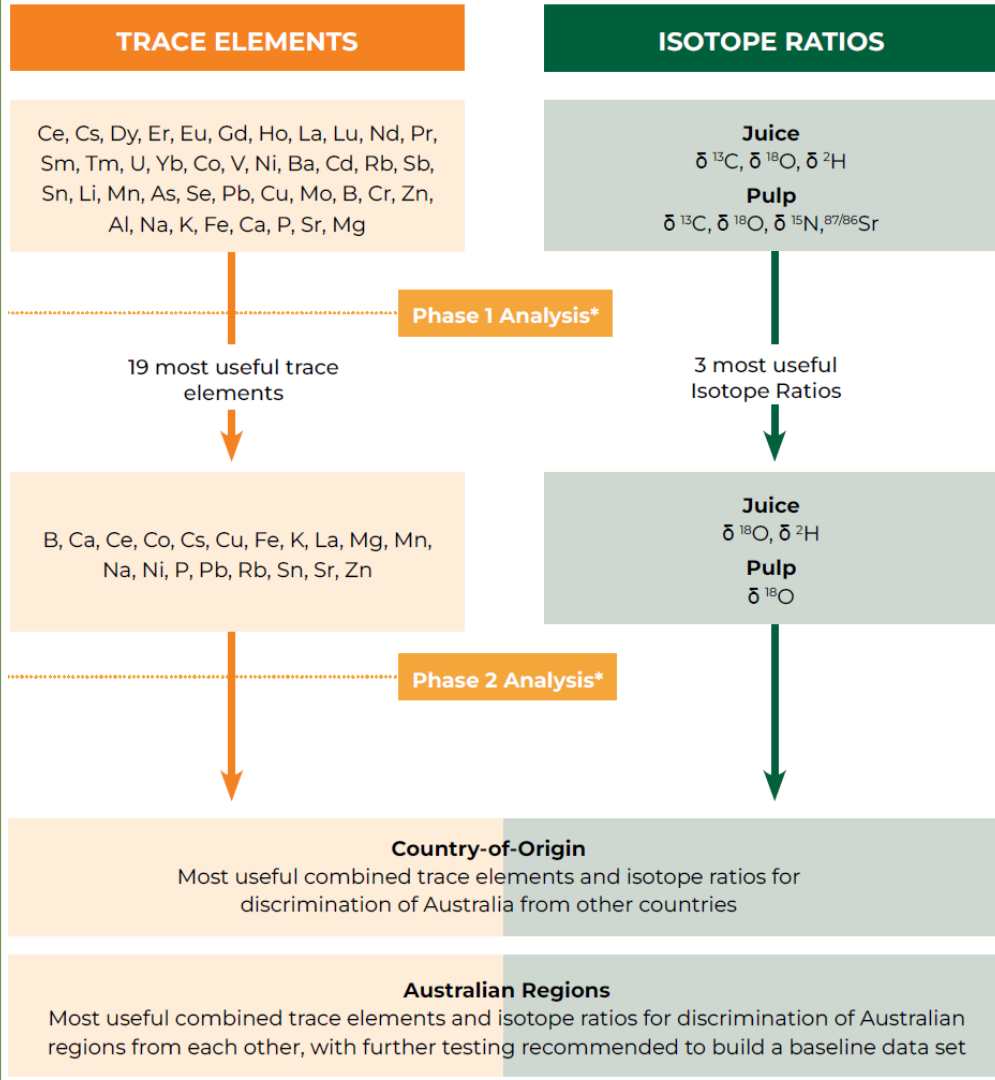


# Testing Phases

Two phases to enable

refinement of most useful isotopes and elements

and best value approach

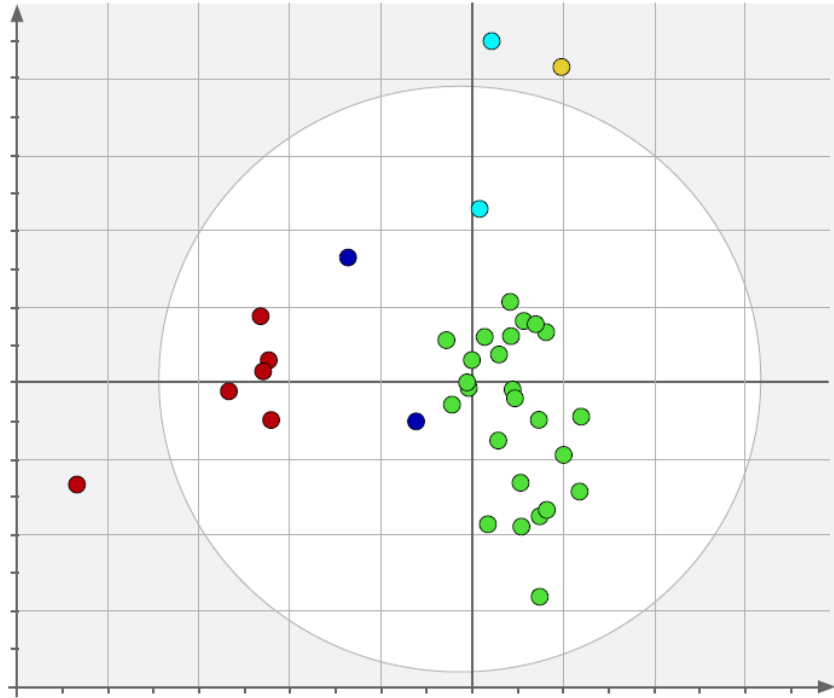


# Multivariate Analysis

Orthogonal partial least squares discriminant analysis (OPLS-DA) model

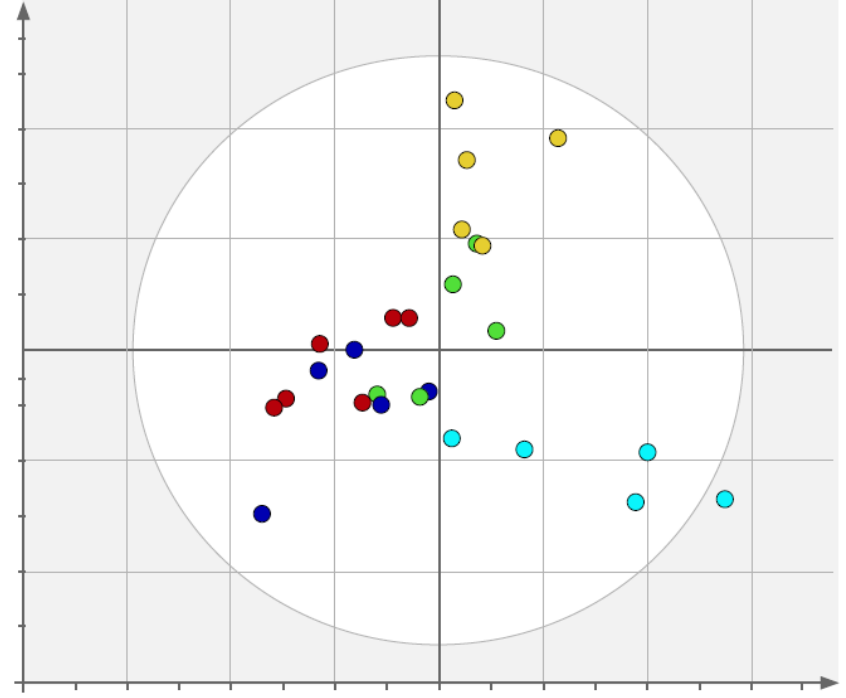


## Australian Country-of-Origin Results

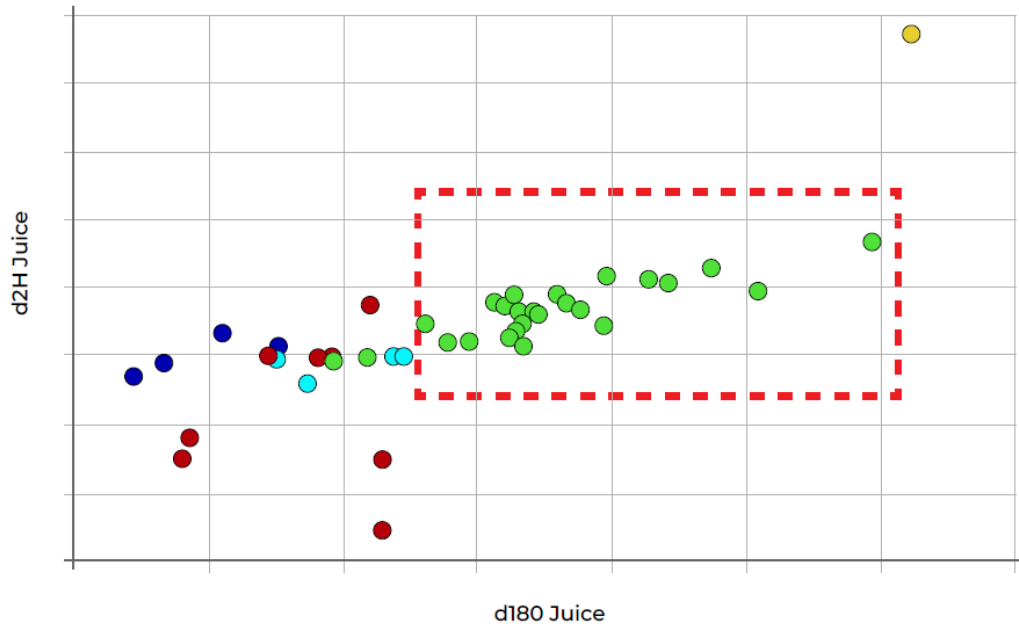


● Australia ● New Zealand ● China ● Egypt ● USA

## Australian Region Results



● VIC ● NSW ● SA ● QLD ● WA



● Australia ● New Zealand ● China ● Egypt ● USA

## Developing a Rapid Screening Method

Australian oranges:  
distinct  $\delta^{18}\text{O}_{\text{juice}}$  (Oxygen isotope ratios in juice)

Potential two-tier testing system:

- $\delta^{18}\text{O}_{\text{juice}}$ :** Rapid, low cost, lower accuracy test
- Full isotope and trace element profile:** Slower, higher cost, higher accuracy test



## Conclusions

### 1. Can we determine if an orange is from Australia?

Discrimination rate in this study: 97.3%

**Yes!**

### 2. Can we differentiate Australian oranges into one of the 5 Australian growing regions?

Discrimination rate in this study: 92.3%

