



The Australian Wine  
Research Institute  
Annual Report 2017



Metals: a key element  
of wine provenance

## Board members

**Ms L.E. Rose**, BAppSc, BSc, GAICD  
Chair – Elected a member under  
Clause 25.2 (c) of the Constitution

**Mr T.J. Bekkers**, BAppSc (Ag)  
(Hons), Grad. Cert. (Mgt)  
Elected a member under Clause  
25.2 (c) of the Constitution

**Mr B. Bryant**, BSc (Oenology)  
Elected a member under Clause  
25.2 (c) of the Constitution (from  
1 January 2017)

**Dr J.S. Harvey**, BSc (Hons), PhD,  
MBA, GAICD  
Elected a member under Clause  
27.1 of the Constitution

**Mr K.R. Horton**, BAppSc  
(Wine Science)  
Elected a member under Clause  
25.2 (c) of the Constitution

**Dr D.L. Johnson**, BSc (Hons),  
PhD, MBA, GAICD  
*Ex officio* under Clause 25.2 (a) of  
the Constitution as Managing  
Director of the AWRI

**Prof. K.D. Kirk**, BSc (Hons),  
PhD, DPhil  
Elected a member under Clause  
25.2 (b) of the Constitution  
(from 1 January 2017)

**Mr B.M. McKinnon**, BAgSc  
(Oenology) (Hons)  
Elected a member under Clause  
25.2 (c) of the Constitution  
(until 31 December 2016)

**Dr S.C. McNab**, BAgSc (Hons), PhD  
Elected a member under Clause  
25.2 (c) of the Constitution

**Ms E.A. Riley**, BAppSc (Wine)  
Elected a member under Clause  
25.2 (b) of the Constitution

**Prof. B.P. Schmidt**, AC, FAA,  
FRS, BS (Astronomy), BS (Physics),  
AM (Astronomy), PhD  
Elected a member under Clause  
25.2 (b) of the Constitution  
(until 31 December 2016)

**Mr M.R. Watson**, BEc, MBA,  
ACA, IPAA  
Elected a member under Clause  
25.2 (b) of the Constitution

## The company

The Australian Wine Research Institute Ltd was incorporated on 27 April 1955. It is a company limited by guarantee that does not have a share capital.

The Constitution of The Australian Wine Research Institute Ltd (AWRI) sets out in broad terms the aims of the AWRI. The AWRI's activities are guided by its business and research, development and extension plans, and its stated mission, values and behaviours:

### Mission

Supporting the Australian grape and wine industry through world class research, practical solutions and knowledge transfer.

### Values

The AWRI's values provide guidance in how it will deliver its mission. These values are:

- Excellence
- Integrity
- Passion

### Behaviours

The behaviours that support those values are:

#### Excellence

- Outcomes focused, delivering results
- Personal mastery – being the best one can be
- Asking and answering the right questions
- Relevant to industry
- Collaborating to achieve faster, better or cheaper outcomes

#### Integrity

- Accountability to stakeholders
- Dealing honestly, impartially and consistently
- Scientific and professional rigour

### Passion

- Enthusiasm for our people, our industry, and our products
- Spirit of creativity
- Enjoying work and celebrating achievements
- Desire to do better
- Pursuing knowledge and understanding

The AWRI's laboratories and offices are housed in the Wine Innovation Central Building within an internationally renowned research cluster on the Waite Research Precinct at Urrbrae in the Adelaide foothills. Grape and wine scientists from other organisations are co-located with the AWRI in the Wine Innovation Central Building.

The Waite Research Precinct is also home to other research and teaching organisations including: Australian Centre for Plant Functional Genomics (ACPF), Australian Genome Research Facility (AGRF), Australian Grain Technologies (AGT), Australian Plant Phenomics Facility, the ARC Centre of Excellence in Plant Cell Walls, CSIRO, South Australian Research and Development Institute (SARDI), the University of Adelaide's *School of Agriculture, Food and Wine* and the Waite Research Institute.

### Registered office

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Louisa Rose

This has been an important year for the Australian wine community. The positive signs of improved economic performance evident for the past couple of years were sustained and enhanced, and there were tangible improvements in export volumes and values, grape prices and general sentiment.

Reforms were made in areas across the industry, notably including taxation, and new opportunities arose to present Australian wine in key export markets and ensure that international perceptions align with the quality of the wine we produce.

The research community plays a central role in underpinning these successes. The Australian wine industry has come to rely on the research network, led by the AWRI as its own research organisation, to be there in all seasons, good and bad, to provide the answers, support and seeds of innovation so essential for its continued success.

These factors, and the general sense of optimism, were all on show at the 16<sup>th</sup> Australian Wine Industry Technical Conference and Trade Exhibition (AWITC&TE) in July 2016. New partnerships saw the sector bring together its key business and marketing event, the Winemakers' Federation of Australia Outlook Conference, and its key technical event, the AWITC&TE, into a single forum with content of interest to all across the value chain. Inclusion of the McWilliam's Maurice O'Shea

Award dinner into the program recognised the importance of innovation in the careers of many recipients of this award. Webcasts and proceedings for this event are now available, and planning is well underway for the next event to be held in Adelaide in July 2019.

Positive reform is also underway in the research, development and extension (RDE) community. The AWRI and its key stakeholders and investors have closely evaluated the performance of the RDE system and made a number of amendments and improvements, all of which are designed to produce the best possible return for those growing grapes and making wine. This review yielded useful insights into the optimal structure for partnerships between Wine Australia and the AWRI. It was recognised that longer-term agreements and high-trust investment frameworks provide greater longer-term certainty and reduced risk when establishing projects, increase the ability of all parties to adapt to changing industry needs, and maximise investment in value-adding activities.

The review was instrumental in the formation of a renewed Wine Australia – AWRI partnership agreement for 2017-2025, with a revised AWRI RDE plan, which takes effect on 1 July 2017.

A lot has been achieved in a short time, and the key players in this discussion, notably the AWRI and Wine Australia, will continue the reform journey over next year and beyond. Wine Australia is thanked for its commitment to this process and for its continued support for the work of the AWRI, without which very few of the outstanding outcomes in this annual report would be possible.

The AWRI Board is warmly thanked for its commitment and contributions, with a particular acknowledgement this year to two concluding Directors, Brett McKinnon and Prof. Brian Schmidt, both of whom made a substantial contribution during their tenure. The Board welcomed Ben Bryant and Prof. Kieran Kirk from 1 January 2017, and both new Directors have already contributed significantly to the Board's deliberations.

The outstanding AWRI management team and staff, led by Dr Dan Johnson, are commended for another very busy year of high quality, dedicated science and service.

A handwritten signature in black ink that reads "Louisa Rose".

Louisa Rose  
Chair

## The innovation story

Innovation is one of the defining characteristics of Australian wine. It has been central to our rise from relative obscurity to a global player in the world of wine, worthy of inclusion in any list of great wine producers and exporters.

Innovation takes many forms, but at a technical level our wine sector uses it to:

- manage production risks, particularly in areas such as biosecurity, and to address some of the inherent challenges that arise in our country and climate such as bushfires, water availability and climate variability
- make or save money in production by improving quality and production efficiency – achieving a comparable product at a lower cost, or hitting a higher quality standard or a desired style
- prevent or reduce technical trade barriers, and secure access to relevant markets.

These benefits are all very evident to practitioners, who go about their businesses very differently today than they did 50, 20 or even 5 years ago. The pace of change is relentless and increasing, and as the half-life of competitive advantages is not what it once was, it can seem like a race without a finish line.

Fortunately, innovation is a point of difference for Australian wine. The system we have to support grape and wine research, development and extension (RDE) in Australia is world class.

In the last year or so our sector has started to make that point of difference clearer to the international market and other key thought leaders. Specifically, through a collaboration between Wine Australia and the AWRI, visitors from around the world are having, as a component of their itinerary, some exposure to the research that underpins Australian wine.

Groups of buyers, sommeliers, journalists, regulators and other key international influencers visit Australia, see the rock, the reef and the bridge, visit regions and producers, and spend part of their time – a few hours, or an afternoon – hearing about the latest Australian wine research. Similar experiences are also provided for other relevant domestic stakeholders, such as bankers and consultants.

These visitors see the laboratories, the research infrastructure and the experimental vineyards and wineries.

They see some of the thousands of individual wines from across Australia that are routinely analysed and subjected to technical quality assurance systems.

They hear about the research programs, and see how they translate into the product enjoyed by consumers, at the same time gaining an insight into the scale of the science that underpins all Australian agriculture.

Feedback from visitors has been very positive and these experiences are undoubtedly contributing to the overall perception of Australian wine.



Dan Johnson

## Technical trends

As with previous years, the nature of the industry's technical support needs over the past 12 months was reflected in the volume, timing and nature of enquiries answered by the AWRI helpdesk team, and the associated extension activities of the AWRI as a whole.

The start of the growing season was wetter than average, which presented many challenges, including preventing some growers from accessing vineyards to deliver the first few critical agrochemical sprays. The wet soils also kept soil temperatures low, slowing early growth and leading to uneven budburst.

Once the weather warmed up, soil moisture drove strong canopy growth and dense foliage required more frequent trimming to allow sprays and light to penetrate into the canopy. With high soil moisture, shoots continued to grow later into the season. As a result, fruit began to ripen very slowly across many regions and this contributed to a later harvest – in some regions, as much as three or four weeks later than in 2015 and 2016.

Throughout the year a total of 4,140 information requests, helpdesk enquiries and problem investigations were addressed, and the AWRI Commercial Services laboratories completed analyses on more than

23,500 samples. A total of 1,696 enquiries and requests for assistance were addressed by the helpdesk, with more than 90% of these answered within 24 hours.

The majority of the enquiries received were from wine companies and suppliers closely aligned with the wine industry, with the remaining queries made up from government organisations, students, legal practitioners and journalists. A total of 208 queries ultimately resulted in investigations, where samples were requested and analysis performed to identify the problem and how it could be remediated.

Most viticultural enquiries over vintage were associated in some way with the cooler/wet season and pest and disease management. More than half of these could be classified under three headings – agrochemicals, pests and disease, and spray drift.

The cooler and overcast conditions favoured the growth of powdery mildew, and also many vineyard insects. High populations of millipedes, light brown apple moth caterpillars, mealy bugs and scale insects were seen, as well as some of their predators, including spiders. In some regions where scale populations were high, 'sooty mould' was an issue which resulted in the downgrading, or even rejection, of fruit.

High soil moisture in spring was also responsible for strong midrow growth, which meant that growers needed to perform more tractor passes to slash or spray herbicide. Unfortunately, wet conditions also delayed access to broadacre farms, resulting in the continued growth of weeds on those farms late into the season. This in turn led to later than usual use of herbicides, which in some cases drifted into vineyards from neighbouring properties and caused damage to grapevine canopies. Reports of leaf damage caused by herbicide drift were received from diverse regions across Australia.

With increased levels of powdery mildew seen late in the growing season, numerous queries were received on how to best manage powdery mildew-affected fruit in the winery. While this disease is commonly managed in the vineyard using fungicide sprays, after veraison commences there are limited control options available that satisfy the regulatory requirements of export markets, and this year some affected fruit was seen in wineries. Advice was provided to assist producers with harvesting and sorting fruit, and to help with pressing and processing aids so as to best manage affected fruit and minimise any sensory impacts.

The helpdesk team also received a number of queries about acidity levels in wines associated with the cooler vintage conditions. While pH levels were generally considered 'normal', titratable acidity levels were commonly slightly higher than usual, caused by higher levels of malic acid in fruit. Reports of 3-4 g/L malic acid were common in regions that usually show only half this amount.

In February, the Australia New Zealand Food Standards Code was amended to permit the limited addition of water to high sugar must and juice to reduce the chance of fermentation problems. Following this amendment, water may be added to high sugar juice or must prior to fermentation to reduce the sugar level to no less than 13.5°Baumé (equivalent to 24.3°Brix). This means that the amount of water able to be added is dependent on the initial sugar level of the juice or must. Articles and a new water addition calculator were prepared to support winemakers in adjusting to this changed regulation; however, high sugar musts did not appear to be a significant issue this vintage, due to the cooler conditions.

## Project highlights

June 2017 saw the conclusion of an overarching AWRI RDE plan and associated investments with key partners, which had been active since July 2013. It's humbling to reflect on what has been achieved by the AWRI team and collaborators working closely with producers during this period. A final report covering the activities conducted in partnership with Wine Australia will be made available from the websites of Wine Australia and the AWRI. This report details highlights in areas across the AWRI's research portfolio. It also outlines key outcomes in extension and industry assistance.

A full list of highlights from 2016/2017 is included elsewhere in this report, but some worth particular mention are listed below:

- High coverage data from resequencing of 15 Chardonnay clones was mapped to a curated Chardonnay reference genome. From a total of 2.46 million single nucleotide variants (SNPs) identified across all clones, 1,264 SNPs were identified as distinguishing specific clones. Some of these SNPs are shared between clones, revealing some degree of shared heritage. Most SNPs are, however, unique to individual clones, and as a result may represent suitable clone-specific markers.
- The comparative genomic evaluation of Shiraz clonal material for the SARDI-led 'Clones for Climate Change' project was completed. The dataset includes clones that are relatively recent imports into Australia and clones derived from Australian clonal identification programs dating to the 1950s. A reference genome was constructed by combining a synthetic long read library preparation technology with Illumina short read sequencing. Mapping of short read data to the reference enabled the identification of 265 SNPs as being different in at least one of the clones. Comparative analysis showed the recently imported Shiraz clonal selections to be more like each other than to the Australian clonal selections.
- Genotyping by DNA sequencing of powdery mildew isolates from the SARDI-led collaborative project 'Understanding fungicide resistance in powdery mildew, downy mildew and botrytis' demonstrated widespread presence of a known allele responsible for loss of sensitivity to the demethylation inhibitor (DMI) group of fungicides, with 70 population samples having more than 50% of the variant with the resistance-related mutation.
- DNA-barcoding analysis was used to assess fungal diversity during the progression of fermentation in wine samples from over 150 commercial uninoculated ('wild') Chardonnay and Shiraz ferments. Over 79 different genera of yeast and fungi were recorded across the samples, indicating a substantial degree of microbial diversity. Results also indicated that the uninoculated ferments were completed to a very high degree by non-commercial 'wild' strains, considered likely to have originated from the surrounding environment.
- AWRI staff provided technical support to Australian Vignerons in two emergency plant pest categorisation exercises and delivered project management to a review of national grapevine phylloxera management.
- Entwine vineyard members completed a Best Management Practice survey for the first time. Almost 200 vineyard businesses completed the survey, which enabled them to benchmark their management of land, soil, chemicals, fertilisers, soil additives, water, biodiversity, biosecurity, waste, air, energy, fuel, human resource and worker health and safety against others. The results showed a high proportion of members operating at best practice and also highlighted some areas for improvement.

- Experiments assessing the impact on texture, tannin, polysaccharide and colour outcomes in red wine from using various approaches to produce lower alcohol wine showed promising results. Harvesting grapes earlier, using winemaking additives (enzyme, marc) and adding water to must were all trialled. Harvesting earlier consistently resulted in wines with lower wine tannin, polysaccharide and colour. Interestingly, adding both enzyme and marc to a ferment of early-harvested grapes resulted in similar tannin concentrations to a wine made from grapes at 'normal' commercial ripeness levels. Also, surprisingly, wines produced with water-diluted must consistently had higher levels of tannin and colour than wines of the same alcohol concentration produced from earlier harvested grapes.
- The effect of dissolved CO<sub>2</sub> on the flavour, taste and mouth-feel of still white wine was quantified for the first time. Commercially available Chardonnay and Viognier wines were each adjusted to two acidity, two alcohol, and four CO<sub>2</sub> levels typical of those found in white wine and presented for tasting in volumes and at a temperature normally experienced during wine consumption. Preliminary results suggest that dissolved CO<sub>2</sub> in still white wine interacts with wine acidity and alcohol to affect the perception of white wine bitterness, sweetness and hotness.
- Dimethyl disulfide, methyl thioacetate and ethyl thioacetate were identified as important precursor compounds for the 'reduced' aroma compounds methanethiol and ethanethiol. Factors such as copper addition to wine and wine pH remain important in determining 'reductive' aroma accumulation in wines post-bottling. In addition, a strong positive correlation was observed between the amount of H<sub>2</sub>S produced by yeast and the concentration of other negative volatile sulfur compounds, such as methyl thioacetate, ethanethiol, ethyl thioacetate and carbon disulfide, in both grape juice and synthetic juice fermentations.
- Working with the International Wine Challenge, AWRI Commercial Services analysed the results from more than 100,000 show entries over 10 years to assess the impact of closures on common wine faults. This analysis shows that despite the common belief that screw caps can lead to a greater prevalence of reductive characters in wine than corks, the levels of rejection for reductive characters for the two closure types was the same (at 0.81% of entries). These results suggest that reductive faults are more strongly linked to winemaking practices than to closure type.
- A survey of 104 Australian white wines (Chardonnay, Sauvignon Blanc, Pinot Gris, Riesling and Viognier) was completed to determine the prevalence of the compound dairy lactone, which has been implicated in recent AWRI work as potentially contributing to 'stone fruit' aroma in white wines. Of the young white wines analysed, 99 out of 104 were found to contain detectable levels of dairy lactone, with Riesling and Viognier wines containing the highest concentrations. Two sensory descriptive analysis studies investigating the role of lactones and monoterpenes in 'stone fruit' flavour were also conducted. Overall this research showed that monoterpenes play a role in 'stone fruit' character in non-floral varieties, with a smaller contribution from several lactones.
- A new wine compound that is perceptually similar to the 'classic' bitter phenol epicatechin was identified using sensory projective mapping techniques. This is a significant practical and scientific finding, as relatively few bitter compounds have been identified in wine to date.
- A new wine show management system (now known as 'ShowRunner'), which covers all aspects of administering a wine show from online entries to electronic scoring and instant production of results, was developed and launched. The underlying software began as a tailored scoring solution for the Advanced Wine Assessment Course, and has been extensively adapted to reflect the processes and practices of the Australian wine show system. Three shows used the system in 2016/2017, and by the end of calendar year 2017 it is expected that more than 20 wine shows across Australia will have been conducted using ShowRunner.
- It was a record year for the extension and events team, delivering 79 events to 2,062 participants across Australia, and internationally supporting Wine Australia – the highest number of events ever staged by the AWRI within a 12-month period. The content delivered covered a broad range of topics in grape and wine production as well as tasting masterclasses and Advanced Wine Assessment Courses. The events team also coordinated the workshop program for the 16<sup>th</sup> AWITC, with 39 workshops presented.

## New directions

A new RDE plan commences in July 2017. This plan is the result of a comprehensive consultation with key stakeholders, and forms the backbone of a new investment agreement with Wine Australia. A great deal of strategic planning has gone into this new plan, and the AWRI Board and staff keenly await the implementation phase in the next financial year. A copy of the new AWRI RDE plan will be distributed to levy payers and made available from the AWRI website.

Other important strategic activities during the year included work on:

- the successful proposal to establish a Cooperative Research Centre (CRC) for Food Agility, in which the AWRI is a foundational partner, and with which the AWRI will focus on RDE related to sustainability platforms
- a promising new CRC bid 'Fight Food Waste and Fraud'
- national research infrastructure roadmaps, particularly with Bioplatforms Australia
- harmonising and realising the full value of Australian environmental sustainability programs
- the formation of the South Australian Food Innovation Centre, which presents an important opportunity to harness the resources of the food and wine communities in RDE and innovation, and to explore opportunities at the food/wine interface.





## Investing for the future

Following the previous development of a new AWRI reserves investment policy, a diversified investment portfolio became fully implemented over the year, under the direction of the AWRI's investment manager Ord Minnett. This portfolio, consisting of investments all quoted and actively traded on the Australian Securities Exchange, reduces the AWRI's exposure to a single class of investment assets, while substantially enhancing the investment returns available for deployment towards infrastructure and activities of benefit to the grape and wine community. The existence of a capital reserve, together with the investment returns realised in 2016/2017, allowed the AWRI to budget for a modest deficit and make a number of strategic investments in the interests of the sector, including:

- two replacement LC/MS units, with one now available for all industry smoke taint incidents
- a new Laboratory Information Management System (LIMS) for AWRI Commercial Services, facilitating better services for customers and improved laboratory operations
- several 'blue sky' investments in projects, including:
  - a survey of industry production practices, which is allowing evaluation of adoption of technologies and R&D outcomes and identification of opportunities for improvement
  - improvements to technologies such as the AWRI Ferment Simulator
  - a new software platform for wine show management, judging and classifications (ShowRunner)
- other capital equipment items which, together with the items outlined above, resulted in an investment greatly exceeding depreciation and thus a net improvement in the AWRI's capital base.

## Recognition

It was pleasing to see a number of the AWRI's staff members and research groups receive prizes, awards, personal scholarships and other external recognition throughout the year. It was also pleasing to be able to assist with the career growth and professional development of a number of staff, with those departing the organisation remaining close collaborators and facilitating several internal promotions.

## Thank you

The AWRI is widely regarded among the world's top grape and wine RDE institutions. The RDE system in Australia and the people of the AWRI are what make it so. Credit is due to the AWRI's Board (particularly its Chair Louisa Rose), investors (particularly Wine Australia), the sector's policy/advocacy bodies, the Australian Government, every entity involved in grapegrowing and winemaking, collaborating institutions and the wonderful people that constitute team AWRI. A huge thanks to all of you for your dedication to the AWRI and its service of the grape and wine community.

Dr Dan Johnson  
Managing Director



## Board notes

### Chair

Ms L.E. Rose

### Audit committee

Mr M.R. Watson (Chair)  
Mr T. J. Bekkers  
Dr S.C. McNab

### Personnel committee

Ms L.E. Rose (Chair)  
Mr B. Bryant  
Prof. K.D. Kirk

## Meetings

### Ordinary General Meeting

The 62<sup>nd</sup> Ordinary (Annual) General Meeting was held on 29 November 2016.

### Extraordinary General Meeting

There were no Extraordinary General Meetings held.

### Board

The Board of the AWRI met on the following dates: 20 September 2016, 29 November 2016, 28 February 2017 and 30 May 2017.

## Investment

The Board of the AWRI acknowledges the continuing financial support of Wine Australia, the Government of South Australia, the Australian Government Department of Agriculture and Water Resources, Bioplatforms Australia and the Grains Research and Development Corporation, along with a large number of confidential commercial clients.

## Appreciation

Activities at the AWRI benefit from collaborations from individuals and organisations from the following different countries: Australia, USA, France and Germany. The assistance and cooperation from partners across the globe are gratefully acknowledged.





## General

### RDE plan completed

June 2017 saw the conclusion of an AWRI RDE plan and associated investments, which had been active since July 2013. A final report covering the activities conducted in partnership with Wine Australia over that time will be made available from the websites of Wine Australia and the AWRI.

### Science and innovation award

Dr Natoiya Lloyd was awarded the 2017 Science and Innovation Award for Young People in Agriculture, which included a grant to fund investigations of smoke taint in wine using a non-targeted metabolomics approach.

### Diversified investment portfolio

Following the previous development of a new investment policy, a diversified investment portfolio became fully implemented over

the year, under the direction of the AWRI's investment manager Ord Minnett. This portfolio, consisting of investments all quoted and actively traded on the Australian Securities Exchange, reduces the AWRI's exposure to a single class of investment assets, while substantially enhancing the investment returns available for deployment towards infrastructure and activities of benefit to the grape and wine community.

### Ongoing implementation of the IT Strategic Plan

The implementation of the previously developed IT Strategic Plan continued throughout the year, supported by the existing Strategic IT reserve. Highlights included the expansion of storage capabilities, enhancement of virtual server infrastructure, implementation of new and updated Microsoft platforms and applications (including SharePoint migration), improved back-up procedures, and strengthening of various aspects of network security. Such enhancements continue to add considerable value to almost every aspect of the AWRI's operations.

## Environment and sustainability

### Assessing clonal genetic variation in Chardonnay

High coverage data from resequencing of 15 Chardonnay clones was mapped to a curated Chardonnay reference genome. From a total of 2.46 million single nucleotide variants (SNPs) identified across all clones, 1,264 SNPs were identified as distinguishing specific clones. Some of these SNPs are shared between clones, revealing some degree of shared heritage. Most SNPs are, however, unique to individual clones and as a result may represent suitable clone-specific markers.

### Assessing diversity of Australia's Shiraz grapevine germplasm

The comparative genomic evaluation of Shiraz clonal material for the SARDI-led 'Clones for Climate Change' project was completed. The dataset includes clones that are relatively recent imports into Australia and clones derived from Australian clonal identification programs dating to the 1950s. A reference genome was constructed by combining a synthetic long read library preparation technology with Illumina short read sequencing. Mapping of short read data to the reference enabled the identification of 265 SNPs as being different in at least one of the clones. Comparative analysis showed the recently imported Shiraz clonal selections to be more like each other than to the Australian clonal selections.



### Understanding the genetic basis for pesticide resistance

Genotyping by DNA sequencing of powdery mildew isolates from the SARDI-led collaborative project 'Understanding fungicide resistance in powdery mildew, downy mildew and botrytis' demonstrated widespread presence of a known allele responsible for loss of sensitivity to the demethylation inhibitor (DMI) group of fungicides, with 70 population samples having more than 50% of the variant with the resistance-related mutation.

### Investigating fungal diversity in 'wild' ferments

DNA-barcoding analysis was used to assess fungal diversity during the progression of fermentation in wine samples from over 150 commercial uninoculated ('wild') Chardonnay and Shiraz ferments. More than 79 different genera of yeast and fungi were recorded across the samples, indicating a substantial degree of microbial diversity. Results also indicated that the uninoculated ferments were completed to a very high degree by non-commercial 'wild' strains, considered likely to have originated from the surrounding environment.

### Biosecurity support

AWRI staff provided technical support to Australian Vignerons in two emergency plant pest categorisation exercises and delivered project management to a review of national grapevine phylloxera management.

### Entwine Australia survey

In 2016, Entwine vineyard members completed a Best Management Practice survey for the first time. Almost 200 vineyard businesses completed the survey which enabled them to benchmark their management of land, soil, chemicals, fertilisers, soil additives, water, biodiversity, biosecurity, waste, air, energy, fuel, human resource and worker health and safety against others. The results showed a high proportion of members operating at best practice and highlighted some areas for improvement.

## Consumers, customers and markets

### Sensory descriptors familiar to Chinese wine consumers

In a collaborative research project 'Testing lexical equivalences for wine flavours in emerging markets: do hawthorns taste like blackberries?' with UniSA, the use of Chinese vs Western sensory descriptors by Chinese wine consumers was analysed. The results (published in the *Journal of Food Quality and Preference*) demonstrated that generic wine descriptors were used three times more often than specific descriptors and that there were only a few differences in the use of Chinese and Western generic terms.

### Wine and health submission

A scientific submission was prepared which provides evidence on the health effects of alcohol consumption for the review of the National Health and Medical Research Council's (NHMRC) alcohol drinking guidelines.

### 'Dog book' expanded

The 'Dog book' continues to be the premier source of pest and disease control advice for Australian grapegrowers. It has now been expanded to include information that will improve grower awareness of biosecurity threats. A new active constituent for controlling powdery mildew (Difenoconazole) was also registered for grape production during the year.

### Regulatory databases updated

The AWRI's databases *Analytical requirements for the export of Australian wines* and *Permitted additives and processing aids for winemaking and wine importing countries* were updated to include analytical requirements for 44 individual countries and information on permitted additives and processing aids in 28 individual countries.

# Improving products and processes

## Retaining texture and colour in lower alcohol wines

Experiments assessing the impact on texture, tannin, polysaccharide and colour outcomes in red wine from using various approaches to produce lower alcohol wine showed promising results. Harvesting grapes earlier, using winemaking additives (enzyme, marc) and adding water to must were all trialled. Harvesting earlier consistently resulted in wines with lower wine tannin, polysaccharide and colour. Interestingly, adding both enzyme and marc to a ferment of early-harvested grapes resulted in similar tannin concentrations to a wine made from grapes at 'normal' commercial ripeness levels. Also, surprisingly, wines produced with water-diluted must consistently had higher levels of tannin and colour than wines of the same alcohol concentration produced from earlier harvested grapes.

## Measuring the effect of dissolved carbon dioxide on the taste and texture of still white wine

The effect of dissolved CO<sub>2</sub> on the flavour, taste and mouth-feel of still white wine was quantified for the first time. Commercially available Chardonnay and Viognier wines were each adjusted to two acidity, two alcohol, and four CO<sub>2</sub> levels typical of those found in white wine and presented for tasting in volumes and at a temperature normally experienced during wine consumption. Preliminary results suggest that dissolved CO<sub>2</sub> in still white wine interacts with wine acidity and alcohol to affect the perception of white wine bitterness, sweetness and hotness.

## A faster heat test

The heat test is the most widely used method in industry for assessing heat stability of white wines and determining bentonite fining rates. This key method has now been optimised to be both shorter and more reproducible. Different versions of the test, with a range of heating and cooling times and cooling temperatures, were investigated and a 5-hour test (heating wine for 2 hours at 80°C in a water bath and cooling for 3 hours at 20°C) was found to work well. A range of different white wines were fined at the bentonite dose rates predicted by a 24-hour version of the heat test and the shorter 5-hour method. Wines fined by each method were clear after 12 months of storage, while haze was observed in the control (unfined) wines. These results demonstrate that it is viable to reduce the total heat test to 5 hours, enabling same-day results.

## Timing of oxygen use is key to minimising 'reduced' aromas during fermentation of Shiraz

The timing of oxygen additions during primary fermentation is crucial in obtaining maximum advantage in terms of fermentation efficiency, aroma and palate structure. Optimal timing of oxygen addition (from a fermentation performance gain perspective) was compared to later addition and repeated aerations in pilot-scale (500 L) Shiraz fermentations. Sensory analysis one year after vintage showed 'Early' and 'Daily' oxygen treatments resulted in wines higher in 'fruity' and 'floral' characters and this was consistent with the results of chemical analysis. In comparison the 'No-Treatment', 'Late' and 'Post-Press' treatments were found to give higher levels of 'reductive', 'vegetal', 'earthy' and 'black olive' characters and lower intensity of fruit characters. The latter treatments had higher concentrations of volatile sulfur compounds.

## Discovery of factors that influence 'reductive' aroma accumulation in wines post-bottling

Dimethylsulfide, methyl thioacetate and ethyl thioacetate were identified as important precursor compounds for the 'reduced' aroma compounds methanethiol and ethanethiol. Factors such as copper addition and wine pH remain important in determining 'reductive' aroma accumulation in wines post-bottling. In addition, a strong positive correlation was observed between the amount of H<sub>2</sub>S produced by yeast and the concentration of other negative volatile sulfur compounds, such as methyl thioacetate, ethanethiol, ethyl thioacetate and carbon disulfide, in both grape juice and synthetic juice fermentations.

## Improved understanding of the role of closures in wine faults

Working with the International Wine Challenge, AWRI Commercial Services analysed the results from more than 100,000 show entries over 10 years to assess the impact of closures on common wine faults. This analysis showed that despite the common belief that screw caps can lead to a greater prevalence of reductive characters in wine than natural corks, the levels of rejection for reductive character for the two closure types was exactly the same (at 0.81% of entries). These results suggest that reductive faults are more strongly linked to winemaking practices than to closure type. This data is consistent with results from long-term closure trials at the AWRI which showed that while closure choice did have some impact, the difference in levels of reductive compounds between closures was much less than the overall changes seen in the wine over the same period. The rate of rejection for all faults for wine sealed with cork closures was significantly higher (4.7%) than that for wines sealed with screw cap closures (1.6%).

## Identification and origin of volatile compounds responsible for important sensory attributes

Following recent AWRI studies showing the role of isobutyl methoxypyrazine (IBMP) and dimethyl sulfide (DMS) in 'green' flavour attributes of Shiraz wine, several sensory studies were carried out to investigate the interactions of these compounds. IBMP was an important contributor to 'green' flavour in a Shiraz base wine even at a low concentration (4 ng/L), and an additive effect was observed for the combination of IBMP with dimethylsulfide and (Z)-3-hexen-ol in red wine.

In further investigations of possible causes of 'green' flavour in red wine, the sensory profiles of Shiraz wines made with 'added stems' and 'added grape leaves' were compared to a 'berries only' control wine. This study demonstrated that producers who include whole bunches in red ferments should be aware of the potential for enhancement of 'green' characters in their wines.

### 'Stone fruit' flavour in white wines

A survey of 104 Australian white wines (Chardonnay, Sauvignon Blanc, Pinot Gris, Riesling and Viognier) was completed to determine the prevalence of the compound dairy lactone, which has been implicated in recent AWRI work as potentially contributing to 'stone fruit' aroma in white wines. Of the young white wines analysed, 99 out of 104 were found to contain detectable levels of dairy lactone, and Riesling and Viognier wines contained the highest concentrations. Two sensory descriptive analysis studies investigating the role of lactones and monoterpenes in 'stone fruit' flavour were also conducted. Overall this research showed that monoterpenes play a role in 'stone fruit' character in non-floral varieties, with a smaller contribution from several lactones.

### New bitter compound identified

A new wine compound that is perceptually similar to the 'classic' bitter phenol epicatechin was identified using sensory projective mapping techniques. This is a significant practical and scientific finding, as relatively few bitter compounds have been identified in wine to date.

### Filtration trial completed

A trial was completed that compared crossflow, lenticular and membrane filtration for industry-scale commercial red winemaking. The results showed no change in wine colour, tannins or polysaccharides with filtration and minimal impact of these common filtration practices on the textural attributes of red wines after 18 months of ageing. The full story can be read in the *American Journal of Enology and Viticulture*.

## Extension and adoption

### Helpdesk support provided

The AWRI helpdesk responded to 1,696 enquiries and conducted 208 winemaking investigations. More than 90% of queries were answered within 24 hours. The growing season was wetter and cooler than recent years for many regions, leading to slow early growth and uneven budburst. Vintage was three to four weeks later than 2015 and 2016 in many areas. Queries about agrochemical issues were common, and numbers of enquiries and investigations on smoke taint were much lower than recent years.

### Events delivered

It was a record year for the extension and events team, delivering 79 events to 2,062 participants across Australia, and internationally supporting Wine Australia – the highest number of events staged by the AWRI within a 12-month period. The content delivered covered a broad range of topics in grape and wine production as well as tasting masterclasses and Advanced Wine Assessment Courses. The events team also coordinated the workshop program for the 16<sup>th</sup> AWITC, with 39 workshops presented.

### ShowRunner

A new wine show management system (now known as 'ShowRunner'), which covers all aspects of a wine show from online entries to electronic scoring and instant production of results, was developed and launched. The underlying software began as a tailored solution for the Advanced Wine Assessment Course and has been extensively adapted to reflect the processes and practices of the Australian wine show system. Three shows used the system in 2016/2017, and by the end of calendar year 2017 it is expected that more than 20 wine shows across Australia will have been conducted using ShowRunner.

### Library services

The John Fornachon Memorial Library collection now includes more than 87,900 items. During 2016/2017 the library responded to nearly 1,500 reference enquiries; delivered 2,327 journal articles; introduced a second eBook platform; and expanded the collection to 121 eBooks. Usage of online information packs is increasing, with a total of 765 articles delivered in 2016/2017 (140 more than the previous year).

### Webinars

The AWRI's sixth webinar series was held during the year, featuring 20 webinars with 315 attendees. Approximately one-third of the webinars were delivered by AWRI staff and the remainder by invited researchers and industry experts.

### In-person interactions

Throughout the year AWRI staff gave 340 external presentations, coordinated 105 events, authored 90 posters, conducted 47 media interviews, presented 22 lectures to university students and supervised or co-supervised 18 students.

### Publications

In 2016/2017 AWRI staff authored 81 peer-reviewed and non-peer-reviewed papers for scientific journals and industry publications.

### Stakeholder communications

Six AWRI reports and six columns on alternative varieties were published in the *Wine and Viticulture Journal*. Twelve 'Ask the AWRI' columns covering issues from the AWRI helpdesk were published in the *Australian & New Zealand Grapegrower & Winemaker*. New technical literature published from around the world was abstracted in six issues of *Technical Review*. Grapegrowers and winemakers were alerted to topical issues in 24 *eBulletins* issued through the year. Updates of AWRI activities were provided in six issues of *eNews*, emailed directly to producers.

### Social media engagement

The AWRI's followers on Twitter grew by more than 220 to 3,315 during the year. The AWRI's Facebook 'likes' also grew by more than 200 likes to a total over 750.

## Service capabilities and foundational datasets

### Analysis record for AWRI Commercial Services

In 2016/2017 the Commercial Services laboratories processed more than 23,500 samples, an increase of 2% over the previous record year. This ongoing trend reflects the increased efficiency seen in the laboratories with the average daily sample throughput in the analytical lab increasing from 34 samples per day in 2010 to more than 71 in the first half of 2017 with no significant changes in staff numbers.

### New laboratory computer system

This year AWRI Commercial Services went live with its new Laboratory Information Management System (LIMS). The new system has seen immediate improvements in sample management, results reporting and invoicing. Going forward it will give customers much greater flexibility in ordering services and monitoring the progress of analyses.

### WIC Winemaking Services

In the 2017 vintage WIC Winemaking processed more than 400 parcels of fruit, over a long and drawn out season. Major improvements were also made to capabilities in a number of critical quality control points.

Readers are strongly encouraged to read the annual report in detail rather than relying on the brief details above for information.

### Acknowledgements

**Edited** by Ella Robinson, Dan Johnson and Peter Godden

**Compilation assistance** from Natalie Burgan, Chris Day, Shiralee Dodd and Alfons Cuijvers

**Design** by Geoffrey Reed Communications

**Photography** by Andy Stevens Photography and Jacqui Way Photography



Mark Braybrook, Eric Wilkes

The actual number of AWRI staff employed in a full-time, part-time and casual capacity as at 30 June 2017 was 116 (95.49 full-time equivalents). When the number of AWRI-based students (both from Australia and overseas) and visiting researchers is added, the total increases to 122. Of these, approximately 57% were funded by Wine Australia in 2016/2017.

## Office of the Managing Director

**Dan Johnson**, BSc (Hons), PhD *Flinders*, MBA *UniAdel*, GAICD, Managing Director

**Vince O'Brien**, BE (Chem) (Hons) *UniAdel*, PhD *UniQld*, General Manager Business Development (concluded 16 June 2017)

**Mark Krstic**, BAgSc (Hons), PhD *UniTas*, MBA *MelbBusSchool*, Business Development Manager

**Ella Robinson**, BA, BSc (Hons) *UniAdel*, Communication Manager

**Shiralee Dodd**, BA, LLB (Hons) *UniAdel*, Company Secretary

**Gregoire Patacq**, MEngAgron *Purpan Engineering School France*, Adv Master Strategic Mgt Int Bus *ESSEC Singapore*, Scientist (concluded 2 June 2017)

**Natalie Burgan**, Cert IV (Bus Admin) *National Group Training*, Executive Assistant to the Managing Director (started 13 June 2017)

**Annette Freeman**, DipBusAdmin *Upskilled*, Executive Assistant to the Managing Director (concluded 30 June 2017)

**Sarah Ballantine**, BSc (Hons) (Chem) *UniAdel*, Wine Innovation Cluster Executive Officer (concluded 21 October 2016)

## Corporate Services

**Chris Day**, BAgSc (Oen), MBA *UniAdel*, Grad Cert Chartered Accounting Foundations *Deakin, CA*, GAICD, Group Manager – Corporate Services

**Mark Braybrook**, Cert IV (Eng/Mech Trade) *TAFE*, Operations Manager

**Kate Beames**, AWITC Conference Manager

**Andrea Francis**, BSc *UniWA*, GradDip (EnvSci) *Murdoch*, AWITC Conference Secretariat (concluded 11 October 2016)

**Adam Holland**, Cert IV (IT) *NTUni*, IT Manager

**Alfons Cuijvers**, MLaw *UniAntwerp*, Human Resources Coordinator

**Catherine Borneman**, BBus (Acc) *RMIT, CA*, Accountant

**Fang Tang**, Undergrad (Foreign Econ) *RenminUniChina*, GradDip (FinMgt), MCom *UniNewEng*, Finance Officer

**Pauline Jorgensen**, Cert III (Bus Admin) *TAFE SA*, Finance Officer

**Kylee Watson**, Cert III (Fin Services) *TAFE SA*, Finance Officer

**Deborah Thornton-Wakeford**, Receptionist

**Jennifer O'Mahony**, Receptionist

## Research

**Markus Herderich**, staatlich geprüfter Lebensmittelchemiker (CertFoodChem), PhD *UniWürzburg*, Group Manager – Research

**Anthony Borneman**, BSc (Hons), PhD *UniMelb*, Principal Research Scientist – Molecular Biology

**Paul Chambers**, BSc (Hons), PhD *UniHertfordshire*, Research Manager – Biosciences (concluded 17 February 2017)

**Chris Curtin**, BSc (Hons), PhD *Flinders*, Research Manager – Biosciences (concluded 10 August 2016)

**Leigh Francis**, BSc (Hons) *Monash*, PhD *UniAdel*, Research Manager – Sensory and Flavour

**Simon Schmidt**, BSc (Hons), PhD *Flinders*, Research Manager – Biosciences

**Yoji Hayasaka**, DipEng (Ind Chem) *Tokyo IT*, MPharm *Victorian College of Pharmacy Monash*, PhD *Yamanashi*, Senior Research Scientist – Mass Spectrometry

**Paul Henschke**, BSc (Hons), PhD *UniAdel*, Emeritus Fellow

**Paul Smith**, BSc (Hons), PhD *Flinders*, Research Manager – Chemistry

**Eveline Bartowsky**, BSc (Hons), PhD *UniAdel*, Senior Research Scientist – Microbiology (concluded 29 July 2016)

**Keren Bindon**, BSc (Hons) (Biol) *UniNatal*, MSc (Plant Biotechnol) *UniStellenbosch*, PhD *UniAdel*, Senior Research Scientist

**Bob Dambergs**, BSc (Hons) *UniAdel*, PhD *UQld*, Senior Research Scientist (started 3 January 2017)

**Cristian Varela**, BSc (Biochem), MSc (Biochem), PhD *CatholicUniChile*, Senior Research Scientist

**Marlize Bekker**, BSc (Ind Chem), BSc (Hons), M (Chem), PhD *Stellenbosch*, Research Scientist

**Cory Black**, BSc (Hons), PhD *UniOtago*, Research Scientist (concluded 5 July 2016)

**Dimitra Capone**, AssDip (Chem), BAppSc (Chem) *UniSA*, PhD *UniAdel*, Research Scientist

**Toni Garcia Cordente**, BSc (Chem), BSc (Biochem), PhD *UniBarcelona*, Research Scientist

**Peter Costello**, BSc (Hons), MSc *UniNSW*, PhD *UniAdel*, Research Scientist

**Julie Culbert**, BSc (Hons), PhD *UniAdel*, Research Scientist (started 7 November 2016)

**Wies Cynkar**, BSc, PhD *Wroclaw*, Research Scientist (concluded 30 June 2017)

**Martin Day**, BSc (Hons) *UniSussex*, PhD *UniNantes*, MOen *UniAdel*, Research Scientist

**Richard Gawel**, BSc, Grad DipEd, *UniAdel*, GradDip (Oen) *Roseworthy*, Research Scientist

**Josh Hixson**, BTech, BSc (Hons) *Flinders*, PhD *UniAdel*, Research Scientist

**Darek Kutyna**, MSc *AgUniPoland*, PhD *Victoria*, Research Scientist

**Jacqui McRae**, BSc (Env Mgt) *Victoria*, BSc (Hons) (Biotechnol), PhD *Swinburne*, Research Scientist

**Agnieszka Mierczynska-Vasilev**, MSc, PhD, *UniLodz*, Research Scientist

**Mark Smith**, BSc (Hons), PhD *UniAdel*, Research Scientist (concluded 30 June 2017)

**Michael Roach**, BBiotech (Hons), PhD *Flinders*, Post Doctoral Research Fellow

**Jenny Bellon**, BSc (Biochem and Genetics) *UniAdel*, Senior Scientist

**Mango Parker**, BSc (Chem) *Flinders*, Senior Scientist

**Wes Pearson**, BSc (Wine Biochem) *UniBritishColumbia*, Grad Cert (Appl Sensory Sci and Consumer Testing) *UC Davis*, Senior Scientist

**Tracey Siebert**, ScTechCert (Chem) *SAIT*, BSc *UniAdel*, Senior Scientist

**Patricia Williamson**, BSc (Food Eng) *StateUniCampinas*, MSc (Food Sci) *Unillinois*, Grad Cert (Appl Sensory Sci and Consumer Testing) *UC Davis*, Senior Sensory Scientist

**Sheridan Barter**, BTech (Foren and Analyt Chem), BSc (Hons) *Flinders*, Scientist

**Yevgenia Grebneva**, DipFoodChem *TechUniDresden*, Scientist (started 12 December 2016)

**Stella Kassara**, BSc (Hons) *UniAdel*, Scientist

**Alex Schulkin**, BSc, *Bar-Ilan*, GradDip (Oen) *UniAdel*, Scientist

**Mark Solomon**, BSc (Med Chem) (Hons) *Flinders*, Scientist

**Peter Sternes**, BBiotech (Hons), PhD *UniQld*, Bioinformatician (concluded 26 August 2016)

**Angus Forgan**, BSc (Hons) *Flinders*, Research Laboratory Manager

**Alice Barker**, BAppSc (Hons) *UniOtago*, Technical Officer (concluded 9 June 2017)

**Caroline Bartel**, BSc (Biotech) (Hons) *UniAdel*, Technical Officer

**Laura Bey**, BSc (Foren and Analyt Chem), GradCert (Bus Admin) *Flinders*, Technical Officer (started 11 July 2016)

**Eleanor Bilogrevic**, BSc (Nutr and Food Sci) *UniSA*, Technical Officer – Sensory Analyst (started 5 June 2017)

**Kate Cuijvers**, BSc (Hons) (Genetics) *UniAdel*, Technical Officer (started 4 July 2016)

**Simon Dillon**, BSc (Hons) *Flinders*, Technical Officer

**Damian Espinase Nandorfy**, BSc (Hons) (Oenol and Vitic) *BrockUni*, Sommelier Certificate *ISG Canada*, Technical Officer – Sensory Analyst (started 1 May 2017)

**Stephen Johnson**, BSc (Hons) (Mol Cell Biol) *UniAdel*, Technical Officer

**Charlotte Jordans**, BSc (Biochem), MSc (Agronomy) *UniCopenhagen*, Scientist

**Radka Kolouchova**, AssDip *TechCollFoodTech*, Technical Officer

**Jane McCarthy**, Cert (Anim Hand), Cert (Vet Nurs) *TAFE SA*, AdvCert (Med Lab Sc) *UniSA*, Technical Officer

**Jelena Jovanovic**, Purchasing Officer

**June Robinson**, Laboratory Assistant

## **South Australian Metabolomics Facility**

**Natoiya Lloyd**, BSc (Hons) *Flinders*, PhD *UniAdel*, Research Scientist

**Esther Kristianto**, BSc (App Chem) *UniTechSydney*, Technical Officer

**Vilma Hysenaj**, BSc, Master (Pharm Chem), PhD *UniGenova*, Post Doctoral Research Scientist

**Luca Nicolotti**, Master (Chem and Pharmaceut Technol), PhD *UniTurin*, Post Doctoral Research Fellow (started 9 January 2017)

## **Casual Sensory Panel**

Sara Davis, Penelope Elliot, Josephine Giorgio-Ion, Philippa Hall, Sonya Henderson, Caroline Holmstrom, Gurinder Khera, Mary Likos, Ralph Osborne, Vivianne Rees, Sue Robinson, Loretta Royal, Heather Smith

## Industry Development and Support

**Con Simos**, BAppSc (Oen) *UniAdel*, MBA *UniSA*, Group Manager – Industry Development and Support

**Peter Dry**, BAgSc, MAgSc, PhD *UniAdel*, Emeritus Fellow

**Paul Petrie**, BHortSc (Hons), PhD *Lincoln*, Viticulture Scientist

**Linda Bevin**, BBus (Info Mgt), GradDip (Lib and Info Stud) *QUT*, Information and Knowledge Manager

**Adrian Coulter**, BSc *Flinders*, GradDip (Oen) *UniAdel*, Senior Oenologist

**Creina Stockley**, BSc (Hons) *UniAdel*, MSc, PhD *Flinders*, MBA *UniSA*, Health and Regulatory Information Manager

**Geoff Cowey**, BSc (Hons) *UniAdel*, BAppSc (Wine Sci) *CSU*, Dip *WSET*, Senior Oenologist

**Matt Holdstock**, BSc *Flinders*, GradDip (Oen) *UniAdel*, Senior Oenologist

**Adrian Loschiavo**, BAgSc *LaTrobe*, Extension Services Manager (concluded 24 January 2017)

**John Gledhill**, BAppSc (Wine Sci and Vitic) *CSU*, Winemaker

**Marcel Essling**, BBus *Victoria*, BAgSc *UniAdel*, Senior Viticulturist

**Mardi Longbottom**, BAgSc, MVit, PhD, *UniAdel*, Senior Viticulturist

**Gayle Baldock**, BSc (Hons) *UniGuelph*, Scientist

**Jorge Comahig**, SharePoint Specialist (started 14 September 2016)

**Francesca Blefari**, BBus, *UniEdithCowan*, Events and Projects Manager

**Anne Lord**, GradDip (Info Stud) *UniSA*, Librarian

**Michael Downie**, BA (Hons) *UniAdel*, GradDip (Lib and Info Mgt) *UniSA*, Library and Information Services Coordinator