**Yes, noting SA, VIC, NSW differentiation would be further supported by additional testing**

## Recommendations

1. Consider Isotope and Trace Element traceability as an adjunct to other forms of traceability
2. Further testing to investigate markets at high-risk of citrus substitution (food fraud)
3. Build a larger data set for Australia and establish appropriate confidence levels
4. Develop a Two-Tier Testing Program
5. Build larger data sets for global citrus
6. Scientific publication and collaboration
7. Develop data sets for interested individual growers, with associated marketing opportunities





## Uptake Challenges for Isotope and Trace Element Testing

- » High cost of entry
- » Bespoke technology and high expertise
- » Variable confidence levels
- » Low levels of awareness (government and industry)
- » Logistical challenges of multi-country sampling
- » Slower verification time compared to digital labelling traceability
- » Intellectual property issues over data and methods with some laboratory business models





## **Intellectual Property of Isotope and Trace Element Testing**

## Intellectual Property of Isotope and Trace Element Testing

A summarised high-level public report is available for the Citrus NITE Profile.

**Citrus Australia retains the full unpublished confidential results, enabling data access, retain, transfer, share and build beyond the project.**

**For your isotope and trace element project**, consider if you wish to

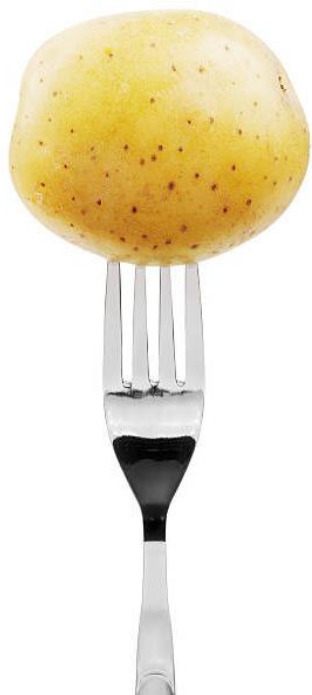
- keep full study results confidential to your industry
- share them with other laboratories
- share them with other peak industry bodies globally
- openly publish full results in scientific journals.

Ask laboratories specifically about intellectual property of methods and results.

Establish who will own the full results of your study: you or the laboratory.

Request laboratory methods and establish if these can be shared openly with other laboratories, industry groups and the scientific community.

**Intellectual property has implications for how you can access, retain, transfer, share and build upon the data beyond the life of the project.**



# A “How to” Guide to Trace Element and Isotope Testing

## The National Isotope and Trace Element (NITE) Profile for Australian Citrus

Enabling traceability differentiation of Australian oranges by Country of Origin and Australian Region