**Virginia Phillips**, Events and Projects Coordinator

**Maria Calabrese**, Events and Projects Administrator

## Industry Engagement and Application

**Peter Godden**, BAppSc (Wine Sci) *UniAdel*, Manager – Industry Engagement and Application

## Commercial Services

**Eric Wilkes**, BSc (Chem) (Hons), PhD *UniNewcastle*, Group Manager – Commercial Services

**Neil Scrimgeour**, BSc (Hons) (App Chem) *Wolverhampton*, Senior Project Scientist

**Leanne Hoxey**, BSc *UniAdel*, Quality Systems and Laboratory Manager

**Randell Taylor**, BSc (Hons) *UniAdel*, Manager Trace Laboratory

**Simon Nordestgaard**, BEc, BE (Hons) (Chem), PhD *UniAdel*, Senior Engineer

**Amy Rinaldo**, BSc (Hons) (Biotech) *Flinders*, PhD *UniAdel*, Project Scientist

**Tadro Abbott**, BE (Hons) (Chem) *UniAdel*, Project Engineer

**Kieran Hirlam**, BE (Hons) (Chem), BFin *UniAdel*, Project Engineer

**Kerry Pinchbeck**, BSc (Medicinal Chem) *Flinders*, PhD *UniAdel*, Scientist

**Pamela Solomon**, BTech (Foren and Analyt Chem), BInnovationEnterprise (Sci and Tech) *Flinders*, Scientist

**Heather Tosen**, BSc *UniAdel*, Scientist

**Bryan Newell**, BAppSc (Chem and Physics) *UniSA*, Senior Laboratory Technician

**Melissa Aitchison**, BAgSc (Oen) *UniAdel*, Laboratory Technician

**Elyce Batchelor**, DipFoodTechnol, Cert II (Food Process) *TAFE*, Laboratory Technician (concluded 3 February 2017)

**Josh Clift**, BSc *UniAdel*, Laboratory Technician (started 20 February 2017)

**Jesse Hall**, BSc (Foren and Analyt Sci) *Flinders*, Laboratory Technician (started 23 January 2017)

**Jacinta McAskill**, Cert III (Lab Operations) *TAFE*, Laboratory Technician (started 20 February 2017)

**Tim Reilly**, BSc (Hons) (Nanotechnol) *Flinders*, Laboratory Technician

**Marco Schoeman**, BSc (Biotechnol) *UniAdel*, Laboratory Technician

**Matthew Wheal**, BSc (Hons) (Biology), PhD *UniAdel*, Laboratory Technician

**Brigitte Lynch**, MBA *Australian Institute of Business*, Customer Relations Supervisor

**Jillian Lee**, Customer Service Officer

**Robyn Gleeson**, Customer Service Officer

**Alana Spears**, Cert II (Hosp Op) *TAFE SA*, Cert IV (Japanese Lang) *VLLC*, Customer Service Officer (concluded 15 July 2016)

## Students located at the AWRI

**Marta Avramova**, *UniBordeaux, France*, visiting student (20/7/16-11/8/17)

**Jessica Lleixa Daga**, *Universitat Rovira I Vigili, Spain*, visiting student (6/3/17-28/7/17)

**Anaïs Faucon**, *Montpellier SupAgro, France*, visiting student (3/4/17-8/9/17)

**Joana Fernandes**, *UniAveiro, Portugal*, visiting student (11/7/16-21/12/16)

**Lisa Hartmann**, *UniAdel*, PhD student

**Ryan Zeppel**, *UniAdel*, PhD student

## Visiting Researcher

**Bo Teng**, *Sichuan University, China* (27/9/16-30/4/18)



## Staff activities

**Tadro Abbott** is a member of the Entwine Reference Group and Entwine Technical Subcommittee.

**Alice Barker** is a committee member of the SA Branch of the Australian Institute of Food Science and Technology.

**Anthony Borneman** is an Affiliate Lecturer at the University of Adelaide.

**Paul Chambers** is coordinator of the Australasian Yeast Group (through its homepage at <http://www.ayeastgroup.org/>) and a member of the Editorial Board of *Microbial Cell*.

**Bob Dambergs** is an Honorary Associate of the University of Tasmania at the Tasmanian Institute of Agriculture.

**Chris Day** is a Chartered Accountant and a Director, Treasurer and Public Officer of the Australian Wine Industry Technical Conference.

**Martin Day** is a Chartered Chemist and member of the Royal Society of Chemistry (UK), and is a member of the editorial board of the Atomic Spectrometry Updates, published in the *Journal of Analytical Atomic Spectrometry*.

**Peter Dry** is an Adjunct Associate Professor, University of Adelaide, and Associate Editor of the *Wine and Viticulture Journal*.

**Angus Forgan** is a member of the South Australian Institutional Biosafety Committee Network Forum.

**Leigh Francis** is an Associate Editor of the *Australian Journal of Grape and Wine Research*; a member of the Editorial Board of the *Journal of the Science of Food and Agriculture*; an Affiliate Lecturer at the University of Adelaide; and an Adjunct Senior Research Fellow at the University of South Australia.

**Peter Godden** is an Ex-Officio Councillor of the Royal Agricultural and Horticultural Society of South Australia.

**Paul Henschke** is an Associate Editor of the *Australian Journal of Grape and Wine Research*, and is a member of the Editorial Review Board of *Mitteilungen Klosterneuburg*. He is an Affiliate Professor of the University of Adelaide and Fellow of the Australian Society for Viticulture and Oenology.

**Markus Herderich** is a Director of the Australian Wine Industry Technical Conference; member of the Metabolomics Australia Executive Management Group; and member of the Wine Innovation Cluster Research Group. He is also an Affiliate Associate Professor, University of Adelaide; a member of the Advisory Board of the *Journal of Agricultural and Food Chemistry*; a member of the Winemakers' Federation of Australia Wine Industry Technical Advisory Committee; and a delegate and expert for the Organisation Internationale de la Vigne et du Vin.

**Matt Holdstock** is a Director of the Australian Society of Viticulture and Oenology.

**Leanne Hoxey** is a member of the Interwinery Analysis Group committee.

**Dan Johnson** is Chair of the Australian Wine Industry Technical Conference; Honorary Adjunct Professor at Macquarie University Graduate School of Management; and a Director of the National Wine Foundation. He is a member of the International Scientific Board of L'Institut des Sciences de la Vigne et du Vin, Bordeaux; the *Australian Journal of Grape and Wine Research* Journal Advisory Subcommittee; the *World of Fine Wine* Editorial Board; the Wine Innovation Cluster Leadership Group; the Waite Strategic Leadership Group; the Winemakers' Federation of Australia Innovation Policy Committee; the South Australian Food Innovation Centre partners group; and the National Wine Sector Research, Development and Extension Implementation Committee. Dan is a graduate of the Harvard Business School Authentic Leadership Development program; the Australian Wine Industry Future Leaders Program; the INSEAD Blue Ocean Strategy program; the IESE Creative Negotiation program; and the Oxford Advanced Management and Leadership Program.

**Mark Krstic** is a member of the Victorian Government's Wine Ministerial Advisory Committee; Horticulture Innovation Australia's Table Grape Strategic Investment Advisory Panel; the National Wine Extension and Innovation Network; and the National Wine Research Network. He is Associate Editor of *Wine and Viticulture Journal*; Honorary Senior Fellow at the University of Melbourne; member of the Yarra Valley Technical Subcommittee; member of the Mornington Peninsula Vignerons Association Technical Subcommittee; and member of the Australian Wine Industry Technical Conference Planning Committee. Mark is a graduate of the Australian Wine Industry Future Leaders Program.

**Natoiya Lloyd** is a member of the Metabolomics Conference 2017 organising committee and is a committee member of the SA branch of the Royal Australian Chemical Institute.

**Mardi Longbottom** is President of the Australian Society of Viticulture and Oenology; member of the Executive Committee of Australian Vignerons; member of the Wine Grape Council of South Australia; member of the Limestone Coast Grape and Wine Council; member of the Limestone Coast Grape and Wine Council Technical Subcommittee; member of the Winemakers' Federation of Australia Innovation Policy Committee; member of the Environmental Technical Committee of Freshcare Australia; Fellow of the Governor's Leadership Foundation Program; and a member of the Australian Wine Industry Technical Conference Planning Committee.

**Agnieszka Mierczynska-Vasilev** is a member of the Australia-China NanoNetwork, an initiative of the Australian Technology Network of Universities and the International Strategic Technology Alliance.



L to R: Con Simos, Virginia Phillips, Maria Calabrese, Francesca Blefari, Matt Holdstock, Geoff Cowey

**Vince O'Brien** is a member of the Winery Engineering Association Conference Planning Committee; the Winemakers' Federation of Australia Wine Industry Packaging Committee; CSIRO's Adaptive Value Chains Project Advisory Group; PIRSA's functional and luxury value chains advisory group; and the South Australian River Murray Sustainability Program Food Loss and Industry Waste Transformation Project Advisory Committee.

**Wes Pearson** is a committee member of the McLaren Vale Districts Group and a graduate of the Len Evans Tutorial.

**Paul Petrie** is a member of the *Australian Journal of Grape and Wine Research* Journal Advisory Subcommittee; a member of the Australian Wine Industry Technical Conference Planning Committee and Chair of the Charles Sturt University wine industry course advisory committee.

**Ella Robinson** is a member of the Australian Wine Industry Technical Conference Planning Committee and a committee member for the SA Chapter of Wine Communicators of Australia.

**Neil Scrimgeour** is a member of the planning committee for Crush 2017 – the grape and wine science symposium.

**Con Simos** is chair of the National Wine Extension and Innovation Network; board member of Wine Communicators of Australia; member of the Australian Wine Industry Technical Conference Planning Committee; member of the National Wine Sector Research, Development and Extension Implementation Committee; member of the WA Wine Industry Association R&D Committee; and graduate of the Australian Wine Industry Future Leaders Program.

**Creina Stockley** is an Affiliate Senior Lecturer, University of Adelaide. She is a member of the Winemakers' Federation of Australia Wine Industry Technical Advisory Committee and Wine and Health

Working Group. She is a delegate and expert for the Organisation Internationale de la Vigne et du Vin and served as Vice President of Commission IV Safety and Health and a member of the Scientific and Technical Committee. She is also an Associate Editor of *OENO-one*, and a member of the editorial board of the *International Journal of Wine Research*, *International Journal of Food and Fermentation Technology*, the *Austin Journal of Cardiovascular Disease and Atherosclerosis*, the *Journal of Nutritional Therapeutics* and the *Journal of Wine Research*, as well as a charter member of the International Scientific Forum on Alcohol Research, a member of the Advisory Board of the Paralelo 40 International Surveillance System on Mediterranean Diet (Spain), a member of the Scientific Board and Scientific Council of Experts of the (European) Wine Information Council, a member of the European Food Safety Authority Expert Database and a member of the International Federation of Wines and Spirits Scientific and Technical Committee. Creina was also a member of the Scientific Committee for the WineHealth 2017 international wine and health conference.

**Cristian Varela** is a member of the Editorial Board of the journals *Applied and Environmental Microbiology*, *International Journal of Food Microbiology* and *Food Microbiology*.

**Matthew Wheal** is the Secretary of the Australasian Plant and Soil Analysis Council.

**Eric Wilkes** is chair of the Interwinery Analysis Group committee and a member of the FIVS (International Federation of Wines and Spirits) Scientific and Technical Committee. He chairs the APEC Wine Regulatory Forum Enhanced Risk Controls Working Group and is a member of the International Wine Technical Summit Authenticity and Counterfeit, Analytical Method Quality, Laboratory Quality and Expression of Limits working groups.

## Environment and sustainability

The success of the Australian grape and wine industry is strongly tied to its long-term custodianship of the natural environment. Soil, water, biodiversity, and climate all contribute to the success or failure of grapegrowing across Australia, and electricity, fuel, refrigeration, and waste disposal are all major costs in winemaking. Projects under this theme aim to assist producers to improve environmental and economic performance; to make the most of the grapevine clonal resources available; and to improve the management of pests and diseases.

### Reduce inputs and environmental footprint across the value chain

#### Staff

Dr Mardi Longbottom, Virginia Phillips.

#### Collaborators

Accolade Wines (Alison Searle); Adelaide Hills Wine Region (Richard Hamilton); Australian Vignerons (Andrew Weeks); Cape Jaffa Wines (Anna Hooper); Clare Valley Vignerons (Anna Baum); Consilius (Rachel Barrett); De Bortoli (Rob Glastonbury); Finlaysons (Kyra Reznikov); Freshcare Ltd (Claire Hamilton-Bate); KPMG Australia (Ben van Delden); Limestone Coast Grape and Wine Council (Kerry DeGaris); McLaren Vale Grape Wine and Tourism Association (Robyn Groffen); National Australia Bank (James Bentley); Pernod Ricard Winemakers (Stephen Cook, Angus Barnes); Perth Region NRM (Keith Pekin); Pfeiffer Wines (Chris Pfeiffer); Primary Industries and Regions South Australia (David Leach); Queensland University of Technology (Dr Richi Nayak); Riverland Wine (Chris Byrne); St Hallett (Megan Coles); Symphony Hill Wines (Mike Hayes); Treasury Wine Estates (Gioia Small); Vitibit (Liz Riley); Wine Australia (Stuart Barclay, Steve Guy); Winemakers' Federation of Australia (WFA) (Tony Battaglene); Wine Tasmania (Paul Smart); Winemaking Tasmania (Jonathan Lord); Yalumba (John Ide).

### Improving the environmental and economic performance of the Australian wine supply chain (Entwine Australia)

#### Background

Entwine Australia is the Australian wine industry's sustainability program – set up to support growers and winemakers in demonstrating and improving the sustainability of their businesses. Entwine is endorsed by the industry peak bodies Australian Vignerons, the Winemakers' Federation of Australia and Wine Australia as the principal vehicle to convey the Australian wine industry's sustainability credentials. Entwine operates as an 'umbrella' sustainability program. Under the Entwine umbrella there are two components for members – the reporting of sustainability metrics to the AWRI and participation in an approved certification program. Entwine provides credentials that

cover the fundamental components of sustainability (environmental, social and economic) and delivers benchmarking tools and resources to enable planning, evaluation, control and communication in vineyards and wineries. The structure, content and strategic direction of Entwine are guided by industry reference groups.

#### Entwine data and extension

This year, a Best Management Practice (BMP) survey was included for vineyard members of Entwine to enable them to complete a self-assessment of their practices and to demonstrate their participation in an Entwine-approved program. The BMP survey was completed by almost 200 vineyard businesses. The results showed a high proportion of members operating at best practice across the management areas of land, soil, chemicals, fertilisers, soil additives, water, biodiversity, biosecurity, waste, air, energy, fuel, human resources and worker health and safety. Additionally, an increasing number of Entwine members sourced energy from renewable energy sources. Approximately 2% of the total electricity used in Entwine member vineyards and wineries was generated by solar panels. Biodiversity is a high priority, with more than half of all Entwine members dedicating part of their property to the enhancement of biodiversity.

During the year, additional resources were added to the Entwine website including fact sheets and webinar recordings. Data generated from Entwine were included as an important part of the program for the AWRI's latest roadshow workshop 'Addressing regional challenges'. Entwine and regional datasets were presented at fifteen regional workshops. Entwine regional presentations consistently generated significant discussion about regional sustainability priorities and opportunities to integrate sustainability credentials into individual, regional and national research, development and marketing initiatives.



Mardi Longbottom

## Capture the full value of clonal resources for key Australian varieties

### Staff

Dr Anthony Borneman, Dr Michael Roach, Dr Simon Schmidt.

### Collaborators

BC Genome Sciences Centre (Prof. Steven J.M. Jones, Justin Chu); Macquarie University (Prof. Isak S. Pretorius); South Australian Research and Development Institute (SARDI) (Dr Michael McCarthy); University of British Columbia (Prof. Hendrik J.J. van Vuuren); Yalumba (Nick Dry).

### Assessing diversity and clonal variation of Australia's grapevine germplasm (Chardonnay and Shiraz)

#### Background

The AWRI is engaged in two collaborative projects that study grapevine clonal diversity. These projects aim to assess the genetic diversity of Chardonnay and Shiraz clones, and evaluate how this variation contributes to chemical and sensory variation in grapes and wine.

Chardonnay is one of the dominant white grape cultivars used for winemaking in Australia. The majority of Australian Chardonnay vineyards are monoclonal, with clone 110V1 dominating the Australian Chardonnay landscape. However, there are many clones of this variety, some of which have only relatively recently become available in Australia. Grapevine clones can exhibit variation in a number of viticultural and oenological traits including fruit composition, flavour and aroma profile, ripening time, flower morphology (leading to seedless grapes), bunch morphology, yield and grape colour. The commercial availability of a significant number of clones affords the possibility of increasing the diversity of Chardonnay plantings.

Shiraz is an iconic variety in Australia with plantings dating back more than 100 years. A collaborative project with SARDI is assessing the genetic diversity of some of Australia's heritage Shiraz material. SARDI

is leading a national team evaluating clonal plantings of Shiraz at multiple sites. Wines made from these sources are undergoing sensory evaluation at the AWRI.

#### Understanding genetic variation in Chardonnay and Shiraz

High coverage data from resequencing of 15 Chardonnay clones was mapped to a curated Chardonnay reference genome, constructed using single molecule real-time sequencing from PacBio. From a total of 2.46 million single nucleotide polymorphisms (SNPs) identified across all clones, 1,264 were identified as distinguishing specific clones. Some of these were shared between clones, revealing some degree of shared heritage; however, most were unique to individual clones (private SNPs) and as a result may represent suitable clone-specific markers. The preponderance of private SNPs is likely the result of rigorous clonal maintenance programs following an initial round of clonal selection during which many of the clones now in use were isolated. Whether or not any of the identified variants map to regions that contribute to specific clonal traits is the basis of current work.

Comparative genomic evaluation of Shiraz clonal material, representing clones used in the SARDI 'Clones for Climate Change' project, is now complete. A similar approach to that described for Chardonnay was used. The approaches differed only in the sequencing technology used to create the reference genome for Shiraz. In this case, a synthetic long read approach based on 10x Genomics Chromium library preparation technology was combined with Illumina short read sequencing to construct a reference genome from clone Yalumba 4. Mapping of short read data to this reference enabled the identification of 3,912,444 SNP/INDEL (insertion/deletion) sites from which 265 were identified as being different in at least one of the clones. The dataset is made up of clones that are relatively recent imports into Australia and clones that have been derived from Australian clonal identification programs dating to the 1950s. A comparative analysis of the clones based on private and shared SNPs shows the recently imported Shiraz clonal selections to be more like each other than to the Australian clonal selections. Detailed analysis and genomic variant curation efforts are in progress.



## Reduce the economic and environmental impact of pests and diseases and the techniques used to manage them

### Staff

Dr Anthony Borneman, Dr Markus Herderich.

### Collaborators

Curtin University (Lincoln Harper, Dr Fran Lopez-Ruiz); National Wine and Grape Industry Centre (NWGIC) (Dr Sandra Savocchia); SARDI (Dr Barbara Hall, Dr Suzanne McKay).

### Understanding genetic variation in grapevine diseases and the genetic basis for pesticide resistance

#### Background

Grapevine diseases caused by fungal/oomycete pathogens such as *Botrytis cinerea*, *Erysiphe necator* (powdery mildew) and *Phomopsis viticola* (downy mildew) are responsible for significant crop losses. Current control measures rely on spraying with agrochemicals; however, there is growing evidence for resistance of fungal/oomycete pathogens to specific fungicides. By determining the genetic basis of these resistant phenotypes, DNA diagnostics to efficiently test for potential resistance prior to choosing an agrochemical will be developed and compared to established slow and complicated assays. This will provide impartial data to inform agrochemical purchasing and spray decisions.

#### Understanding fungicide resistance in Australian viticulture

The SARDI-led collaborative project 'Understanding fungicide resistance in powdery mildew, downy mildew and botrytis' has been completed and the final report is available on the Wine Australia website. The project used a network of collaborators in research organisations, agrochemical companies and the viticulture industry to collect samples of *Botrytis*, powdery mildew and downy mildew from vineyards in the main viticultural regions of Australia. The samples were tested against a range of commonly used fungicides to determine the incidence and

severity of fungicide resistance in Australian vineyards. Specifically, leaf disc assays were used to phenotypically test isolates of the fungus responsible for powdery mildew for sensitivity to pyraclostrobin, penconazole, myclobutanil and tetraconazole, and the oomycete responsible for downy mildew to metalaxyl M, mandipropamid and pyraclostrobin. *Botrytis* was tested by mycelial growth assay for sensitivity to fenhexamid, iprodione, pyrimethanil and boscalid. Representative samples were genotyped for the presence of mutations known to confer resistance.

Results from the project showed that resistance to some fungicides is widespread (e.g. quinone outside inhibitor fungicides in powdery mildew), whereas for others it is less common (e.g. demethylation inhibitors [DMI] in powdery mildew) or occurs rarely (e.g. mandipropamid in downy mildew). Some populations of *Botrytis* are now resistant to more than one fungicide group. While phenotypic resistance to DMIs was not widespread, the allele that confers loss of sensitivity to DMIs was present in over 60% of the isolates tested. This suggests that the number of cases of phenotypic resistance to DMIs may increase in future years.

The research will continue to June 2020 through the SARDI-led collaborative project 'Improving the understanding of fungicide resistance in Australian viticulture', with a focus on:

- characterising the relationship between laboratory testing and fungicide efficacy in the field
- determining the relative fitness of resistant populations compared to wild type
- elucidating the link between phenotype results, presence of allele(s) and field failure
- understanding the differences in DMI resistance and efficacy among various products
- investigating the feasibility of monitoring and in-field detection of pathogens and resistant populations.

# Consumers, customers and markets

The Australian wine industry depends on producing wines that consumers value, trust and are able to access in both domestic and international markets. Projects under this theme aim to take a scientific approach to understanding consumer preferences; to inform consumers about health impacts of wine consumption; to provide technical guidance on agrochemical use to meet export market requirements; to investigate methods for assuring wine authenticity and to contribute technical expertise to national and international forums on wine regulation.

## Build and safeguard brand Australia

### Staff

Dr Martin Day, Marcel Essling, Dr Markus Herderich, Dr Mardi Longbottom, Anne Lord, Con Simos, Dr Creina Stockley, Dr Eric Wilkes.

### Collaborators

Accolade Wines (Jonathan Breach); Alcohol Beverages Australia (ABA) (Stephen Riden, Fergus Taylor, Gohar Yazdabadi); Australian Vignerons (Andrew Weeks); Bronco Wines, USA (Paul Huckaba); CropLife Australia (Alastair James); CSIRO Land & Water (Dr Jason Kirby); Department of Agriculture and Water Resources (DAWR) (Dr Susie Collins, Gary Fan, Nigel Pinto, John Power); DrinkWise Australia (Tess McLachlan, John Scott); E. & J. Gallo Winery, USA (Greg Hodson); Nufarm Australia Ltd (Matthew Gratton, David Rumbold); Plant Health Australia (Susanna Driessen); Sumitomo Chemical (Doug Paton); Vinehealth Australia (Inca Pearce); WFA (Tony Battaglione, Nicole Cosgrove); Wine Australia (Andreas Clark, Steve Guy, Rachel Triggs); Wine Institute, USA (Katherine Bedard).

## Collecting and disseminating information regarding agrochemicals registered for use and maximum residue limits in Australian viticulture

### Background

Governments around the world set limits for the amount of residue of agrochemicals that is legally allowed in foods, including grapes and wine. Up-to-date information on agrochemical management is needed to ensure that finished wines meet these limits and do not encounter trade barriers. The aim of this project is to enable grape and wine producers to manage agrochemical residue levels in their products by collating and providing accurate and timely information on regulatory and technical aspects of chemicals registered for use in Australian viticulture, and the maximum residue limit (MRL) requirements of those chemicals in domestic and key export markets.

The project team identifies potential pest, disease and agrochemical issues through a number of established information-gathering and support mechanisms and through liaison with key industry and government stakeholder networks. Up-to-date reference tools are maintained, including the AWRI MRL and agrochemical databases. A number of dissemination channels are employed to update stakeholders of changes. Chemical manufacturers and distributors are also consulted to keep abreast of changes in the range and supply of agrochemical products. The outcomes are made available in the publication *Agrochemicals registered for use in Australian viticulture* (known as the 'Dog book'), an online search portal and a smart phone agrochemical app.

### Providing the latest information

The project team reviewed 193 Sanitary and Phytosanitary notifications from the World Trade Organization and 29 gazettes issued by the Australian Pesticides and Veterinary Medicines Authority (APVMA). The outcomes of these reviews included changes to MRLs for markets such as Canada, the European Union and Taiwan. The APVMA gazettes also highlighted the registration of new active constituents such as difenoconazole.

Each year, post-harvest, the project team reviews the latest information on agrochemicals by liaising with regulators, chemical manufacturers, suppliers and end-users. Best practice recommendations are then incorporated into a new version of the 'Dog book'. In total, more than 9,000 copies of the 2017/2018 'Dog book' were produced and distributed by direct mail to all levy payers, via regional association networks, AWRI roadshow events, chemical retailers and as an insert in the *Australian & New Zealand Grapegrower & Winemaker*. Further updates were made to the online search portal and the smart phone agrochemical app, and an electronic version of the publication was made available through the AWRI website. The 'Dog book' was expanded to include information on active constituents and new products. One significant change was the inclusion for the first time of information about biosecurity in the booklet. The 'Dog book' now lists six key practices growers should consider adopting to reduce the risk of exotic vineyard pests as well as information about the exotic plant pest hotline to encourage growers to report any suspected new pests or diseases.

Six *eBulletins* were issued during the year to provide timely information on agrochemical issues. For example, on 12 September 2016 a notification was released to inform industry about updated CropLife resistance management strategies and a new active constituent registered for control of downy mildew, and on 26 October 2016 an *eBulletin* recommended against the use of two plant growth regulators on grapes destined for export wine.

## Origin verification and detection of counterfeit Australian wines

### Background

Wine is periodically the subject of substitution or counterfeiting. Efforts to develop and refine methods to establish a wine's authenticity continue, particularly in Europe. This project aims to protect the reputation of Australian wine and individual brands by developing a robust way to determine the authenticity of an unknown wine sample. To achieve this, a number of existing and novel parameters are being assessed in wines of known origin, with a focus on ratios of metal isotopes and elemental content.

### New methods developed

As a keynote speaker in the 'Authenticity Guaranteed?' session of the 16th AWITC, Martin Day presented the findings of the first Australian feasibility study on using strontium isotope ratios and some carefully chosen trace element concentrations to determine the origin of

Australian wines. To bolster the promising initial results, further capability to measure isotope ratios was developed and validated by project partners, CSIRO Land & Water, using multi-collector inductively coupled plasma mass spectrometry (ICP-MS). New methods for determining a range of isotopic ratios in wine formed the core of the partnership with CSIRO. These isotope ratios were chosen from the literature, with some being completely novel to studies of wine authenticity. A subset of 60 wines from the feasibility study has already been re-analysed using these new parameters. To develop a truly robust authenticity framework, the influence of variation due to variety or year of production needs to be assessed on these new discriminating parameters. To this end, sample sets of several vertical series of single vineyard wines and sets from different regions of numerous cultivars grown on the same block have been assembled ready for analysis.

### Informing wine consumers through understanding issues of wine consumption, health and nutrition

#### Background

The aim of this project is to generate and disseminate evidence-based and scientifically sound information regarding wine and health/nutrition, facilitating informed decision-making by the alcohol and wine industries, policy-makers and consumers.

#### Submissions

Project staff prepared a comprehensive scientific submission to the 'Public Call for Evidence on the Health Effects of Alcohol Consumption' for the review of the National Health and Medical Research Council's *Australian Guidelines to Reduce Health Risks from Drinking Alcohol (2009)*.

#### Provision of scientific information

A number of scientific information and briefing papers were prepared for WFA and ABA. Topics covered included:

- a description of the health impacts for Australians from the moderate consumption of alcoholic beverages on cognitive decline/dementia, diabetes and metabolic syndrome
- alcohol advertising in sport and social media
- the relationship between alcohol consumption and domestic and other violence, and general alcohol-related injuries
- consumption of alcohol by at-risk groups
- new draft alcohol drinking guidelines in France and Italy
- the role of wine in daily diet and lifestyle.



Summaries and critiques of a number of journal articles related to alcohol, wine and human health were prepared. A further health policy paper on alcohol's impact on cognitive dysfunction and dementia was drafted. Complementary to this, the content of the AWRI's 12 wine and health fact sheets and frequently asked questions was updated. In addition, three position papers were published after peer review and another three articles were published in non-peer-reviewed publications.

#### International conference

A keynote presentation was provided at the WineHealth 2017 international wine and health conference, which was held in Logroño, Spain in February 2017. Project staff also chaired sessions and participated in the concluding round table discussions of the conference (see Appendix 1 for details).

### Increasing Australia's influence in market access, safety, regulatory and technical trade issues

#### Background

Maintaining market access, or opening markets for Australian wine, nationally and internationally, is facilitated by managing and reducing current and potential barriers to trade. The Australian wine industry needs to anticipate, facilitate and influence regulation of wine composition, production, labelling and marketing. This project provides

regulatory-related scientific and technical advice and assistance for the activities of key industry stakeholders. In addition, representation at national and international industry forums raises awareness of matters of concern to the Australian wine industry.

#### Technical support

Scientific and technical advice and assistance to the Australian wine industry continued to be provided for a number of market access issues. These included the analysis of allergens in wine and associated labelling in different exports markets and the energy content of wine and energy calculations. The AWRI's databases of *Analytical requirements for the export of Australian wine* and *Permitted additives and processing aids for winemaking and wine importing countries* were updated regularly and now cover 44 and 28 individual countries respectively, in addition to information on regional trading blocs. Further information on technical support provided in relation to regulatory issues can be found in the helpdesk section of this report.

The project team continued to participate at the Organisation Internationale de la Vigne et du Vin (OIV) as members of the DAWR-led Australian delegation, together with a representative from WFA. During 2016/2017, comprehensive dossiers on meta-tartaric acid, tannins and yeast mannoproteins prepared by the AWRI for DAWR, OIV and WFA were submitted to the Joint Expert Committee on Food Additives. The AWRI provided additional information and assistance during the



Markus Herderich, Dan Johnson, Chris Day, Kristy Bartrop, David Wollan, Tony Battaglione



Creina Stockley



six-month review period prior to evaluation at the 49<sup>th</sup> Session of the Codex Committee on Food Additives, where the safety assessment and draft specifications were provided. Subsequently, a technical and toxicological dossier on meta-tartaric acid was also prepared for submission to the European Food Safety Authority by the OIV, and to the Japanese Ministry of Health, Labour and Welfare by Oenoppia. Additional information was prepared and presented to support the Australian-initiated draft resolutions and dossiers on dimethylpolysiloxane, potassium carbonate and protease enzymes to OIV expert groups, since although these processing aids are permitted in Australia, they not yet permitted for winemaking under OIV regulations. In addition, numerous draft OIV proposals were reviewed through participation in the Microbiology, Technology, Specifications of Oenological Products, Food Safety and Consumption and Nutrition and Health expert groups and the Methods of Analysis Sub-commission.

The AWRI continues to partner with regulatory and industry bodies to support export and regulatory activities through the provision of unique datasets and presentations. This year saw AWRI Commercial Services commissioned to provide survey data on the levels of methanol and glyphosate in Australian wine. A major study was also undertaken, with the support of Wine Australia, to understand the impact of different forms of sugar measurement in the determination of sugar free extract and the validation of the commonly used method to calculate this parameter compared to the classical evaporation method. These studies are important in demonstrating the safety of Australian wine and supporting arguments against the imposition of regulatory barriers to trade. AWRI representatives also presented at a range of international meetings on market access issues including the International Wine Technical Summit in Seattle, USA and the APEC Wine Regulatory Forum in Hanoi, Vietnam. AWRI Commercial Services has also been asked to continue

to run the international ring test program of regulatory laboratories in conjunction with the Interwinery Analysis Group on behalf of the APEC Wine Regulatory Forum, and to present a range of virtual workshops for laboratory staff. This program is helping to ensure that analysis is consistent across APEC wine-importing countries, reducing the chances of disputes over regulatory requirements.

## Biosecurity

### Background

The AWRI delivers biosecurity management activities on behalf of Australian Vignerons. As a signatory to the Emergency Plant Pest Response Deed, Australian Vignerons has a national responsibility for biosecurity arrangements in the wine sector and undertakes this responsibility in close association with WFA, Wine Australia and other agricultural industries.

### Activities

Two exotic pest and disease categorisation exercises were conducted during the year, which resulted in a number of meetings of the Consultative Committee for Emergency Plant Pests (CCEPP). AWRI viticulture staff provided technical support to these activities. The AWRI also provided project management support to deliver a desktop review to inform an approach to national grape phylloxera management which will be presented to the National Viticulture Biosecurity Committee and the broader industry in early 2017/2018.

## Improving products and processes

There are numerous processes involved in wine production, from grapegrowing through to delivery of finished product to consumers. Projects under this theme aim to optimise these processes and reduce costs, resulting in overall improvements to wine quality and business sustainability. Specific areas include target setting for wine style, optimisation of primary and secondary fermentation, assessing new winery processes, preventing and treating taints and faults and improving packaging and transportation.

### Objective measurement and target setting of grape and wine style

#### Staff

Alice Barker (until 9 June 2017), Sheridan Barter, Laura Bey (from 1 October 2016), Eleanor Bilogrevic (from 5 June 2017), Dr Keren Bindon, Dr Dimitra Capone, Dr Wies Cynkar, Damian Espinase Nandorfy (from 1 May 2017), Dr Leigh Francis, Yevgeniya Grebneva (from 1 January 2017), Richard Gawel, Dr Yoji Hayasaka, Dr Markus Herderich, Dr Josh Hixson, Stella Kassara, Dr Jacqui McRae, Dr Agnieszka Mierczynska-Vasilev, Mango Parker, Wes Pearson, Dr Paul Petrie, Alex Schulkin, Tracey Siebert, Mark Solomon, Dr Paul Smith, Joanna Verwey (until 30 September 2016), Patricia Williamson.

#### Students

Liang Chen (University of Adelaide); Sijing Li (University of Adelaide); Olaf Schelezki (University of Adelaide); Fangzhou Chen (University of Adelaide).

#### Visiting scientist

Dr Bo Teng (Sichuan University).

#### Collaborators

Accolade Wines (Alex Sas, Warren Birchmore); Angove Family Winemakers (Richard Angove); Australian Vintage (Dr Nick Yap, Jakub Rys); Bay of Fires (Peter Dredge); Brokenwood Wines (Simon Steel); Casella Family Brands (Steve Warne, James Wilson); CSIRO (Dr Rob Bramley, Dr Paul Boss, Peter Clingeleffer, Dr Gupta Vadakattu, Dr Shane Seabrook); De Bortoli Wines (Steve Webber); HS Geisenheim, Germany (Dr Simone Mueller-Loose, Prof. Doris Rauhut, Prof. Manfred Stoll); Institut Francais de la Vigne et du Vin Sud-Ouest (Olivier Geffroy); Josef Chromy Wines (Jeremy Dineen); Lion (Brooke Halkett); Marandoo Estate (Jon Baldwin); McWilliams Wines (Anna Lawrence, Adrian Sparks); Mt Langi Ghiran (Damien Sheehan); Mt Majura Vineyard (Dr Frank van de Loo); Pernod Ricard Winemakers (Dr Jean Macintyre, Dan Everitt, Kate Lattey, Don Young); Pfeiffer Wines (Jen Pfeiffer); Plantagenet (Cath Oates); Printhie Wines (Drew Tuckwell); Punt Road Wines (Tim Shand, Behn Payten); SARDI (Lee Bartlett, Dr Barbara Hall); See Saw Wine (Justin Jarrett), Shaw + Smith (Adam Wadewitz); Stonier Wines (Michael Symons); The Lane Vineyard (Michael Schreurs); Treasury Wine Estates (Clare Flintoff, Melanie Chester, Dr Anthony Robinson, Dr Alison Soden, Dr Vanessa Stockdale); Tyrrell's Wines (Tom Lynar); University of Adelaide (Assoc. Prof. Cassandra Collins, Dylan Grigg, Assoc. Prof. David Jeffery, Assoc. Prof. Kerry Wilkinson); University of Bordeaux Institut des Sciences de la Vigne et du Vin (Prof. Philippe Darriet, Dr Panagiotis Stamatopoulos); University of South Australia (Dr Miguel de Barros Lopes, Prof. Larry Lockshin, Dr Armando Corsi, Ava Huang, Prof. Peter Majewski);

University of Tasmania, Tasmania Institute of Agriculture (Dr Anna Carew, Dr Fiona Kerslake); Vasse Felix (Michael Langridge); Wine Australia (Willa Yang); Wines by Geoff Hardy (Geoff Hardy and Shane Harris); Yalumba (Brooke Howell, Louisa Rose, Alana Seabrook).

### Identification and origin of volatile compounds responsible for important wine sensory attributes

#### Background

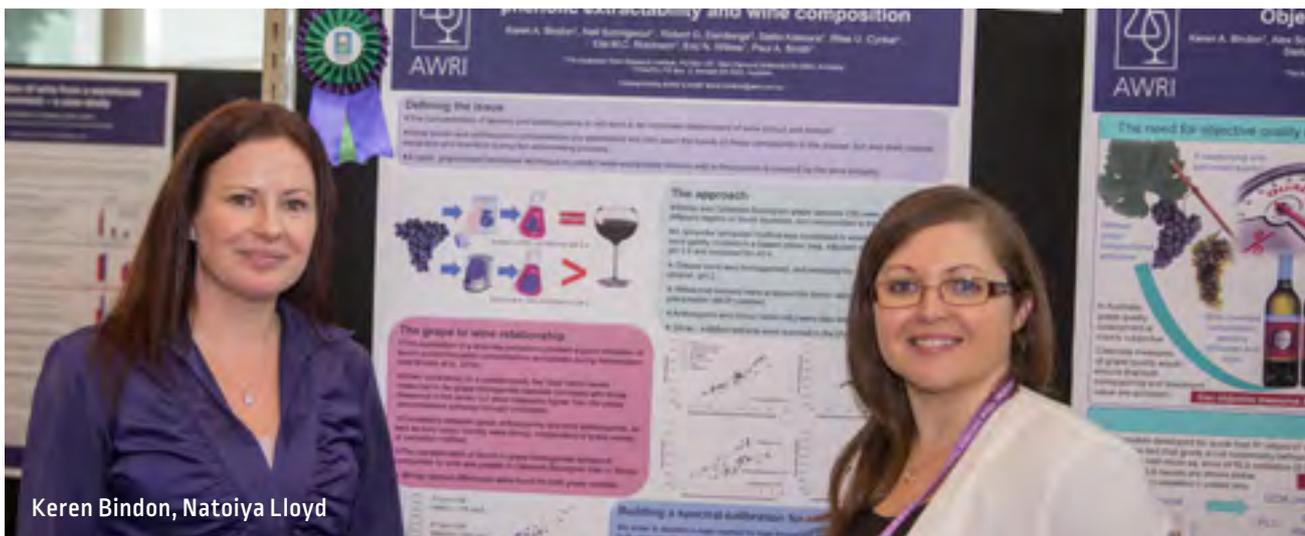
The flavour of wine is determined to a large extent by volatile compounds that are perceived during consumption by the sense of smell. The overall flavour of a wine, as well as specific flavour notes, is provided by dozens of chemical compounds of widely varying potency and concentration. This project aims to better understand wine flavours such as 'stone fruit' in white wines, 'struck match' and 'tropical fruit' in Chardonnay wines and 'green flavour' in red wines. It also seeks increased knowledge on the viticultural and winemaking influences on key wine flavours. The sensory properties and consumer preferences for wines with different levels of these flavours is also an important aspect of this project.

#### 'Stone fruit' flavour in white wines

Two sensory descriptive analysis studies were conducted to investigate the role of lactones and monoterpenes in 'stone fruit' flavour, using additions of aroma compounds in a model system. These sensory studies were carried out to better understand which specific volatile compounds cause 'peach' or 'apricot-like' aromas, especially in Chardonnay, but also in Viognier and wines made from *Botrytis*-affected grapes. Lactones are considered key compounds in peaches and apricots, while monoterpenes are of greatest importance to citrus fruits and to the aroma of flowers. Monoterpenes contribute substantial flavour to wines from floral grape varieties such as Riesling and Muscat cultivars, where they give 'lemon'/'lime' or 'floral' aromas.

A base model wine reconstitution, consisting of 55 aroma compounds and a range of non-volatile compounds, was considered to resemble white wine exceptionally well. Adding specific compounds to or omitting them from the mixture highlighted the role of some monoterpenes in 'stone fruit' character, notably 'apricot' aroma, reinforcing the results from earlier correlative sensory studies.

A set of 104 young white wines of the varieties Chardonnay, Sauvignon Blanc, Pinot Gris/Grigio, Riesling and Viognier was analysed for these monoterpenes and lactones. Results showed that 99 out of the 104 wines contained a detectable concentration of the most potent lactone, with Riesling and Viognier wines containing the highest concentrations. The differences in concentrations of monoterpenes across the varieties demonstrated the importance of several monoterpenes to Viognier wines. Free and bound monoterpenes were also quantified in grape samples from 11 Viognier clones over three vintages, and the results showed that there can be large differences across clones.



Keren Bindon, Natoiya Lloyd

Overall, this project has shown that monoterpenes can play a role in 'stone fruit' character in non-floral varieties, with a smaller contribution from several lactones. This will provide targets for future viticultural and winemaking studies aiming to optimise this important flavour in white wines.

#### 'Pepper' aroma in Shiraz

Previous research demonstrated that the Grampians and Pyrenees regions in Victoria can produce wines with substantially higher levels of rotundone than other notable Shiraz-producing regions (such as Barossa and McLaren Vale). Patterns of rotundone variation appear to be stable within an individual vineyard across different growing seasons, with large differences in concentrations occurring across individual vineyards (~15-fold differences observed) and across different growing seasons (~30 to 40-fold differences). In general, cooler ripening periods and limited bunch exposure appear to favour the synthesis/accumulation of rotundone in Shiraz grapes. However, it appears unlikely that temperature and bunch exposure alone can explain the magnitude of the observed differences in rotundone.

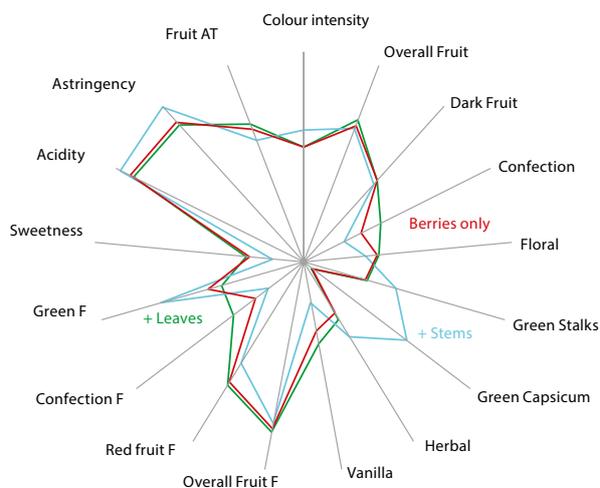
A new collaborative project with CSIRO commenced in 2017, which is focusing on premium cool climate Shiraz and aims to define features at the within-vineyard scale that contribute to rotundone formation. The project seeks to understand the genetic and biophysical factors responsible for large differences in rotundone concentrations at harvest, and will provide insights into how the rotundone element of terroir may be preserved, influenced and managed at a range of scales.

#### 'Green' flavour in red wines

As previously reported, a study was conducted to assess the sensory and compositional effect of fermenting Adelaide Hills Shiraz grapes with added stalks and grape leaves. The presence of stems or stalks can allow additional tannins to be extracted, affecting astringency and mouth-feel, but they can also give rise to 'green' or 'stemmy' aromas, and potentially bitterness.

Figure 1 shows the sensory profiles of wines made with 'added stems' and 'added grape leaves' treatments, compared to the 'berries only' control. The 'added stems' wines were rated higher than the control in 'green capsicum' and 'green stalks' attributes, as well as astringency and acidity. The wines with added stems were also higher in methoxypyrazine compounds, as well as monoterpenes. In contrast, the wine made with added leaves did not show any 'green' attributes, and was in fact rated higher in 'confection' ('artificial fruit', 'estery'-type

aroma) compared to the 'berries only' wines. The 'added leaves' treatment gave generally higher amounts of the so-called C6 compounds (often associated with 'grassy' flavours), which derive from leaf tissue, as well as the potent 'fruity' compound  $\beta$ -damascenone, which has also previously been found in leaf material. This study showed that producers who include whole bunches in red ferments should be aware of the potential for enhancement of 'green' characters in their wines.

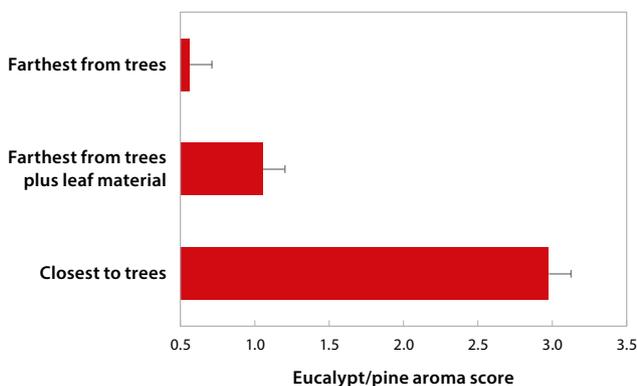


**Figure 1.** Sensory profile of a 2014 Adelaide Hills Shiraz wine made with crushed and destemmed fruit (berries only, shown in red), with added stems (shown in blue), and with added grape leaves (shown in green)

In further investigations of possible causes of 'green' flavour in red wine, a recent project investigated the effect of windbreak trees planted close to vineyards. The three main vineyards studied were a Pinot Noir vineyard in the Adelaide Hills with a radiata pine windbreak, a Shiraz vineyard at Langhorne Creek with a windbreak row of she-oaks and a Cabernet Sauvignon vineyard in the Yarra Valley close to plantings of Monterey cypress. Wine made from Cabernet Sauvignon vines grown close to Monterey cypress trees had a notable 'eucalypt'/'pine-like' aroma and flavour, while no clear sensory influence was seen from sheoak or radiata pine trees. Figure 2 shows the sensory panel mean scores for wine made from grapes harvested from the vineyard closest to the Monterey cypress trees, compared to

wine made from grapes furthest from the trees. The addition of foliage material from the trees to the grapes harvested furthest from the trees resulted in intermediate ratings for the 'eucalypt/'pine-like' attribute in the wines.

Producers with vines planted close to Monterey cypress trees may consider removing tree material from harvested grapes or conducting separate hand-harvesting of vines close to the trees if they wish to minimise the trees' flavour influence.



**Figure 2.** Mean sensory rating for 'eucalypt/'pine' aroma for a Yarra Valley Cabernet Sauvignon wine made from grapes picked furthest from Monterey cypress trees, wine made from grapes picked furthest from the trees with the addition of Monterey cypress leaf material and wine made from grapes picked closest to the trees

Following recent AWRI studies showing the role of isobutyl methoxy pyrazine (IBMP) and dimethyl sulfide (DMS) in 'green' flavour attributes of Shiraz, several sensory studies were carried out to investigate the interactions of these compounds. Isobutyl methoxy pyrazine (IBMP) present at a low to moderate concentration in combination with DMS and Z-3-hexenol was found to give stronger 'green' flavour compared to the compounds assessed alone. IBMP was an important contributor to 'green' flavour in a Shiraz base wine even at a low concentration (4 ng/L), while at this concentration moderate additions of DMS and Z-3-hexenol had a suppressing effect on the sensory contribution of IBMP.

A study was completed to assess practical methods for removal of compounds responsible for 'green' flavour in wines. Plastic materials were evaluated for their ability to remove the 'green capsicum'-like IBMP from red wine. Silicone tubing (which had previously been reported in the literature to selectively remove IBMP when added to a fermentation) as well as polyethylene and common PVC food grade 'cling wrap' film, were separately added at the start of a red fermentation and were removed once the fermentation was complete. The PVC film was found to be the most effective in removing IBMP and there was minimal associated loss of desirable volatile aroma compounds. This has promise as a potential tool for winemakers to selectively remove IBMP from wine.