NITE Profile for Australian Citrus 1

## Final Report

### Appendix 1:

#### Laboratory Traceability: A Check List for Trace Element and Isotope Ratios Testing

##### Questions for laboratories during the quotation process

Question	Answer
<b>Laboratory</b> Provide the address of your laboratory / laboratories. If samples will be 'received' and 'tested' in different laboratories, provide addresses of all of them. Are all of the above laboratories NATA accredited (or have other relevant accreditations)? Provide Laboratory Submission Forms. Provide a copy of any import permits for samples submitted from all states of Australia (or your country). Can your laboratory accept the following sample types from all states of Australia (or your country)? - Whole fruit? - Pulp? - Fresh Juice? - Pasteurised Juice? - Irrigation water? - Soil? Any other sample type?	
<b>Customs regulations for samples</b> Provide customs forms for all relevant sample types. <b>Sample Handling</b> Provide a <b>sampling protocol</b> that can be issued to each sample collector to assist with sampling (containing): Provide sample pot, storage, packaging and transit instructions. If you will supply any sampling or packaging materials, provide details and costs. Provide details of method of sample transit from all states of Australia to your laboratory / laboratories (e.g. mail, courier etc. If you will provide transit of sample materials (e.g. arrangement of couriers), provide costings for transit of sample materials. <b>Testing Plan &amp; Pricing Quotation</b> Provide a <b>test plan</b> Provide a <b>pricing quotation</b> for isotope and/or trace element testing. Include any costings relating to forwarding of samples between laboratories. <b>Turnaround Times</b> List your total Turnaround Times for results (including any time for forwarding samples between laboratories). <b>Final Results</b> Outline which testing methods will be used. Provide example sheets of final results, including imagery to illustrate method analysis, graphs / plots and confidence intervals for horticultural testing. <b>Results Ownership and Transferability</b> Will you provide fully transparent method units, numerical and graphical results? Will these results be provided in sufficiently transparent detail that they could be replicated by other laboratories? Do you have any intellectual property arrangements that prevent fully transparent sharing of the methods and results? Who will own the fully transparent results at the end of the testing process? If the relationship between our businesses ends, is the information generated by this testing process fully transferable to other laboratories as a data set? <b>Scientific Advice and Results Interpretation</b> Provide name and contact details of scientist who will provide ongoing project advice and results interpretation. If the cost of advice and interpretation is not included within the testing costs, provide costings. <b>Examples of Previous Studies</b> Provide examples of previous studies, including final results, imagery to illustrate method analysis, graphs / plots and confidence intervals. Provide examples of published results, preferably horticulture studies in peer-reviewed journals. <b>Results Publication</b> Confirm that you are in agreement with open publication of the study results.	

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### Appendix 1: (Continued)

##### Information to provide to laboratories during the quotation process

Provide a background to your industry
List the reasons why you wish to undertake laboratory traceability
Provide a basic map of your growing regions
Provide basic statistics about the number of orchards per region
Provide basic statistics about production volume per region
Describe the variety of fruit you wish to test
Outline your harvest season timings

##### Test Plan and Pricing Quotation Outline

Request the laboratory to provide the minimum testing protocol that will answer these questions in a crisis event:

1. Is this product from my country, yes or no?
2. If yes, which growing region of my country is this product from?
3. If required, which firm in my country is this product from?

	Cost per sample	Growing region 1	Growing region 2 etc	Competitor Country 1	Competitor Country 2 etc	Total
Number of Samples						
Isotope Ratio: Sample preparation						
Isotope Ratio: Isotope 1						
Isotope Ratio: Isotope 2 etc						
Trace Element: Sample preparation						
Trace Element: Element 1						
Trace Element: Element 2 etc						
Sampling Materials e.g. pots, chiller pads, polyethylene boxes etc						
Transit Costs e.g. initial transit to laboratory, or transit between laboratories						
Scientific Interpretation and Reporting Costs						
<b>GRAND TOTAL</b>						

##### Sampling Protocol

1. See example earlier in the document
2. Include instructions on:
  - a. equipment e.g. juicing method
  - b. storage of the samples in transit
  - c. documentation: sample submission forms, import permit and quarantine requirements
  - d. Transport containers, packing materials and transit method

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...including a Testing and Intellectual Property Checklist



# Thankyou

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[LinkedIn](#)



# Panel Session



National GS1 Traceability  
**Advisory Group**  
**Solution Provider Group**

## Moderator



**Peter Carter**

General Manager  
Public Policy &  
Government Engagement

## Panelists



**Cameron Scadding**



**John Keogh**



**Caroline Barrett**



**Stacey Barlow**



**Karyne Rogers**



**Nathan Hancock**

# How can you join the TSP-SIG?



- Traceability Solution Provider - Special Interest Group



Open to all industries and solution providers interested in supporting enhanced product traceability for Australian industry and governments. Traceability requirements are continually evolving. No single solution is likely to meet all industry needs, now or into the future.

You are welcome to play an active or passive role in the group with the intention of networking, sharing insights and hearing from industry and government representatives to discuss projects, issues, trends and, where possible, align needs.

There is no cost to participate in this group other than the contribution of your time.



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Thank you for joining today's session