#### Chinese consumer preferences

A study evaluated the response of more than 300 Chinese consumers to Australian red wines in comparison to French and local Chinese wines, tasted under both blind and informed conditions. Sensory descriptive data were also collected from a trained panel in China. Results showed that Australian wines were generally preferred over French or Chinese wine when tasted blind. A higher price and being from France were the strongest predictors of liking under informed conditions, but there was a considerable proportion of consumers who, even with

knowledge of the identity of the wines, had greater liking of the Australian wines than the French. The study also indicated that sensory aspects of the wines were important, with well-liked wines generally high in 'fermented bean curd', 'hawthorn' and 'woody' attributes, and low in 'salty' and 'dried longan' (developed) attributes.

### Assessment of relationships between grape chemical composition and grape allocation grade

#### Background

A wide range of compounds that contribute to wine's appearance, aroma, flavour and texture are derived from grapes. Many of these compounds are known and measurable, and can be manipulated through viticultural and/or winemaking practices. By measuring a range of chemical compounds in multiple grape batches of different grades, this project aims to determine which compounds, independently or in combination, can differentiate between grape grades. The objectives are to determine how variable the chemical measures are across a wide range of fruit grades, if there is a relationship with fruit grade, and if fruit can be clustered based on similarity of chemical composition. A primary aim of the project is to assess the practical application of grape grading measurements, including the potential for grapegrowers to more efficiently produce grapes to defined specifications, and for winemakers to select fruit with greater confidence that it will be appropriate for a targeted wine style.

#### Predicting grape quality grade using objective measures

Cabernet Sauvignon, Shiraz and Chardonnay grapes from a range of quality grades were sourced from multiple regions across Australia. A wide range of chemical analyses were performed to determine the concentrations of compounds known to affect wine style and key sensory properties. Juice and grape homogenate samples were also analysed spectrally in the UV/Vis, NIR and MIR regions. The grading data for the grapes were supplied by the grower or the winery that made wine from those grapes. Statistical models were developed to predict the grade of the fruit samples. A range of statistical techniques were trialled and overall the models were very successful, able to classify samples correctly to a high degree (85-100%).

Further analysis was used to determine which aspects of grape composition were most important in differentiating between grades. For Cabernet Sauvignon, the key measures that were higher in higher grade fruit were phenolics (in particular colour and tannin), selected amino acids, Brix, chloride and glycosyl-glucose (a measure of overall flavour). Those measures that were negatively associated with higher grade fruit included the 'green/'grassy' C6 flavour compounds, and glutamic acid (an amino acid). The role of other nitrogen measures, titratable acidity (TA) and  $\beta$ -damascenone was less clear, with different effects across two vintages studied. For Shiraz, many of the key measures that were increased in higher grades were similar to those that were important for Cabernet Sauvignon, namely phenolics measures (in particular tannin), some amino acids, Brix and chloride. Others that were different from Cabernet Sauvignon and higher in higher grades included two of the C6 compounds and yeast assimilable nitrogen (YAN). Negatively associated measures were aspartic acid, Z-3-hexenol and berry weight, with berry weight one of the measures that had the greatest influence on the predictive models for this variety. For Chardonnay, key variables with higher values in higher grades included total acidity, malic acid, glycosyl glucose, varietal thiol precursors, chloride, ammonia nitrogen and two C6 compounds. The measures of UV-Vis absorbance at 370nm (flavonols, a sun exposure marker) and proline concentration were higher in lower grades, and higher pH and E-2-hexenal were also associated with lower grades.

Grape spectral data (a combination of UV-Vis spectra of grape extracts, MIR spectra of juice and grape homogenates and NIR spectra of homogenates) were statistically analysed separately from the targeted chemical analytical data, and were found to predict grade with better than 90 percent accuracy for Cabernet Sauvignon, Shiraz and Chardonnay. Spectra of grape homogenates in the mid-infrared region were found to be the most effective for grape grade prediction across the three varieties. The technology needed for this analysis is readily available to commercial laboratories, rapid, easy to use and can be calibrated across multiple seasons. This could have significant advantages over the slower and more complex methods needed for some of the important chemical measures.

#### **Wine style, wine grade and grape quality**

The project was extended to explore the relationship between grape composition and wine style. For this part of the study, only two varieties (Shiraz and Chardonnay) were considered, from a single region (Riverland). Grapes from a range of grades were sourced from the Riverland; however, the grading system used in that region was different from that used in the previous season and the samples represented a narrower range of grape grades. As such, the results could not be directly compared with those from the previous season. Small-lot wines (50 kg) were made in duplicate using standardised winemaking conditions. Quantitative descriptive analysis was used to characterise the sensory properties of the wines and a panel of winemakers assessed style and grading categories from a commercial standpoint. Statistical analysis was used to relate grape compositional measures with wine style and grade allocations as well as the more detailed sensory profiles. Overall, it was possible to develop models to predict wine style and grade based on grape measures, but the accuracy of the predictions was not as high as the models developed to predict grape grade in the previous vintage. This may have been partly due to the limitations of the sample set (narrowness of quality grades compared with the previous study and limited numbers of samples in each category) but also due to the complexity of defining subtle differences in wine flavour and aroma.

A new project that builds on the previous project commenced in vintage 2017. This new project will assess differences between two premium quality grades of Shiraz fruit and wine from 20 vineyards in South Australia. The aim is to identify chemical and spectral indicators that define the vineyards that produce fruit of the two grades, both in terms of quality rating and wine style. Additional objectives are to identify vineyard or winery management options to shift fruit to the higher grades, and explore options to reduce the costs of producing high grade grapes. Wines have been produced from each vineyard/grade and will be analysed compositionally and sensorially to determine differences in styles achievable between grades.

#### **Flavour precursors: contribution to wine aroma, in-mouth sensory properties and flavour release**

##### **Background**

A critical aspect of wine quality from a consumer perspective is the overall impression of the wine in the mouth. Wine flavour is driven by volatile compounds (including ethanol), and also by non-volatiles such as sugars, salts, acids and phenolic compounds including tannins, polysaccharides and proteins. Overall flavour is also potentially derived from non-volatile precursor compounds, such as glycosides (compounds joined to sugars) or amino acid conjugates that can be broken down in-mouth, thereby releasing volatile aromas. The individual wine components alone are not sufficient to achieve a desirable in-mouth perception; this can only be obtained through the interaction of multiple components.

This project has the overall aim of establishing the extent to which wine flavour is due to precursor compounds releasing flavour compounds in-mouth. The persistence and intensity of fruit flavour are very important aspects of wine quality. Grape-derived compounds that are non-volatile, but which can be degraded during the tasting process to produce flavour, are a potentially important source of desirable flavour that has not been previously investigated.

##### **Enhancing flavour precursors in winemaking**

Previous work in this project demonstrated that non-volatile glycosides can contribute to flavour and aftertaste during wine tasting. The mechanism of release was via in-mouth enzymes, most likely from salivary bacteria; however, the flavour impact of glycosides was variable across individuals. A recently completed vintage experiment showed that increasing the levels of glycosides in a juice prior to fermentation, or in a wine prior to bottling, boosts monoterpenes and monoterpene glycosides in the final wine. Formal sensory assessment reflected the chemical data, with increases in ratings for sensory attributes including 'overall fruit aroma', 'overall fruit flavour' and 'floral aftertaste' due to the treatments.

#### **Factors affecting wine texture, taste, clarity, stability and production efficiency**

##### **Background**

Wine texture is considered a major product differentiator both for wine style and value in the marketplace. In addition, clarity and colour stability (absence of haze development and the retention of colour) are generally considered essential for market success. Achieving desired textural qualities, clarity and stability can involve processing steps with significant costs. The ability to modulate these characteristics of wine while maintaining profitability is a significant challenge for the wine industry. This project aims to elucidate key compositional drivers of texture, bitterness, clarity, stability (protein and colour) and wine filterability, and seeks to develop strategies to modulate them in a production environment.

##### **Molecular drivers of texture and taste**

In a previous study, the combination of sensory data with non-targeted metabolomics led to the identification of an indole derivative as a possible contributor to white wine bitterness. A preparative scale method was developed and applied to isolate the compound to assess its bitterness and other in-mouth properties. As only small quantities of the compound could be isolated, alternative sensory approaches to classical threshold testing were required and Napping® was selected as an appropriate method. In a Napping® experiment experienced wine tasters map their overall perception of the target compound in a sensory space defined by other compounds with known sensory properties. The sensory characteristics of the new target compound were found to be perceptually more like those of known bitter compounds epicatechin and quinine sulfate than the astringency of aluminum sulfate and grape skin tannin, hotness from ethanol or acidity from organic acids. The results suggest that the indole derivative, and possibly other similar compounds, might represent a new class of bitter compounds in white wine.

##### **The effect of dissolved carbon dioxide on the taste and texture of white wine**

The effect of dissolved CO<sub>2</sub> on the flavour, taste, and mouth-feel of still white wine was quantified for the first time. A sensory approach was developed to account for the dynamics of CO<sub>2</sub> loss during pouring and during the course of tasting from the wine glass, and to accommodate the expected effect of wine temperature on carbonation perception. Commercially available Chardonnay and Viognier wines

were each adjusted to two acidity levels, two alcohol levels, and four CO<sub>2</sub> levels typical of those found in white wine. The wines were presented for tasting under conditions typically experienced during wine consumption; that is, using 'restaurant'-type glasses, 150 mL tasting pours and a serving temperature of 10°C. The dissolved CO<sub>2</sub> levels in the wine were measured from the glass at the same time and under identical conditions to those under which the wines were being tasted, enabling CO<sub>2</sub> losses to be modelled and accounted for in terms of their impact on mouth-feel and overall flavour. Preliminary results suggest that dissolved CO<sub>2</sub> levels in still white wine interact with wine acidity and alcohol to affect the perception of white wine bitterness, sweetness and hotness. Future work will investigate the effect of dissolved CO<sub>2</sub> on the perception of flavour and mouth-feel in red wines and how dissolved CO<sub>2</sub> relates to astringency.

### Novel protein stabilisation strategies

In industry, protein haze in wine is currently prevented by the removal of proteins using bentonite; however, the non-selectivity of this treatment and the amount of wine lost as bentonite lees makes alternative methods of interest. Previous work demonstrated the potential of using magnetic nanoparticles for the rapid and selective removal of pathogenesis-related proteins from white wine. Different coatings can be placed onto these particles that allow them to bind specifically to different compounds (Mierczynska-Vasilev et al. 2016a, 2016b). In a recently published study (Mierczynska-Vasilev et al. 2017), an acrylic acid coating designed specifically to bind haze-forming wine proteins was used. Studies are currently underway to establish which coating is the most effective in removing protein haze from wine. In addition, research is focusing on the potential for industry application of the technology and the possibility of regenerating the magnetic nanoparticles.

Enzymes that can remove wine proteins without pasteurisation, and/or at lower temperatures, are also under investigation. Natural proteases from sunflowers were screened and found to have potential in reducing wine haze proteins but are not viable alternatives for industry application at this stage.

The polysaccharide, carrageenan, has also demonstrated protein removal capacity. A trial conducted in collaboration with Treasury Wine Estates showed that pectinase addition to must prior to carrageenan treatment improved wine filterability and the protein-removing efficacy of carrageenan. Sensory analysis using difference testing indicated that there were significant differences in carrageenan-treated wines with and without initial pectinase treatment, but the nature of the differences was not assessed.

### Matrix effects on protein haze formation

Haze formation in wines is a complex process involving interactions between wine proteins and other wine matrix components and properties including phenolics, ionic strength, metal ions, sulfate ions, polysaccharides and pH. To potentially improve the robustness of and/or simplify heat tests, model wine studies were conducted to understand the role of individual wine components in protein interactions at room temperature and at elevated temperatures. The influence of each component on wine haze in real wines was also measured.

Results from the model wine and real wine matrix studies indicated that combinations of components produced varying results at each concentration. In general, from the model wine studies, greater ionic strength led to greater aggregation at both room temperature and 70°C. In real wines, individual components did not significantly influence haze formation in the heat test, except for protein concentration and wine pH. These results further highlighted the complexity of haze formation in white wine and the importance of protein removal as the main strategy for avoiding haze.

### Development of a predictive model for determining white wine haze risk

A heat test is commonly used in industry to test heat stability of wines and, in combination with a bentonite trial, to determine appropriate bentonite additions. The original heat test method (Pocock and Rankine 1973) required a 24-hour turnaround time to yield results, as it included an overnight cooling step. Anecdotal evidence suggests that within industry a range of heating and cooling times and temperatures are used for the heat test, potentially causing inconsistent and unreliable results. To investigate if a shorter heat test could be used, an experiment was developed to determine the influence of heating time, cooling time and cooling temperature on the results of the test. A selection of wines were fined at bentonite dose rates predicted using the four heat test methods below and stored for 12 months at 16°C and 28°C:

- 6 hours at 80°C, overnight cooling at 4°C, 1 hour at room temperature (the original test)
- 2 hours at 80°C, overnight cooling at 4°C, 1 hour at room temperature (heat test as revised by Pocock and Waters in 2006)
- 2 hours at 80°C, 3 hours at 20°C in temperature-controlled bath (alternative test 1)
- 2 hours at 80°C, 2 hours at 0°C (ice bath), 1 hour at room temperature (alternative test 2).

Dose rates predicted were the same for heating wine for 2 hours instead of 6 hours at 80°C for most wines and slightly lower for some wines. Cooling temperature (20°C or 0°C) did influence the observed change in turbidity, but did not influence the predicted bentonite dose rates. Wines fined by each method were clear after 12 months' storage, while haze was observed in the control (unfined) wines. These results demonstrate that it is viable to reduce the total heat test to 5 hours, enabling same-day results (alternative test 1).

### Impacts of filtration on wine macromolecules

Red wines (Cabernet Sauvignon and Shiraz from the 2013 and 2014 vintages) filtered through industry-scale commercial filters in sequence, including crossflow, lenticular filters and membranes of pore size 0.65 µm and 0.45 µm, showed no change in wine colour parameters, tannins or polysaccharides with filtration (McRae et al. 2017). In addition, after 18 months of ageing, there were no significant filtration-related sensory impacts for any wine.

### Retaining texture and colour in lower alcohol wines

A number of experiments continued to study how various approaches to achieving lower alcohol affect tannin, polysaccharide and colour outcomes in red wine, with the goal of understanding how these affect wine texture. A primary objective was to explore the possibility of harvesting grapes earlier to naturally lower wine alcohol, and to explore whether winemaking techniques (additives) could be used to improve the texture of these wines. The regulation introduced in 2017 enabling the limited pre-fermentation addition of water to high sugar must (to a minimum of 13.5°Baume) warranted the inclusion of must dilution as a further objective of this research.

For all experiments which studied grape maturity as a means to modify wine alcohol, harvesting earlier consistently resulted in wines with lower levels of wine tannin, polysaccharide and colour. As expected, lowered levels of these key wine components were associated with reduced astringency, palate fullness and colour, but also importantly, wine alcoholic hotness. In order to ameliorate the lack of texture and colour in the earlier-harvested wines, a number of approaches were



attempted, including treatment with macerating enzyme, tannin addition and marc addition. Macerating enzyme addition most consistently increased tannin and colour in the wines made from less ripe grapes, but reduced wine polysaccharide content. Marc addition (unfermented white grape marc) was also found to contribute additional tannin to early-harvest wines, but not to the same extent as enzyme addition. Interestingly, adding both enzyme and marc to an early-harvest ferment resulted in a tannin concentration similar to a wine made from commercially ripe grapes. An important sensory study by PhD student Sijing Li showed that while enzyme addition increased wine astringency, the wines were seen as having greater 'surface coarseness'. Enzyme-treated wines also lacked palate fullness compared with those made from riper grapes (Li et al. 2017), indicating a possible limitation in the use of macerating enzymes.

Dilution of high sugar must was also explored in conjunction with earlier harvests as a means to lower wine alcohol. To do this, red grapes were harvested at various stages of maturity from early (unripe, low alcohol) to late (commercially ripe, overripe). Two experiments were undertaken which applied different dilution techniques to lower must sugar. Depending on the condition of the grapes, must dilution produced varying results. A study by PhD student Olaf Schelezki diluted musts without changing the solids:juice volume ratio, by running off juice and replacing it with water or 'green harvest' (5% alcohol) wine. This study showed that when grapes were overripe (17°Baume, shrivelled), dilution with either 'green harvest' wine or water had minimal effect on wine tannin, colour or polysaccharide; and did not change any wine sensory attributes apart from reducing wine hotness. In a second study of commercially ripe (15.5°Baume, not shrivelled) grapes by visiting scientist, Dr Bo Teng, water addition to must was trialled as well as the previous juice 'run off and replace' approach. In this case it was found that water addition lowered tannin and colour in wines independently of the mode of addition, showing that maintaining the solids:juice volume ratio did not necessarily increase the retention of phenolics in the wine. Nevertheless, wine produced with dilution consistently had higher levels of tannin and colour than wines of the same alcohol concentration produced from earlier harvests (Schelezki et al. in press). These results indicate that to effectively lower alcohol whilst maximising wine macromolecule extraction and wine texture, dilution treatments are likely to lead to more favourable outcomes than earlier harvesting.

#### Wine colour development

A collaborative study looking at Shiraz wine colour in the Barossa Valley with University of Adelaide scientists Assoc. Prof. Cassandra Collins and PhD student Dylan Grigg concluded this year. The project aimed to determine the phenolic components which most strongly contributed to the maintenance of stable wine colour with ageing. Wines from two vintages and five areas across the Barossa were comprehensively analysed for their flavonoid composition. Wines from one of the two vintages were aged for three years, and fractionated to determine the degree to which small and large polymeric pigments contributed to wine colour development. It was found that wine colour density was

most strongly predicted by non-bleachable pigments, which were correlated with tannin concentration, tannin molecular mass (and mean degree of polymerisation) and the proportion of epigallocatechin (skin tannin). The flavonols quercetin, myricetin and isorhamnetin were also higher in wines with higher wine colour density and non-bleachable pigments. Interestingly, in these wines the concentration of various anthocyanins was not correlated with wine colour. An important finding was that the flavonoid composition and colour properties of the wines were more strongly defined by the vineyard/area of origin than the vintage. In the ageing study, it was found that wines lost up to 15% in wine colour density after three years, but there were corresponding increases of up to 40% in total polymeric pigments (small and large). Wine tannin concentration most strongly predicted the formation of small and large polymeric (non-bleachable) pigments, and this was maintained with ageing.

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## Optimise primary and secondary fermentation for effective production of targeted wine style

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### Are there regional microorganisms and can they be harnessed to produce regionally distinct wine styles?

#### Background

Regional wine style expression has been identified as one way that wine companies can differentiate their products in the market. An important aspect of terroir, particularly where spontaneous fermentations are performed, may be differences in wine microbiota. Focused microbiological research has shown that both vineyards and spontaneous fermentations contain diverse mixtures of microbial species (with species often being represented by multiple strains). However, the inability to efficiently and accurately assess the large numbers of samples required to understand such complex systems has limited subsequent insights.

Recent advances in metagenomics (genomic sequencing of mixed microbial communities) can address these issues by providing detailed identification of species and their proportions in complex microbial mixtures in a high throughput manner. In addition, through detailed genomic assembly of these datasets, the genetic make-up of individual strains within these mixtures can also be obtained to provide direct links between novel genetic and phenotypic characteristics.

#### Vintage 2017

Wine samples were sourced from more than 150 commercial uninoculated Chardonnay and Shiraz ferments from 32 wineries spread across seven states and territories. DNA-barcoding (phylotyping) analysis was used to assess fungal diversity throughout the progression of fermentation. Significant microbial diversity was seen, with 79 genera of yeasts and fungi observed across the dataset.

In addition to the metagenomic sampling, wine yeast were also isolated from selected fermentations to investigate the strain-level variation in uninoculated fermentations and to assess the potential for commercial



Peter Costello

strains to appear in wild ferments. Genome sequence data were generated from yeast strains from three selected wineries, with the results compared to the AWRI commercial wine yeast genome collection (Borneman et al. 2016). While all of the 132 strains analysed had genomes that were consistent with 'wine/European' strains of *S. cerevisiae*, fewer than 5% were genomically equivalent to commercial isolates. These results therefore indicate that the uninoculated ferments studied were completed by non-commercial 'wild' strains considered likely to have originated from the surrounding environment.

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### Enhanced winemaking outcomes and wine style diversification through provision of fit-for-purpose yeast starter cultures

#### Background

It is common practice for winemakers to choose particular yeasts in pursuit of desired wine styles. Availability of new yeasts that impart novel flavour profiles or that accentuate specific varietal characters can provide winemakers with an expanding array of options to achieve stylistic flexibility. This project aims to facilitate the development of wine styles with distinctive flavour profiles and the production of existing wine styles with lower input costs, with a particular focus on the contribution of yeast to red wine flavour. A broad approach is being taken to microbial modulation of wine flavour, including harnessing the overall genetic diversity of yeast germplasm (both within and outside the *S. cerevisiae* species) with the objective of establishing yeast 'flavour profiles' and accompanying genomic markers. Classical breeding, mutagenesis and interspecies hybridisation, guided by genomic insights into 'what each genome brings to a wine strain', are being applied to generate novel wine strains that modulate red wine flavour, display appropriate flocculation behaviour, produce low levels of off-flavours and exhibit stable performance.

### Using yeast to modulate wine aromatic composition

A series of pilot-scale winemaking trials was completed with both white and red grape varieties, using two non-GMO variants of the wine yeast (AWRI796) that produces high levels of 'rose'/'floral' aromas. Chemical analysis demonstrated large increases in the flavour compounds responsible for 'rose'/'floral' aromas in all the wines fermented with both yeast variants. Sensory analysis of the wines indicated that enhancing 'floral' aromas was generally favourable for white varieties, particularly Chardonnay and Semillon; however, in red wines enhanced rose character was not always perceived as a positive attribute. Some of these wines were presented in a workshop at the 16<sup>th</sup> AWITC.

Detailed chemical analysis of the pilot-scale wines showed that both 'rose' aroma strains also influenced the concentrations of other metabolites. Two of these compounds (tyrosol and tryptophol) are particularly interesting because they seem to affect the palate of wine, and might also have antioxidant and cardioprotective properties.

Previous work in which the aroma profiles of 100 yeast strains were characterised in laboratory-scale trials identified a relationship between the genetic group to which a strain belonged and its aromatic contribution to wine. This study revealed a great diversity in aroma contributions across the different yeasts but in general, they could be broken down into six broad groups based on their aromatic profile. During the 2017 vintage, six strains, representative of the different aromatic groups, were evaluated in a pilot-scale winemaking trial. The sensory characteristics of Grenache wines made using these six yeasts confirmed the results of small-scale profiling work and this is providing further insight into the yeast-based contributions to wine composition.

Two yeast blends containing two strains have been commercialised by Anchor Yeast (Alchemy III and IV). These yeast blends have been shown to enhance the intensity of red fruit characters in red wine.

### Novel application for interspecific hybrid wine yeast

Due to their volatile nature, many wine flavour and aroma compounds are susceptible to loss during fermentation when temperatures rise. Modern winemaking practices use cooling equipment to moderate rising fermentation temperatures, but temperature conditions need to remain sufficiently high for robust yeast growth and to avoid sluggish fermentations. While some of the other *Saccharomyces* species are capable of growth at much lower temperatures than the wine yeast species *Saccharomyces cerevisiae*, these other species rarely ferment grape juice to completion. Two species capable of low temperature growth are *S. kudriavzevii* and *S. eubayanus*. Screening of interspecific hybrids generated with these species has identified a number of hybrid yeast strains that complete fermentation at 12°C, but with a protracted timeline (15–18 days). However, two hybrid strains showed robust fermentation properties at 12°C and completed fermentation in a timely manner (9–12 days). Future work using these interspecific hybrid strains will establish if low temperature fermentation delivers a higher level of volatile flavour and aroma compounds to wines.

### Controlling the timing of flocculation for improved wine processing

Cell to cell binding that results in the formation of large clusters of cells that settle to the bottom of a fermentation vessel is known as flocculation. This process is particularly helpful at the end of fermentation because it makes wine clarification and filtration easier. In a proof-of-concept study, gene technologies enabled control of the onset of flocculation at any point during fermentation using an external signal. Additionally, employing a collection of barcoded wine yeast strains, the flocculation behaviour of more than 70 strains in response to several environmental conditions was determined.

A subset of these strains were found to flocculate strongly at the end of fermentation and were therefore candidates for facilitating wine clarification. Two of these wine yeasts were evaluated in pilot-scale trials. Compared to a control wine yeast, one of the selected strains increased wine filterability, and the other strain produced more compacted lees, which resulted in increased wine volume after racking.

## Defining the nutritional drivers of yeast performance and matching yeast to must

### Background

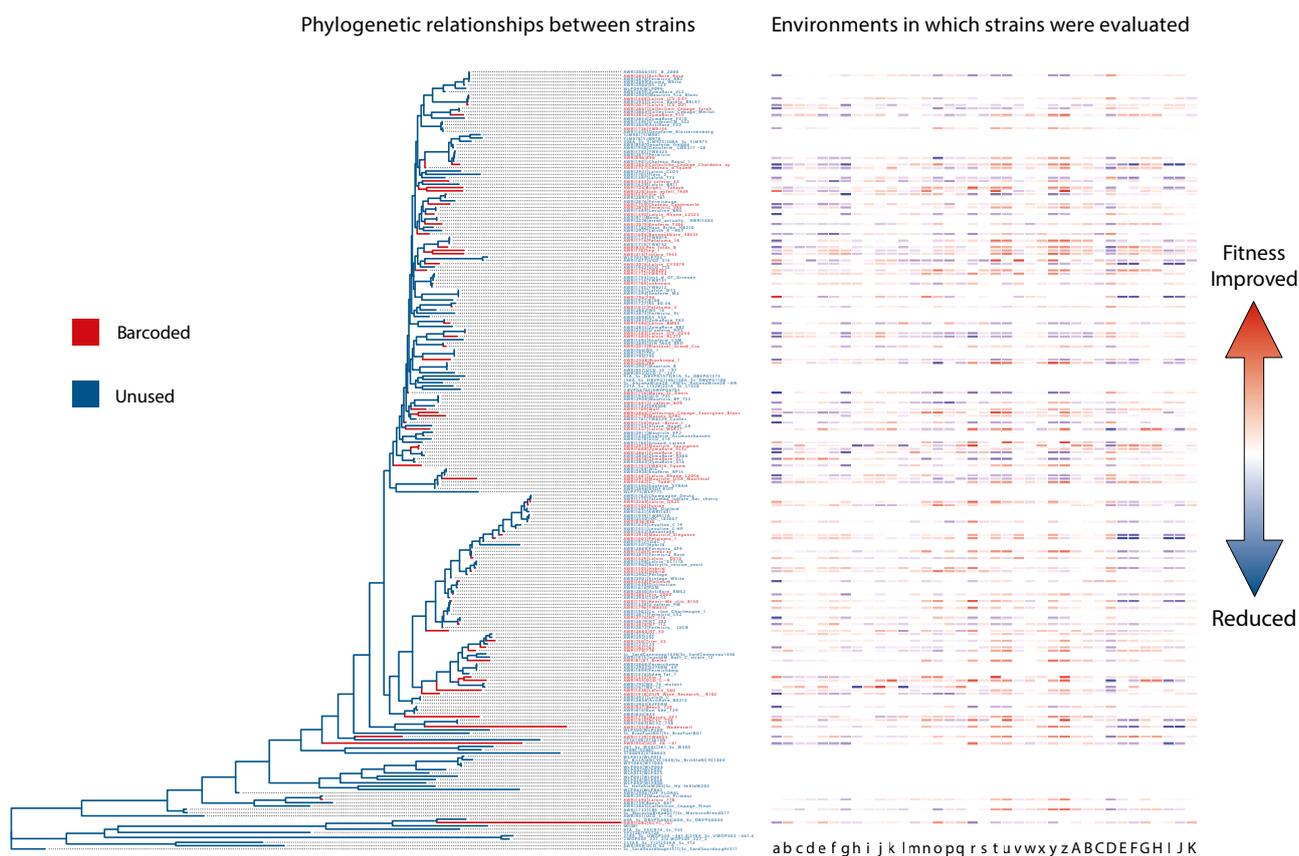
From the AWRI's extensive experience in the rescue of suboptimal fermentations, it has become increasingly clear that the ability to predict problematic fermentations, beyond an understanding of the impacts of sugar and nitrogen, is extremely poor. Work is therefore in progress to develop a greater understanding of the interactions of yeast strains with their environment. While currently more than 200 yeast strains are available to the wine industry, there is limited detail known about how they perform in different contexts. This project aims to expand knowledge of yeast strain performance under a range of environmental conditions (i.e. in grape juices of widely varying composition as used for a range of wine styles) and inform winemakers about how they can reduce the risks of suboptimal fermentations through yeast strain choice.

### Wine yeast fitness profiling

A fundamental property of any commercial yeast is the degree to which it can compete for resources in its working environment. Yeast competitiveness is being assessed directly in this project using a representative collection of barcoded wine yeasts (Figure 3). Following earlier work in which major environmental variables were assessed in a defined medium (i.e. defined levels of sugar, temperature, pH, YAN, potassium, copper and sulfite), this year the project team initiated fitness profiling experiments on freshly prepared unfiltered juice. This enabled a comparison between the earlier 'defined medium' results and those from an environment complete with the rich microbial ecology that comprises a standard grape juice. Using this approach, it was possible to evaluate the barcoded strain collection in a grape juice with different additives (e.g. DAP, SO<sub>2</sub>, increased sugar) or to evaluate yeast strain fitness in a panel of juices. Yeast fitness profiles are shown in the heatmap in Figure 3. It is evident that not all yeast strains perform well under all conditions. With the knowledge gained from this experimental work it will be possible to make condition-specific yeast strain choices to optimise performance in wine fermentations.

### Uncovering the genetic basis of performance

To uncover the genetic basis of performance in specific environmental conditions, classical genetics (mating and screening of progeny) and modern genomics (whole genome sequencing of progeny) have been combined to identify regions of the genome that positively or negatively contribute to the performance of different strains. The primary focus has been on sulfite and copper tolerance, both of which are highly discriminatory for wine yeasts. The genetic basis of resistance to both stresses is well researched and much is already known about the evolutionary strategies that yeast use to tolerate these powerful selective agents. However, this work is uncovering a previously unknown interdependence between these strategies, the exact nature of which is the subject of current work.



**Figure 3.** A phylogenetic tree (left) showing relationships between wine yeast strains, coloured to indicate which strains have been barcoded. Shown on the right is a heat map showing yeast strain fitness under selected conditions. Red indicates improved fitness, blue indicates reduced fitness.

### Efficient and reliable malolactic fermentation to achieve specification wine style

#### Background

Malolactic fermentation (MLF) is an important but sometimes unreliable stage in the winemaking process, with the potential to significantly affect wine quality. In recent years, research at the AWRI has improved MLF efficiency by developing co-inoculation strategies (yeast and bacteria inoculated together) that have been demonstrated to reduce overall fermentation time. However, achieving a reliable MLF still provides winemakers with challenges from time to time. One contributing factor is the lack of MLF starter strains specifically suited to Australian winemaking conditions, as commercially available strains have largely been selected and developed for overseas markets. In addition, while MLF is primarily used for wine deacidification, there is a significant but largely hidden pool of grape and wine aroma compounds in wines that can be released during MLF to influence wine style and enhance complexity. In previous research the AWRI has identified compounds and potential enzymatic pathways that enable some *O. oeni* strains to enhance berry aromas in red wine. More recently, the genomes of many *O. oeni* strains have been sequenced and this revealed extreme genetic diversity across the species. While a high level of genetic diversity provides a promising opportunity to identify MLF strains with unique properties, there is currently little information available regarding genomic markers for wine-relevant phenotypes.

#### Industry trials of Australian *Oenococcus oeni* strains

In a continued effort to identify robust Australian isolates of malolactic bacteria, a method for minimum inhibitory concentration screening was developed to enable reproducible, systematic profiling of bacterial stress tolerances in a model wine test system. Using this system, screening of 10 genomically sequenced AWRI *O. oeni* isolates provided information about their pH and ethanol tolerance, and their sensitivities to temperature, SO<sub>2</sub> and some combinations of stress factors. This information, together with results from further laboratory-scale testing in wine, increased the pool of potential candidate strains for industry trials. During the 2017 vintage, in collaboration with two industry partners, three candidate AWRI *O. oeni* strains underwent winery-scale evaluation of their MLF performance using an optimised bacterial starter culture scale-up protocol. From these trials, two of the strains showed promising results in, respectively, Shiraz and Chardonnay sparkling base wine. The effect of the timing of bacterial inoculation on MLF efficiency was also investigated in two of the winery trials, with co-inoculation more efficient than sequential inoculation in Shiraz wine, but no clear effect observed in the sparkling base wine. The reasons for this matrix-dependent variability are not yet understood and will form the basis of future work in this area.



Cristian Varela

### Safeguarding and realising the potential of the Australian wine microbial germplasm collection

#### Background

The AWRI Wine Microorganism Culture Collection (AWMCC) originates from early microbiological investigations in Australian wines by John Fornachon in the 1940s and the earliest days of the AWRI. Since that time ongoing additions to the AWMCC from wineries and researchers across Australia have led to the development of a repository that houses the Australian wine industry's microbial germplasm heritage. The AWMCC currently holds more than 3,100 yeasts, more than 1,100 bacterial strains and two yeast genome deletion libraries, with an electronic database used to record information about each strain and to manage strain movement (deposition and supply) and intellectual property. The AWMCC holds reference strains, research strains and a large number of Australian indigenous yeast and bacterial isolates. Many of these have yet to be identified and characterised for what they can bring to winemaking.

#### Identification, storage and distribution of microbial strains

In 2016/2017, 246 yeast and bacterial strains were submitted to the AWMCC from researchers and wineries. All strains submitted were checked for purity, had their identity determined and were placed into cryogenic storage at -80°C. An additional 96 strains already present in the AWMCC were identified. During the year, the AWMCC distributed 549 microbial samples from cryogenic stocks.

### Novel products and effective processes

#### Staff

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### Technologies and strategies for the production of lower-alcohol wine

#### Background

There is interest from some consumers in wines with lower alcohol concentration that maintain robust aroma and flavour profiles. Producers may also face financial penalties for higher alcohol wines in markets where taxes are levied on the basis of alcohol concentration.

The microbial biodiversity of spontaneous fermentations contains great potential for shaping wine style, including the production of wine with reduced alcohol concentration. Harnessing this diversity in controlled, inoculated ferments may provide winemakers with simple, cost-effective and low-risk strategies for tailoring wines to market demands. In the context of this project, non-conventional yeast (yeast other than *S. cerevisiae*) can be used to remove some fermentable sugar from the must prior to inoculation with *S. cerevisiae*.

#### Vintage trials of non-conventional yeast

Given the great diversity of non-conventional yeasts, it is not surprising that some have the potential to oxidise grape sugars and therefore decrease ethanol concentration in wine, something *S. cerevisiae* is not able to do. A *Torulaspota delbrueckii* strain and a *Zygosaccharomyces bailii* strain were identified which had potential to produce wine with reduced ethanol content when provided with minimal aeration. Pilot-scale trials with Shiraz showed that both strains were able to produce reduced-alcohol wines compared to a *S. cerevisiae* fermented wine.

### Influencing wine style through management of oxygen during winemaking

#### Background

Effective management of oxygen during winemaking can help to create diverse wine styles, that appeal to a range of consumers. Many approaches to oxygen management are currently practised; however, understanding of the impact of oxygen management practices has largely been confined to those employed post-fermentation, during bottling and relating to the effects of closure selection on post-bottling development. The effects of oxygen management during the process of winemaking (from crushing through fermentation) are, in contrast,

not well understood, with the limited information that exists relating mostly to the management of fermentation efficiency and reliability.

The role of oxygen during winemaking is likely, however, to have a profound effect on the final wine, and there is therefore a significant opportunity for winemakers to use oxygen management before or during fermentation to influence critical aspects of winemaking, such as wine aroma, texture and post-bottling stability. This project combines small-scale laboratory and winery-scale experimental work, aiming to provide new insights into the timing and amount of oxygen required to achieve desirable outcomes in red and white winemaking, including the prevention of 'reductive' odours. The science and technique of adding oxygen in the early stages of fermentation is relatively new in wine science terms, and more widely accepted and used in countries such as France. Anecdotal evidence suggests, however, that small-scale work is being undertaken in this area by Australian wineries, with positive results.

#### Evaluating oxygen use in the fermentation of Shiraz

The timing of oxygen additions during primary fermentation is crucial in obtaining maximum advantage in fermentation efficiency, aroma and palate structure. Optimal timing of oxygen addition (from a fermentation performance gain perspective) was compared to later addition and repeated aerations in pilot-scale (500 L) Shiraz fermentations. One treatment received a one-off addition during pump-over to saturate the fermenting must with air when sugars had dropped by 20% ('Early'), while another treatment consisted of repeated aerations to achieve air saturation over five consecutive days ('Daily'). Another single treatment occurred later when the initial concentration had dropped by 80% ('Late') and a final treatment on previously unaerated wines was carried out after pressing ('Post-Press').

Sensory analysis one year after vintage showed 'Early' and 'Daily' treatments were higher in 'fruity' and 'floral' characters, which was consistent with the results of volatile aroma chemical analysis. In comparison the 'No-Treatment', 'Late' and 'Post-Press' treatments were found to exhibit higher levels of reductive 'vegetal', 'earthy' and 'black olive' characters and lower intensity of fruit characters. The latter treatments had higher concentrations of volatile sulfur compounds. This trial demonstrated that all on-skins aeration treatments resulted in lower H<sub>2</sub>S concentrations post-MLF. The 'Daily' treatment showed significantly lower methanethiol concentrations than the 'No-Treatment', with methane thioacetate being totally absent in this case. Textural descriptors from sensory analysis also showed differences in perceived astringency, viscosity, hotness and acidity due to the treatments, which were not correlated with the aroma characteristics. Only the 'Daily' treatment showed significant effects on the tannin composition: total phenolics were lower, tannin polymer length was shorter, and skin-like tannins were reduced with a corresponding increase in seed-like tannins. Wine colour density and total anthocyanins were depressed and hue was increased with less obvious corresponding trends in improvements to stabilised colour.

The possibility that a beneficial aeration in active red ferments might interfere with simultaneous malolactic fermentation was tested during vintage 2017; early results show no adverse effects on primary or secondary fermentation efficiency.

## Winemaking interventions to modulate glutathione status: effects on white wine quality

### Background

Glutathione (GSH) is a naturally occurring antioxidant present in grapes that plays an important role during winemaking. It can preserve wine colour and aroma by reacting sacrificially with quinones and acting as an antioxidant. Depending on the nitrogen status during fermentation, GSH may contribute to production of H<sub>2</sub>S and similarly, addition at bottling can lead to H<sub>2</sub>S formation, depending on other factors. GSH reacts with a number of components in grape juice to form new compounds of relevance to wine sensory properties and quality. Firstly, it reacts with unsaturated aldehydes to form varietal thiol precursors, which are cleaved during fermentation to contribute positively to wine aroma (particularly in Sauvignon Blanc). Secondly, it reacts with caftaric acid quinones, produced under oxidative conditions, to form 'grape reaction product', which has a beneficial impact on white wine texture.

In 2015 the OIV passed resolutions permitting the addition of GSH to juice and wine. Addition of GSH at different stages of winemaking has profound implications for the formation of compounds that contribute (positively or negatively) to wine sensory properties. It is not clear whether GSH application as outlined by the OIV could be implemented solely for a beneficial impact on wine quality. Furthermore, the effect of GSH addition in varieties other than Sauvignon Blanc is not well understood. This project aims to expand understanding in this area.

### Evaluation of glutathione additions prior, or following, initiation of fermentation

The primary objectives for the first year of this collaborative project were:

- to determine to what degree GSH addition to juice increases GSH concentration in wine
- to assess whether GSH concentration and its antioxidative efficacy are predictable
- to examine winemaking factors (e.g. timing of GSH addition, SO<sub>2</sub> concentration) that may influence the relationship between juice and wine GSH concentrations.

To this end, a vintage trial was completed in which GSH was added prior to, or following, yeast inoculation of Chardonnay and Riesling. The concentrations of GSH used in the trial were based on previous laboratory trials in which the effects of GSH addition rates were evaluated against a range of different yeast strains. A concentration of glutathione sufficient to increase the production of H<sub>2</sub>S by responsive strains was used. Wines were fermented and bottled under 'normal' (0.8 mg/L molecular) and 'low' (0.6 mg/L molecular) SO<sub>2</sub> regimes, producing 36 wines in total. Preliminary results indicate that, even at the relatively high concentrations of GSH employed in this work, volatile sulfur compound (VSC) production was not stimulated to any significant extent in these wines. Glutathione consumption remained constant (at around 100 mg/L) irrespective of whether GSH was added before or after inoculation. The wines have been bottled and will undergo sensory evaluation periodically over the next two years to determine any effects of GSH on in-bottle VSC development.



## Reduce cost of production

### Staff

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### Genomics innovation initiative

#### Background

Synthetic biology and metabolic engineering are frontier areas of biological research. These cutting-edge technologies represent exciting new opportunities in areas such as the creation of plant-derived pharmaceuticals, production of economically feasible sources of biofuels and major improvements in current food and beverage production.

The yeast *Saccharomyces cerevisiae* represents an obvious target for synthetic engineering. It is an established and prominent industrial microorganism, used to produce a diversity of high-value food, beverage and biotechnology products such as biofuels, pharmaceuticals, wine and beer. In addition, yeast is a key model organism for the development of new technologies in fundamental research, including genomics, transcriptomics, metabolomics and systems biology. The existing fundamental knowledge provides an extensive base on which to build a synthetic biology strategy that can be applied in an industrial setting to address key opportunities. Specific objectives of this project are to engineer *Saccharomyces cerevisiae* with new metabolic pathways to enable biosynthesis of compounds such as monoterpenes, raspberry ketone, anthocyanins and lactic acid during fermentation.

In partnership with Macquarie University, the AWRI is also a member of the international Sc2.0 collaboration that is building the world's first synthetic yeast. Macquarie and the AWRI are responsible for building chromosome XIV and a series of other projects related to the Sc2.0 collaboration. Other collaborating institutions on the project are located in the USA, China, the UK and Singapore.

#### Production of raspberry ketone by wine yeast

Raspberry ketone is the primary aroma compound found in raspberries and the naturally derived compound is a valuable flavouring agent. The economic incentives for the production of raspberry ketone, combined with the very poor yields from plant tissue, make it an excellent target for production by synthetically engineered microbial strains.

As previously reported, a *de novo* pathway for the production of raspberry ketone was assembled using four genes from other species, in an industrial strain of *Saccharomyces cerevisiae*. Subsequently, pathway

optimisation was performed to increase yields of raspberry ketone. Alterations have been made to increase the supply of metabolic precursors (phenylalanine and tyrosine) by relaxing metabolic control of precursor production by introducing feedback-resistant mutations into flux-control points and by expanding bottlenecks in the pathway by increasing the concentration of key enzymes through gene overexpression.

#### Sc2.0 international collaboration

Work is continuing on the synthesis of the chromosome XIV allocated to the Macquarie/AWRI partnership. The AWRI's focus is translating the new knowledge gained about yeast through this project for application in yeasts used in industries such as wine, beer, sake, baking or biofuels.

The synthesis of a neochromosome containing the pan genome for the new Yeast 2.0 platform is now complete and phenotyping efforts are underway. Efforts to engineer metabolic pathways of yeast to produce flavours and aromas are also yielding valuable results, with laboratory strains of yeast able to undertake novel transformations and/or produce novel compounds.

### Transforming Riverland food loss and industry waste into profit

#### Background

A substantial proportion of horticultural production is lost pre-farm gate, or removed as an industrial waste stream. These losses and wastes are often directed into low value applications such as animal feed or simply dumped; however, if waste can be regionally aggregated there is potential for higher-value applications to be realised. A collaborative project with SARDI, funded through the South Australian River Murray Sustainability (SARMS) Program, aimed to research the opportunity to add value to food losses and industry wastes through aggregation across agricultural sectors in the Riverland, Murraylands and Murray Mallee regions.

#### Quantifying regional waste and transformation opportunities

The objectives of the first stage of the project were to:

- expand the previous AusIndustry waste mapping conducted in the Riverland, Murraylands and Murray Mallee to quantify all waste streams, including volumes, seasons, current use practices and prices received
- evaluate potential waste transformation infrastructure in the region to assess the region's capability to process, upcycle or use agricultural waste.

The initial survey response rate was low, attributed to data not being collected by industry or remaining confidential; however, through more directed discussions with key industry bodies, survey responses were extrapolated and finalised with a high degree of consultation. The key findings of the survey highlighted that rejected potatoes, almond husks/shells, unsaleable citrus and grape marc were the four largest horticulture and agriculture waste streams within the study region. Although of significantly lower volume, stockpiles of copper chrome arsenic treated posts were also reported in the survey.

#### Bioprospecting waste streams

The second stage of the project characterised all identified waste streams in the study area to determine their nutritional profiles, agrochemical residues, tannin levels and calorific value for bioenergy, in order to identify waste use options, including industry aggregation opportunities. Bioprospecting of wine industry waste streams identified several potentially valuable bioactive components, along with other potentially valuable extracts (grape seed extract and grape seed oil) and bioenergy opportunities.



Toni Garcia Cordente

- presenting a series of workshops on design thinking and luxury business strategy tools
- completing a five-workshop 'Creating Consumer Value' program with the Barossa Grape & Wine Association, which included presentations of opportunities in high net worth Asian markets, courses on design thinking and luxury business strategy and mentored sessions on how to develop novel product concepts and experiences using these tools
- completing the development of product concepts designed to appeal for use in Chinese weddings in collaboration with Riverland Wine and the University of Adelaide
- continuing work on the design of the VALO amphora, with a particular emphasis on ensuring the magnetic closure provides optimal oxygen transfer rate. The final VALO event, where VALO participants will receive their amphoras and the program will conclude, will be held in 2017/2018.

### Market insights

Feasibility studies were conducted based on the local industries' perception of what were the potential highest value and/or most likely waste use opportunities. 'Bioactives' or functional molecules present in waste streams included antioxidants, carotenoids, glucose, flavonoids, grape seed extract and resveratrol. Development of new bulk food product industries, including grape seed oil were investigated. Opportunities for bioenergy generation through aggregated anaerobic digestion combining vegetable (carrot, potato and onion) waste and grape marc were evaluated.

### Future work

The SARMS project was completed in June 2017. The research and industry engagement conducted throughout the project will support the Fight Food Waste and Fraud Cooperative Research Centre (CRC) bid currently in progress.

## Identifying cost reduction opportunities by mapping the grape and wine value stream

### Background

As part of its mission to support the profitability of the Australian wine sector, the AWRI, together with the South Australian Government's Department of State Development, the McLaren Vale Grape Wine and Tourism Association and Scholle Packaging, established a design thinking program to showcase the development of business initiatives that engage consumers on attributes other than price. It was decided to progress one of the concepts developed to commercialisation to demonstrate how innovation can rapidly generate demand for wine at a high premium. This program also aims to cultivate new opportunities for Australian wine producers to access and exploit business innovation tools and expertise supporting the generation of product premiums.

### Applying new tools to support premiumisation

A series of projects were conducted to support wine industry premiumisation through adoption of design thinking and luxury business strategy including:

- developing a reference report and wine sector relevant fact sheets from the PIRSA functional and luxury foods program

## Reduce the economic impact of taints and faults

### Staff

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## Smoke taint diagnostics and mitigation

### Background

Since 2003, major fire events have resulted in over \$400M worth of grapes and wine being rendered worthless or downgraded in Australia as a result of smoke taint. The frequency of days with very high and extreme Forest Fire Danger Index is predicted to increase by 4-25% by 2020 and 15-70% by 2050 under various climate change scenarios. In addition to natural bushfires, controlled burn activities by public land management agencies will continue. Thus it is important that the Australian wine industry manages this major financial and reputational risk and develops cost-effective remediation tools for smoke-affected grapes and wine which minimise the expression of smoke taint characters and retain wine quality and integrity.

A collaborative project has been funded from 2016 to 2020 by a Rural Research & Development for Profit grant. Project partners include Wine Australia, the Australian Government Department of Agriculture and Water Resources, Agriculture Victoria, La Trobe University and Wine Victoria. The AWRI's primary role in the project is to evaluate a range of possible remedial management options and processing tools for dealing with smoke-affected grapes and wine. This is especially important as smoke taint is known to develop during bottle ageing of wine through continued conversion of non-volatile glycosides from contaminated grapes into their free volatile forms. The AWRI is also continuing to expand its database of 'background' levels of smoke taint compounds in non-smoke-exposed grapes and wines. In addition, the project team is collaborating with Agriculture Victoria/La Trobe to evaluate a range of possible monitoring, preventative and remedial management options and tools for dealing with the variable composition of atmospheric smoke and associated risk of smoke taint in wine.

#### Smoke taint mitigation studies

A range of horticultural products were evaluated for their effectiveness at preventing the uptake of smoke taint volatile phenols from the atmosphere using a controlled environment model system. The studies used excised wine grapes (Chardonnay, Sauvignon Blanc and Semillon) and table grapes bunches that were placed in a glass vessel containing a gaseous phenol mixture. The free phenols were absorbed by the grapes and subsequently converted to glycosides (mono- and di-saccharides). Results indicated that uptake and metabolism of volatile phenols by berries occurred even after removal of bunches from the vine. Using the excised bunch model system, 12 agrochemicals and horticultural materials were evaluated. The materials tested included oily/hydrophobic materials, pest control products, sunscreen protectants and other solid materials that may provide a physical barrier. The effectiveness of the treatments in preventing the uptake of free phenols by grapes and their subsequent conversion to glycoconjugates was evaluated by comparison to a non-treated control. Most treatments provided little if any protection, and instead often resulted in higher levels of free phenols and their glycosides in the grapes, with the highest levels being observed for the more oily/hydrophobic materials.

#### Smoke taint baseline study

In 2010/2011, the AWRI conducted a survey of the baseline concentrations of volatile phenols and phenolic glycosides in grapes that had not been exposed to smoke, with the results used to assist with interpretation of smoke taint analyses via a 'traffic light' system. The initial dataset was limited to five grape varieties. In 2016, a project commenced to expand the database to include additional varieties.

Frozen samples of Sauvignon Blanc, Pinot Gris, Semillon, Merlot and Grenache grapes from the 2016 vintage that had not been exposed to smoke were analysed for the concentration of volatile phenols and phenolic glycosides. Small-lot fermentations were conducted and the resulting wines were also analysed. The data obtained from the 2016 samples were subjected to statistical analysis and the 'traffic light' database used in the interpretation of analytical results from suspect samples was updated. The database now contains data for ten varieties: Cabernet Sauvignon, Shiraz, Merlot, Grenache, Pinot Noir, Chardonnay, Riesling, Semillon, Pinot Gris and Sauvignon Blanc. In order to increase the statistical power of the database, more than 170 non-smoke-exposed grape samples (including samples of Mataro and Sangiovese) were collected in 2017. These will undergo small-lot winemaking and analysis during the coming year.

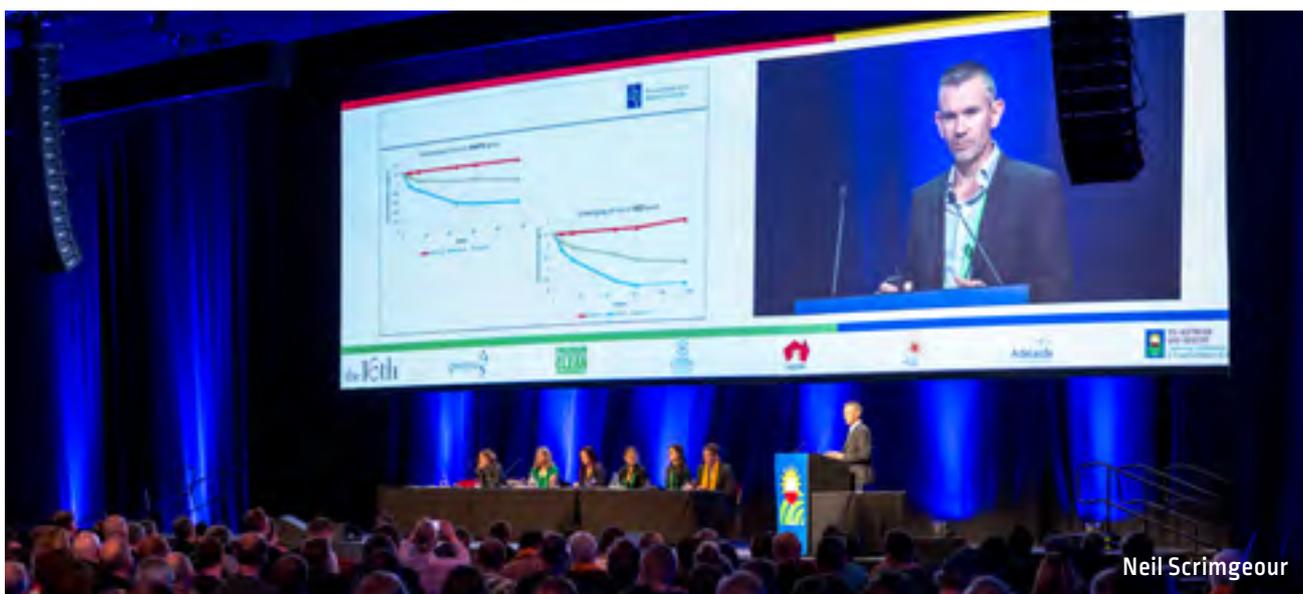
#### Ensuring the continued efficacy of *Brettanomyces* control strategies for avoidance of spoilage

##### Background

*Brettanomyces* yeast can cause wine spoilage by producing 4-ethylphenol and 4-ethylguaiacol which are responsible for 'phenolic', 'leather', 'sweaty' and 'medicinal' aromas (collectively known as 'Brett' character). Although wine spoilage from this yeast was a major issue in Australian red wines produced during the late 1990s and early 2000s, the risk of 'Brett' spoilage is now commonly managed via a multi-faceted strategy developed by the AWRI, enabling winemakers to significantly decrease levels of 'Brett' spoilage compounds in finished wines. Yet, *Brettanomyces* has not been eliminated from Australian wineries,



Yoji Hayasaka



Neil Scrimgeour

and loss of wine value still occurs. To ensure Australian winemakers' continued ability to manage *Brettanomyces* in a cost-effective manner, the control strategy must be future-proofed against market pressures to minimise levels of sulfite in wine, and augmented with rapid detection methods.

#### The potential for emergence of sulfite-tolerant *Brettanomyces* strains

Several different environmental lineages of *Brettanomyces bruxellensis* have undergone long-term growth experiments under ever-increasing amounts of sulfite. All populations were shown to adapt to the increasing levels of sulfite, with some strains showing a stable doubling of their sulfite tolerance. In order to ascertain if this adaptation to sulfite may be occurring outside of the laboratory, winery isolates are being collected and assayed to determine if tolerance is increasing over time. Preliminary results suggest that adaptation to sulfite is not yet a problem for winemakers; however, additional monitoring will be conducted to ensure that industry is not taken by surprise.

In addition to the *Brettanomyces* monitoring, experiments are now underway to determine the action of alternative control measures, such as chitosan, against the laboratory-adapted strains to provide a suitable means of control should sulfite tolerance emerge as a future problem in wineries.

#### Formation and fate of positive and negative sulfur compounds

##### Background

Volatile sulfur compounds (VSCs) can contribute both positive and negative attributes to wines, and their control in a winery environment is an important avenue to increasing wine value either by increasing positive sensory attributes or through the reduction of negative characters. The occurrence of VSCs can be influenced by factors including: yeast selection and fermentation conditions; the nature and quantity of precursor compounds; the availability or absence of oxygen at different points of the winemaking process; and availability and speciation of transition metal ions such as copper.

Winemakers are familiar with the practice of adding copper sulfate to wines that exhibit 'rotten egg' or other 'reduced' characters when in tank. Many winemakers have also seen these 'reduced' characters disappear from their wines in the short term, only to see them return at

a later date, sometimes after bottling. By exploring the chemistry of VSC formation and the important role played by metals, these common winemaking observations can be better understood, potentially leading to recommendations for ways to reduce the risk of undesirable 'reduced' aromas.

#### Factors that determine 'reductive' aroma accumulation in wines post-bottling

It was hypothesised that the presence of certain precursor compounds, such as cysteine, glutathione (GSH), methionine (Met), disulfides, and thioacetates such as methylthioacetate (MeSAC) and ethylthioacetate (EtSAC), are the main contributing factors in determining hydrogen sulfide ( $H_2S$ ), methanethiol (MeSH), ethanethiol (EtSH), and dimethylsulfide (DMS) concentrations in wines post-bottling. Experiments were set up to test these hypotheses in real wines.

Results showed that the presence of cysteine and GSH was associated with smaller increases in  $H_2S$  concentrations than those associated with the presence of copper (acting on yet to be identified precursors) in Shiraz wines. For MeSH and EtSH, important precursor compounds were their corresponding disulfides and thioacetates, such as dimethyldisulfide, MeSAC, and EtSAC. These precursor compounds produced large concentrations of MeSH and EtSH, respectively, of between 30% to 70% yields of the thiols. Factors such as copper addition and wine pH were important in determining 'reductive' aroma accumulation in wines post-bottling.

#### Metabolic pathways that lead to the formation of volatile sulfur compounds

Five yeast genetic determinants were identified that regulated the formation of  $H_2S$  from cysteine during fermentation of a synthetic juice. Of all these genes, *IRC7* played a pivotal role in the formation not only of negative VSCs but also of the 'tropical' thiols 3-mercaptohexan-1-ol (3MH) and 4-methyl-4-mercaptopentan-2-one (4MMP).

Sequencing the genome of more than 100 wine yeast strains allowed the identification of several variants of *IRC7*, which differ in their enzymatic activity and their potential to modulate VSC formation. Four of these variants were assessed, and it was seen that the amount of  $H_2S$  released by yeast was dependent on the *IRC7* variant, and correlated with the initial concentration of cysteine in the media.



Finally, a strong positive correlation was observed between the amount of H<sub>2</sub>S produced by yeast and the concentration of other negative VSCs such as MeSAc, EtSH, EtSAc and carbon disulfide, both in grape juice and synthetic juice fermentations. These results confirmed the important role played by yeast in the formation of VSCs other than H<sub>2</sub>S.

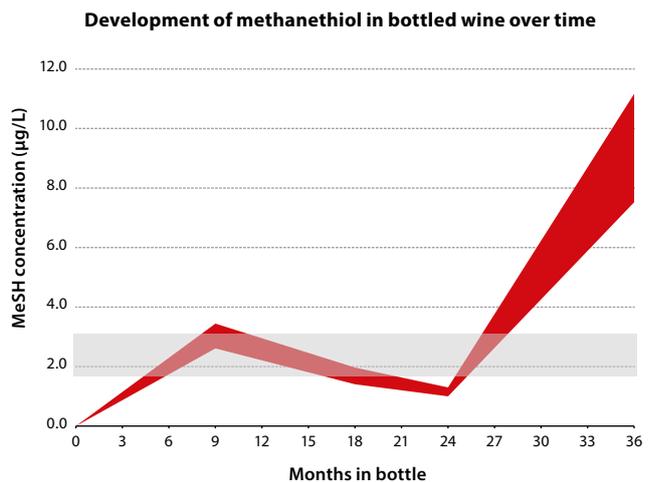
#### The chemical speciation of copper in wine

Efforts to develop a simple and effective colourimetric method for the determination of both the quantity and nature of copper in wine continued. Earlier efforts to determine the ratios of copper (I) to copper (II) were discontinued as results showed that equilibria between the two species were particularly dynamic and the actual measurement of the species could potentially shift the ratios, leading to erroneous results. Work by collaborators at CSU had shown that a potentially more informative measure was the relative proportion of labile to non-labile copper, as this had been shown to correlate with the presence of reductive compounds in wine. A method to separate these two forms of copper in wine using simple exchange columns was adapted and then after decolourisation of the wine the total amount of each form was determined using a simple colourimetric assay. Work to validate this methodology is continuing.

#### Data from the International Wine Challenge

The importance of unique and large datasets in developing a real understanding of wine industry issues is highlighted by recent work which has improved the understanding of the role of closures in wine faults. Working with the International Wine Challenge, AWRI Commercial Services analysed the results from more than 100,000 show entries over 10 years to assess the impact of closures on common wine faults. This analysis showed that despite the common belief that screw cap closures can lead to a greater prevalence of reductive characters in wine than natural corks, the levels of rejection for reductive character for the two closure types was exactly the same (0.81% of entries). This suggests that reductive faults are more strongly linked to winemaking practices than to closure choice. This

result is consistent with research done in long-term closure trials which showed that while closure choice did have some impact, the difference in levels of reductive compounds between closures was much less than the overall changes found in the wine over the same period (Figure 4). The data from the International Wine Challenge also showed that the rate of rejection for all faults for wine closed with cork closures was significantly higher (4.7%) than that for wines closed with screw cap closures (1.6%).



**Figure 4.** Graph showing the development of methanethiol over time in a bottled wine sealed with a range of different closures. The results show that the range of values for methanethiol for different closures (represented by the thickness of the red line) is relatively insignificant compared to the overall changes in concentration as the wine ages, independent of closure type. The grey area represents the sensory threshold for methanethiol.

## Extension and adoption

The value of research and development is only realised in industry when outcomes are effectively and efficiently implemented by practitioners. For this to occur, both extension and support for adoption are required. Projects under this theme apply a range of proven mechanisms to communicate research outcomes, solve industry problems, provide access to relevant technical resources, educate tertiary students, foster industry adoption and bridge gaps between research and practice.

### Drive productivity, sustainability and profitability through facilitating rapid adoption of R&D outcomes

#### Staff

Gayle Baldock, Linda Bevin, Francesca Blefari, Maria Calabrese, Adrian Coulter, Geoff Cowey, Michael Downie, Marcel Essling, Dr Kerry DeGaris, Peter Godden, Dr Yoji Hayasaka, Dr Markus Herderich, Matt Holdstock, Dr Mardi Longbottom, Anne Lord, Dr Paul Petrie, Virginia Phillips, Ella Robinson, Con Simos, Dr Creina Stockley.

#### Collaborators

State and regional wine industry associations; NSW Department of Primary Industries (Adrian Englefield); Wine Communicators of Australia (Lynda Schenk).

#### The staging and conduct of extension programs

##### Background

The key objectives of the AWRI's extension programs are to raise awareness and facilitate uptake of research outcomes, assist producers to understand the practical value of these outcomes and overcome any potential barriers for adoption. These aims are achieved by extending research outcomes in forms that encourage adoption by Australia's grapegrowers and winemakers. These efforts include many of the trusted and successful extension initiatives undertaken by the AWRI, for example the long-standing roadshow program, held on a rotational basis across Australian wine regions. In addition, a wide variety of training and educational programs in viticulture, winemaking, environmental sustainability and wine evaluation are delivered, including the AWITC workshop program, Research to Practice workshops, the Advanced Wine Assessment Course and other tasting events. Staff that contribute to extension programs also produce content for many of the AWRI's publication commitments. See Appendices for more details.

##### Roadshow seminars and workshops

During the year, 17 days of roadshow seminars and 29 days of workshops, including ones on 'Evaluation of winemaking treatments in Pinot Noir,' 'Lean' and 'Spray application', were held in the following Australian winemaking zones and regions: Adelaide Hills, Barossa, Canberra District, Central Ranges, Clare Valley, Geelong, Gippsland, Great Southern, Hunter Valley, Langhorne Creek, McLaren Vale, Mornington Peninsula, Murray Darling, North East Victoria, Pemberton, Riverina, Riverland, Swan Valley, Tasmania and Yarra Valley.

To maximise attendance, events were publicised via a range of mechanisms including the Australian Grape and Wine Events Calendar, the AWRI website, social media, state and regional association websites

and local press. In addition, staff liaised with the local associations to coordinate promotional efforts within the regions, including discussion at local association meetings, direct email notification and placements in print media. A total of 1,216 participants attended seminars and workshops during the year.

#### Webinars

The AWRI webinar series continued during 2016/2017 with 20 webinar sessions and 315 participants. Approximately one-third of the webinars were presented by AWRI staff, with the remainder delivered by guest presenters from other research organisations and industry. The portfolio of presentations was diverse and included topics such as manipulation of vine balance, stuck fermentations, analytical tools to test wine provenance and understanding luxury in wine. Webinars provide a convenient format to reach grape and wine producers across the country in a single session. Participants have the opportunity to speak with subject experts, ask questions and share experiences. Recordings of all webinars are available on the AWRI's YouTube channel.

#### Content provision

Extension staff are responsible for contributing a significant amount of content to the AWRI's communication platforms including the AWRI website, *eBulletins*, *eNews*, *Technical Review*, *Wine Australia's R&D News* and a regular column in the *Australian & New Zealand Grapegrower and Winemaker*. See Appendix 7 for further details.

#### Wine tasting courses and events

Four Advanced Wine Assessment Courses (AWACs) were held at the AWRI during the year; with 16 participants in each course. Each course is delivered over four days with more than 40 hours of content.



Ella Robinson

Participants evaluate more than 310 wines under simulated wine show conditions. Lectures are also presented by AWRI staff and the course features guidance from a range of wine show judges, journalists and winemakers. At each AWAC, the top performing participant (based on statistical analysis of scores, verbal skills and group interaction) is named *dux* of the course and given the opportunity to participate as an associate judge at a national wine show. This year the *dux* winner for AWAC 39 was announced as Daniel Graham from Red Heads Wines. Daniel was offered an associate judging position at the 2017 Royal Queensland Wine Show.

The one-day wine judging course launched in 2015 continued this year, with courses held in September and November 2016. This course provides AWAC graduates with additional insight into wine show judging approaches.

Two 'Flavours, faults and aromas' workshops were held for Sommeliers Australia in Sydney and Melbourne. The Winery Engineering Association requested a tailored tasting 'Shiraz and its regional differences' as part of its annual conference.

#### Communicating R&D outcomes to key customers and consumers of Australian wine

As part of its continuing support for the promotion of Australian wine, the AWRI was invited by Wine Australia and Austrade to participate in their 'Australian Wine Grand Tasting' events in Seoul and Tokyo. The AWRI provided a booth with a wine education focus, presenting common wine aromas, both positive and negative, including 'Brett', 'cork taint', 'pepper' and 'eucalypt' characters. A masterclass was also presented on 'pepper' and 'spice' characters in Australian Shiraz.

Various groups were welcomed to the AWRI during the year as part of visits hosted by Wine Australia, including delegations from the Wine & Spirit Education Trust, EU media and Asian trade groups. Tours of the AWRI, presentations and/or short tastings were provided to showcase the AWRI's research, development and extension capabilities.

The AWRI played a role with Charles Sturt University in a visit to Melbourne of 50 eminent sommeliers from around the world, organised by Wine Australia to coincide with the announcement in Melbourne of the 50 world's best restaurants. A sensory assessment using the rapid sensory method called 'pivot profiling' was conducted with the sommeliers, with super-premium Shiraz sourced from well-known producers from across Australia as well as several international benchmark wines. The event was well received by the sommeliers, with some animated discussion following the tasting, and the sensory descriptors and preferences of the sommeliers were compared to those of a group of Australian winemakers in a subsequent event. This work formed the initial step in a collaborative project with Charles Sturt University investigating Shiraz sensory and chemical differences related to regionality.

#### Research to Practice

The Research to Practice (RtP) training model provides practical, themed, user-pays training sessions for the wine sector. AWRI staff and external providers contribute to the design and delivery of the programs. One module on alternative varieties was presented in the Limestone Coast during 2016/2017.

#### NSW weather station network

The New South Wales weather station network forms part of a broader electronic pest and disease warning system, a key initiative of the Skills Development Program for NSW grapegrowers and winemakers. In 2016/2017, 10 weather stations were added to the online network available from the AWRI website, bringing the total number of weather stations to 42. NSW grapegrowers and winemakers have

around-the-clock access to a range of weather data such as air temperature, soil temperature, rainfall, wind speed, wind direction and frost hours.

#### Wine show management software

ShowRunner is an all-in-one wine show management system developed at the AWRI, which covers all aspects of a wine show from online entries to electronic scoring and instant production of results. The software began as a tailored solution for the Advanced Wine Assessment Course and has been adapted to the processes and practices followed by the Australian wine show system.

In 2016/2017 ShowRunner was used by three wine shows – in the Hunter Valley, Orange and Langhorne Creek. By the end of calendar year 2017, more than 20 wine shows across Australia will have used the system. In addition, discussions have taken place with a number of national and regional shows about using Showrunner in 2018. Interest has also been received from international wine shows and shows of other beverages.

#### Specialised technical troubleshooting and responsive helpdesk services for the Australian wine sector

##### Background

The AWRI's technical helpdesk plays an important role supporting grapegrowers and winemakers across Australia. The helpdesk provides rapid, confidential support on a wide range of topics including winemaking, viticulture, health, regulatory and trade issues, delivered by an experienced multidisciplinary team with detailed knowledge of grape and wine technical issues. Industry personnel are able to contact the helpdesk by phone or email to ask advice, seek information or discuss issues. Samples can be submitted for further investigation, which may involve sensory, chemical or microbiological analysis to help understand the nature and extent of the problem. By identifying and quickly resolving issues as they arise, producers are able to minimise losses while being assured that this service maintains strict confidentiality.

##### Helpdesk enquiries

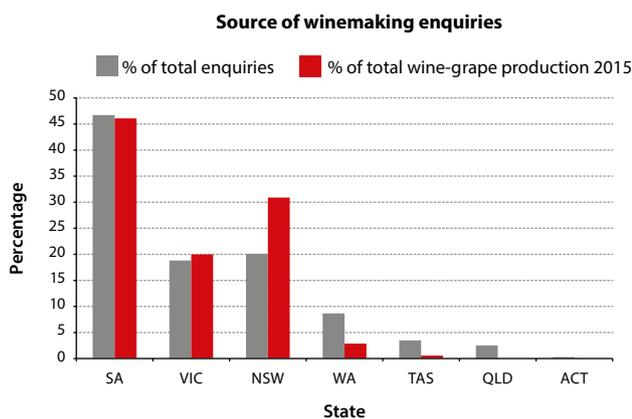
Almost 1,700 enquiries were received during 2016/2017 (Table 1) with more than 90% of these enquiries answered within 24 hours, highlighting the rapid response of the AWRI helpdesk. A database is maintained of all queries, which allows trends to be monitored, and appropriate responses coordinated and implemented as required.

**Table 1.** Enquiries received by the AWRI helpdesk in 2016/2017

	Number of enquiries
Winemaking	1,117
Viticulture	483
Regulatory	96
Total	<b>1,696</b>

##### Winemaking enquiries

The majority of the winemaking enquiries received during the year were from wine companies and suppliers closely aligned with the wine industry, with the small number of remaining queries from government organisations, students, legal practitioners and journalists. Approximately 20% of winemaking-related enquiries resulted in investigations, with samples requested and further analysis performed to identify the problem and recommend a process for remediation. Figure 5 shows the sources of winemaking enquiries in relation to the proportional volume of wine-grape production for each state/territory.



**Figure 5.** Winemaking enquiries received by the AWRI helpdesk in 2016/2017 by state/territory, compared to wine-grape production in 2015

The type and number of enquiries received by the helpdesk were strongly influenced by the climatic conditions experienced during the vintage period. Vintage 2017 did not follow the same early and compressed trend experienced in recent years, but saw fruit ripen much later, with harvest dates aligned closely with those experienced in the mid-1980s.

#### Viticultural conditions

With only one year in the past ten being cooler than long-term average (2011), and seven of Australia's ten warmest years having occurred since 2005 (Bureau of Meteorology State of the Climate Report 2016), grape-growers and winemakers were presented with a different vintage in 2017. The start of the growing season was wetter than average, with the Bureau of Meteorology recording the wettest May to September on record for Australia (BOM Annual Climate statement 2016). The wet conditions provided many challenges, including preventing some growers from accessing vineyards to deliver the first few critical agro-chemical sprays. The wet soils also kept soil temperatures low, slowing early growth and leading to uneven budburst.

Once the weather warmed up, soil moisture drove strong canopy growth. The dense foliage required more frequent trimming to allow sprays and light to get into the canopy. With high soil moisture, shoots continued to grow late into the season, where a drying soil would normally signal to the vine to turn its resources towards fruit ripening. This meant that the fruit began to ripen very slowly across many regions and contributed to a later harvest.

Conditions during the growing season were cooler and generally more overcast than usual. This favoured the growth of powdery mildew, which can be inhibited by bright sunlight and hot temperatures. The absence of short periods of very hot weather also may have favoured many insects and greater than usual insect pest problems were reported. High populations of millipedes, light brown apple moth caterpillars, mealy bugs and scale insects were seen, as well as some of their predators, including spiders. In some regions where scale populations were high, 'sooty mould' was an issue which resulted in the downgrading or even rejection of fruit.

#### Viticultural enquiries

During the year, the viticulture team responded to 483 viticulture-related enquiries. Around one-third of the viticulture issues related to sustainability issues, namely environmental impacts of a changing climate, enhancing environmental quality credentials and striving for efficiencies in resource use, such as electricity and water. The next most common topics for queries were agrochemicals (20%), vineyard pests (11%), vineyard practices (13%) and viticulture in general (5%). Other common queries covered weather, grapevine varieties and spray drift.

Agrochemical queries reflected the cooler and wetter conditions experienced, with the majority of these related in some way to pest and disease management. Early season interest in the use of aircraft to apply chemicals was novel. Later in the season, growers were looking for information about possible curative programs for diseases and had questions about the risks associated with agrochemical residue levels in grapes after late-season fungicide sprays. As a result of the seasonal conditions, fungal diseases made up a greater proportion than usual (over 70%) of the pest/disease-related queries. Of the insect-related issues, queries about scale were predominant. Elevated soil moisture levels caused weed problems in other farming systems which resulted in increased reports of damage from spray drift into vineyards from nearby farms.

Numbers of viticulture queries to the helpdesk broken down by state/territory broadly reflected national plantings. The states/territories taking a larger share than their grape area would suggest were those with smaller plantings, namely the ACT, Tasmania and Queensland.

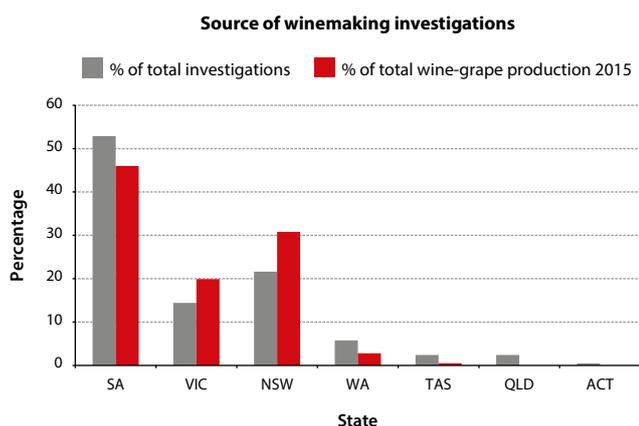
#### Regulatory enquiries

There were 96 regulatory-related enquiries during 2016/2017. The questions covered the broad areas of allergens, general food safety/toxicology, and legality of compounds, practices and processes (which generally fall under the auspices of the Australia and New Zealand Food Standards Code). Specific topics where queries were received included:

- the legality of practices such as electrodialysis and ion exchange
- the legality of addition of compounds such as GSH to ferments and additions of ammonium bisulfite, chitin-glucan, hydrogen peroxide, low sugar juice, polyvinylimidazole/polyvinylpyrrolidone co-polymers, polyaspartate and silver chloride to wine
- flavouring additions such as butterscotch and peach to wine/wine products
- sulfur dioxide additions to wine in Australia and international markets
- Australian and international status of GMO products in viticulture and winemaking
- Australian and international status of water additions in winemaking
- organic standards, certification and subsequent classification of products.

#### Winemaking problem-solving investigations

In 2016/2017, the AWRI helpdesk team conducted 208 winemaking problem-solving investigations, which is slightly lower than last year's figure (247), and in alignment with the 10-year average of 213 investigations per year. The number of samples analysed as part of these investigations decreased compared to last year (Table 2), mainly due to a drop in the number of closure-related investigations. A breakdown of the investigations conducted by state/territory is shown in Table 3. Trends are generally similar to previous years, with SA accounting for the highest number of investigations followed by NSW and Victoria. The sources of the winemaking investigations conducted were generally aligned with the volume of wine-grape production of the different states/territories (Figure 6).



**Figure 6.** Winemaking investigations undertaken by the AWRI helpdesk team by state/territory, compared to wine-grape production in 2015

**Table 2.** Winemaking investigations conducted and samples analysed by the AWRI helpdesk team during the past three years

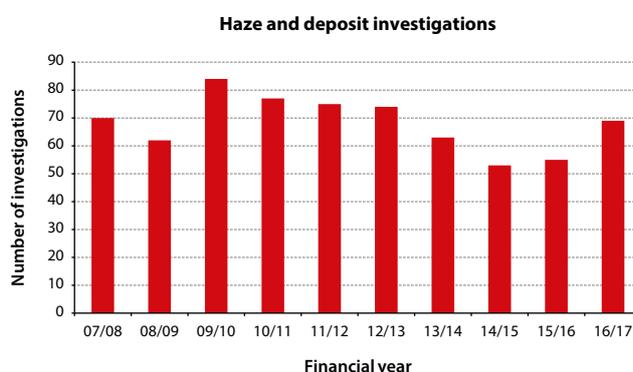
Type of investigation	2014/ 2015	2015/ 2016	2016/ 2017
Identification of hazes and deposits	53	55	69
Microbiological investigations	23	29	24
Sensory assessments	48	68	61
Taint and contamination problems	47	61	30
Other investigative analyses	29	27	24
Closure-related investigations	4	7	0
<b>Total number of investigations</b>	<b>204</b>	<b>247</b>	<b>208</b>
<b>Total number of samples analysed</b>	<b>1,152</b>	<b>1,291</b>	<b>837</b>

**Table 3.** Winemaking investigations conducted during the past three years, broken down by state/territory

State/territory	2014/2015	2015/2016	2016/2017
SA	102	107	110
VIC	34	57	30
NSW	36	51	45
WA	19	20	12
ACT	1	1	1
TAS	8	11	5
QLD	4	0	5
<b>Total</b>	<b>204</b>	<b>247</b>	<b>208</b>

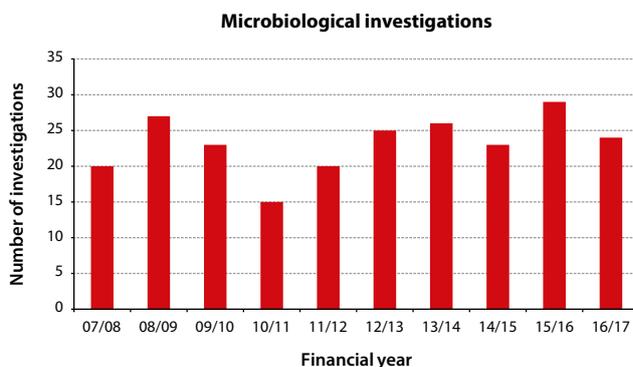
The total number of investigations conducted into wines affected by hazes and deposits continued to be substantial and was slightly higher than the previous year (Figure 7). Crystalline deposits made up almost 40% of all deposits isolated this year. The most commonly isolated crystalline deposit was potassium hydrogen tartrate, followed by calcium L tartrate. Other crystalline deposits included quercetin dihydrate, ellagic acid and calcium DL tartrate. Protein hazes from heat unstable wines also made up significant numbers (11%), as did wines containing either yeast or bacteria cells (~9%), most likely caused by ineffective filtration or contamination during packaging. There were

three investigations where grapeseed oil was identified in wine; this is usually caused by excessively hard pressing of ripe seeds. Grapeseed oil can be readily identified through its distinctive pungent and herbaceous aroma and its yellow/green appearance.



**Figure 7.** Haze and deposit investigations conducted by the AWRI helpdesk team between 2007/2008 and 2016/2017

The number of investigations conducted into microbiological instabilities decreased slightly this year (Figure 8). Microbiological instabilities have the potential to produce significant off-flavours, hazes and deposits and can render wines undrinkable. Types of microbiological issues seen this year included: *Brettanomyces* spoilage; wines containing yeast post-bottling, caused either by ineffective sterile filtration or contamination during bottling; secondary fermentation-related problems; mousiness; volatile acidity; and stuck fermentations. In vintage 2016 stuck fermentations made up a high proportion of the microbiological investigations, with high sugar and alcohol levels being the most likely causes of stuck or sluggish fermentations. Harvest dates in vintage 2017 were a lot later than recent years and the cooler vintage conditions experienced in many regions may have resulted in lower numbers of stuck primary fermentation investigations this year.

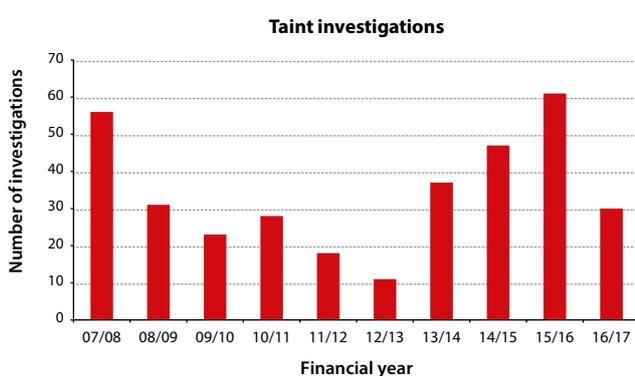


**Figure 8.** Microbiological investigations conducted by the AWRI helpdesk team between 2007/2008 and 2016/2017

There were 30 'taints and contaminations' investigations carried out during 2016/2017 (Figure 9), a number that was 50% lower than the previous year (61) and lower than the long-term average from 1999/2000 to 2015/2016 (46). The low figure this year is encouraging. A review of the types of investigations recorded under this category highlighted again that there was no common theme or consistent issue, but many varied and different problems that wineries encounter each vintage. To provide information about how to avoid these types of problems, a number of different forums were used including the 'Ask the AWRI' column, eNews and discussions during face-to-face workshops.

Smoke taint was not as big an issue in vintage 2017 as it was in 2016, with only six investigations and significantly lower numbers of enquiries compared to the previous year. Although no extensive bushfires were experienced in grapegrowing regions during the 2017 vintage, there were still some smoke-related queries stemming from minor fires and prescribed burns that occurred close to vineyards in Tasmania, Victoria, South Australia and Western Australia. The later timing of vintage resulted in some cross-over between times when quite ripe fruit was hanging on vines and times when other landholders were conducting burn-offs. Grapes are highly sensitive to uptake of smoke taint compounds from around veraison onwards, making the risk of the fruit becoming smoke tainted high if smoke exposure occurs close to harvest.

Other investigations under the category 'taints and contaminations' covered issues of hydraulic oil, TCA-related taint (five investigations), paint taint, 'ladybird taint', fining to remove excess copper, hydrocarbons (four investigations) and chemical taints.



**Figure 9.** Taint investigations conducted by the AWRI helpdesk between 2007/2008 and 2016/2017

Several communications (*eBulletins* and website updates) were developed during vintage 2017 in response to enquiries to the AWRI helpdesk; these covered topics including sooty mould, dealing with flooding and waterlogged vineyards, and changes to regulations to allow limited addition of water to high sugar musts.

## Library service

### Background

The John Fornachon Memorial Library holds the largest knowledge base of grape and wine technical resources in the southern hemisphere. The library continues to support the Australian grape and wine sector through strategic sourcing, management and dissemination of relevant and useful electronic and print resources covering 'vines to wines'. More than 87,879 items (including books, journals, article reprints, conference proceedings, reports, theses, standards and legislation, as well as a reference collection of directories, foreign dictionaries and atlases) are available to levy payers, industry organisations, students and AWRI staff. Members of the Australian grape and wine industry can search the library catalogue online via the AWRI website.

### eBook collection

The library introduced a second eBook platform in 2016/2017, which expanded the range of titles available via this medium. The collection currently holds 121 eBooks and is steadily growing. Titles are easy to access and can be read across a range of devices or downloaded for offline use.

## Staff publications database

The AWRI staff publications database contains more than 1,900 citations of publications authored by AWRI staff. This useful tool, accessible from the AWRI website, received more than 5,570 hits this year with 826 staff publications requested. The database is updated on a regular basis to ensure the latest publications are available.

## Online information packs

Online information packs are collections of relevant references and other resources focused on a single topic. They have been developed to help users easily locate the information they need on common topics in oenology, viticulture, sustainability and wine and health. The website received more than 1,630 hits on information packs and the library delivered more than 765 articles from information packs, an increase of 146 articles from 2015/2016.

## Library reference and information requests

The library responded to 1,300 reference and information requests and delivered 2,236 articles (up by almost 100 articles from last year). Over 80% of the requests were completed within one business day and over 85% of the requests were received via the AWRI website or other electronic means. Table 4 outlines the types of articles requested.

**Table 4.** Articles supplied from library collections

Article type	Number of articles supplied
AWRI staff publications	826
<i>Technical Review</i> Current Literature	933
Library reprint collection	577
<b>Total</b>	<b>2,236</b>

## Specialised information services

The library has access to a range of databases and external resources, and offers specialised information services such as literature searches for in-depth retrieval of information. Sixty-four literature searches were conducted in 2016/2017 on topics including vineyard management, winemaking chemistry, winery operations and wine and health.

## Communication with stakeholders

### Background

Communication with Australian grape and wine producers is a key priority for the AWRI, with aims including:

- keeping industry up to date with current research
- providing advice to grapegrowers and winemakers
- sharing news, events and ideas
- seeking feedback or interaction.

Content is derived from across the AWRI's research and extension projects, and delivered through a variety of channels. The AWRI communicates directly with stakeholders via its *eNews*, *eBulletins*, webinars and social media, publishes the bi-monthly *Technical Review* and contributes regularly to other industry publications. Activities within this project complement the communication objectives of all AWRI staff – the details of presentations delivered and articles published by AWRI staff in 2016/2017 can be found in the Appendices.

## AWRI website

The AWRI website is a major platform for communicating with stakeholders, students, potential employees and the general public. Approximately 78,000 visitors accessed the AWRI website during the year (a 13% increase in visitors from the previous year) with more than 336,118 page-views. Updates to content during the year included new fact sheets, case studies, updated laboratory methods, information about the new Ferment Simulator app and details about the new roadshow workshop.

## eBulletins and eNews

Electronic newsletters and bulletins allow the AWRI to quickly reach grape and wine industry producers across Australia. The *eBulletin* format is used to send out alerts on technical issues, agrochemical updates and notifications about *Technical Review* and the webinar program. Twenty-four *eBulletins* were delivered during the year and are shown in Table 5. The *eBulletin* mailing list included more than 3,250 addresses by the end of the year.

**Table 5.** *eBulletins* issued during 2016/2017

Date	Topic
3/08/2016	AWRI webinar series 2016
4/08/2016	<i>Technical Review</i> August 2016 issue now available online
31/08/2016	AWRI Board election now open
5/09/2016	AWRI webinars – what’s coming up?
7/09/2016	Vineyard and winery practices survey
12/09/2016	Agrochemical update September 2016
21/09/2016	Results from AWRI Board election
23/09/2016	Managing vineyards after a wet winter and spring
5/10/2016	Weather update, managing waterlogged vineyards and additional re-entry period information
11/10/2016	AWRI webinars – what’s coming up?
20/10/2016	<i>Technical Review</i> October 2016 issue now available online
25/10/2016	Luxury workshops
26/10/2016	Agrochemical update October 2016
3/11/2016	Agrochemical update November 2016
16/11/2016	AWRI webinars – what’s coming up?
28/11/2016	New eBooks available
8/12/2016	<i>Technical Review</i> December 2016 issue now available online
21/12/2016	Agrochemical update December 2016
22/12/2016	Christmas closure
13/02/2017	<i>Technical Review</i> February 2017 issue now available online
16/02/2017	Change to Food Standards Code regarding addition of water to high sugar must/juice
20/04/2017	<i>Technical Review</i> April 2017 issue now available online
8/06/2017	<i>Technical Review</i> June 2017 issue now available online
22/06/2017	Agrochemical update – new ‘Dog book’ available

The AWRI’s electronic newsletter, *eNews*, was distributed bi-monthly to an audience of approximately 3,600 subscribers. This publication provides an avenue to promote upcoming events, deliver brief updates on research projects or papers that have been published and give a general snapshot of the AWRI’s activities. The distribution of *eNews* in alternate months to *Technical Review* means that stakeholders hear from the AWRI on at least a monthly basis.

## Social media

The AWRI’s Twitter following grew by more than 220 during 2016/2017 to 3,315. Twitter is a popular social media platform in the wine industry and can be an excellent forum for informal interactions and promoting events. The AWRI’s Facebook presence also grew by more than 200 likes during the year to a total over 750. The AWRI’s YouTube channel includes AWRI webinar recordings and other AWRI video content. Since its launch, the channel has attracted nearly 10,000 views and 167 subscribers.

## Annual report

For the past 62 years, the AWRI has produced a printed annual report such as this one, as its formal report to Australian winemakers and grape-growers. Since 1999, the annual reports have also been made available on the AWRI’s website. The AWRI also publishes a summary of the annual report in the *Australian & New Zealand Grapegrower & Winemaker*, and offers to deliver an annual presentation to the board or executive of each major state-based winemaking body. This formal activity complements the vast range of presentations and publications undertaken by AWRI staff members throughout the year (see Appendices).

## Technical Review

*Technical Review* publishes abstracts of the latest grape and wine-related technical literature, allowing readers to stay in touch with the latest research and to easily order copies of papers from the AWRI library. It also includes technical articles authored by AWRI staff and information about AWRI events. *Technical Review* is published six times a year, and is available to grape and wine producers via the AWRI website or in hard copy. A total of 933 articles featured in the *Technical Review* Current Literature section were requested by and provided to readers during the year, an increase of more than 180 compared with the previous year.

## Editorial support

The AWRI contributes regular articles to *Wine and Viticulture Journal*, *WBM* and *Australian & New Zealand Grapegrower & Winemaker*, while also contributing other papers to Australian and international industry journals. All articles authored by AWRI staff for non-peer-reviewed publications are edited by the AWRI Communication Manager. (Details of the articles published are presented in Appendix 7.)

## Media liaison

The AWRI is regularly approached for comment regarding wine technical matters from national and international media. This provides an excellent opportunity to ensure accurate information is published, and to generate further opportunities to communicate with the AWRI’s stakeholders. A number of requests from the media were handled during the year, with specific details provided in Appendix 6. Six media releases were prepared and distributed during the year (see Table 6).

**Table 6.** Media releases prepared and distributed during 2016/2017

Announcement	Date distributed
AWRI researchers win award for work on anthocyanins and human health	18/07/16
Drinking in the science	5/08/2016
Survey to delve into Australian grape and wine production practices	1/09/2016
AWRI Board election results announced	23/09/2016
New app to help winemakers manage ferments in vintage 2017	24/01/2017
Talented taster rewarded	27/06/2017

## Align supply chains with industry needs

### Staff

Tadro Abbott, Dr Simon Nordestgaard.

### Ferment simulator upgrade

#### Background

The AWRI Ferment Simulator has been updated and redeveloped into a simple and powerful web application to support winemakers (Figure 10). The application allows users across the winery to have access to their ferment data wherever they are, on a range of devices.

#### Vintage release

A new web app was produced with a local developer and was released for the 2017 vintage. The app is a free module on the AWRI WineCloud, is accessible through any device with an internet connection. It allows winemakers to get an early warning of problematic fermentations as well as to investigate corrective actions before taking action in the winery. Anonymous data collected through the app will also be used to aid research and increase understanding of ferment performance. During vintage 2017 approximately 50 wineries signed up to use the app and 650 fermentations were entered into the system.



**Figure 10.** The 'new look' Ferment Simulator App is available on a range of devices

### AWRI Vineyard and Winery Practices Survey

#### Background

The Australian wine industry has good data on the quantities of grapes and wine it produces, but not on the prevalence of the different techniques it uses in viticulture and winemaking such as trellis types, pruning methods, yeast strains and juice clarification methods. The AWRI Vineyard and Winery Practices Survey aims to address the lack of data on these and many other practices. The results will allow producers to compare their practices with regional and national averages and will assist organisations such as the AWRI to tailor the most relevant research and extension activities for different regions.

#### Web-based survey and follow-up site visits

The web-based survey was performed in September 2017. There were 464 responses to the vineyard component of the survey and 227 responses to the winery component of the survey. The responding vineyards covered 26,000 ha (19% of Australian vineyard area) and responding wineries covered 1.3 million tonnes of grapes (74% of the Australian wine-grape crush). The data were aggregated and site visits are now being performed to seek producers' impressions on the overall trends and 'sense check' the data. A final report is expected to be issued in 2017/2018.

## Enhance national outreach and promote regional engagement

### Staff

Dr Mark Krstic, Virginia Phillips.

### Collaborators

Brown Brothers (Sean Dean, Brett McClen); Department of Economic Development, Jobs, Transport and Resources/Agriculture Victoria (DEDJTR/AV) (Dr Michael Crawford, Dr Sze Flett, Sue McConnell, Assoc. Prof. Ian Porter, Dr Kevin Powell, Jenny Treeby, Dr Michael Treeby); Giant Steps (Steve Flamsteed); Hoddles Creek Estate (Franco d'Anna); Mac Forbes Wines (Mac Forbes); Moorooduc Estate (Richard McIntyre); Mornington Peninsula Vignerons Association (Cheryl Lee); Murray Valley Winegrowers (Mike Stone); Paradigm Hill (George Mihaly); Thousand Candles (Stuart Proud); University of Melbourne (Prof. Snow Barlow, Dr Sigfredo Fuentes, Dr Kate Howell, Dr Pangzhen Zhang); Wine Australia (Dr Liz Waters); Wine Network Consulting (Mark O'Callaghan); Wine Victoria (Nikki Palun, Damien Sheehan, Rachel Sweeney); Yarra Valley Wine Growers Association (Richard Howden, Susanne Pyle); Yering Station (Andy Clarke, Brendan Hawker, Willy Lunn).

### Victorian node

#### Background

The AWRI's Victorian node delivers high quality extension and practice change services to Victorian wine-grape growers and wineries through a partnership between Wine Victoria (WV), Murray Valley Winegrowers (MVW), Wine Australia, DEDJTR/AV and the AWRI. Project activities are overseen by a Victorian Winegrowers Liaison Committee, which agrees on an annual workplan of activities under funding from DEDJTR/AV and Wine Australia's regional program.

#### Node activities

The establishment of the Wine Ministerial Advisory Committee in Victoria and involvement of the AWRI Victorian node have been integral in the development of a new Victorian wine industry strategy, focusing on all facets of the value chain, regulatory issues, tourism, trade, research, development and extension, and the establishment of a wine growth fund. The new Victorian wine industry strategy (2017-2021) was released on 9 June 2017.

In 2016/2017 the key outcomes for the Victorian node included the delivery of nine unique extension events across Victoria, over and above the AWRI's existing national roadshow seminar and workshop program. These extension activities were delivered in partnership with Wine Victoria and the regional grape and wine industry associations across Victoria. More details can be found in Appendix 2.

## Service capabilities and foundational datasets

The research, development and extension activities of the AWRI are underpinned by an efficient service capacity that provides and supports infrastructure; provides technical support; manages governance, legal and financial affairs, information technology and workplace safety; and facilitates the exchange of international scientists for the benefit of Australian grape and wine science.

### Staff

Alice Barker (until 9 June 2017), Sheridan Barter, Laura Bey (from 1 October 2016), Eleanor Bilogrevic (from 5 June 2017), Natalie Burgan (from 13 June 2017), Catherine Borneman, Mark Braybrook, Dr Dimitra Capone, Alfons Cuijvers, Dr Wies Cynkar, Chris Day, Shiralee Dodd, Damian Espinase Nandorfy (from 1 May 2017), Dr Leigh Francis, Annette Freeman, Peter Godden, Yevgeniya Grebneva (from 1 January 2017), Dr Markus Herderich, Dr Josh Hixson, Adam Holland, Dr Vilma Hysenaj, Dr Dan Johnson, Pauline Jorgensen, Esther Kristianto, Dr Mark Krstic, Dr Natoiya Lloyd, Dr Luca Nicolotti (from 9 January 2017), Dr Vince O'Brien (to 16 June 2017), Jennifer O'Mahony, Wes Pearson, Tracey Siebert, Fang Tang, Deborah Thornton-Wakeford, Kylee Watson, Patricia Williamson.

### Visiting scientists and students

Marta Avramova (Université de Bordeaux, France and University of Adelaide); Joana Fernandes (University of Aveiro, Portugal).

### Collaborators

Australian Society for Viticulture and Oenology (Dr Mardi Longbottom, Chris Waters); Charles Sturt University (Dr Leigh Schmidtke, Dr John Blackman); Flinders University (Dr Martin Johnston); Food Innovation Australia Limited (Dr Barry McGookin); Food South Australia (Catherine Sayer); HS Geisenheim, Germany (Prof. Manfred Grossmann, Prof. Simone Mueller-Loose, Prof. Hans Schulz, Prof. Manfred Stoll, Prof. Doris Rauhut); ISVV, Bordeaux, France (Dr Warren Albertin, Prof. Phillippe Darriet, Prof. Serge Delrot, Prof. Isabelle Masneuf-Pomarède, Dr Takis Stamatopoulos, Jing Wu); Murdoch University (Prof. Rob Trengrove); PIRSA (Prof. Pauline Mooney); SARDI (Dr Peter Appleford, Dr Mike McCarthy, Dr Victor Sadras); University of Adelaide (Prof. Mike Keller); University of Queensland (Dr Mark Hodson, Dr Esteban Saldana); University of Melbourne (Prof. Ute Roessner, Prof. Tony Bacic, Prof. Malcolm McConville); University of South Australia (Prof. Andy Koronios); University of Western Australia (Dr Michael Clarke); Wine Industry Suppliers Australia Inc. (Matthew Moate).

### Chemistry, sensory, chemometrics and development capacity Background

Access to advanced and highly specialised equipment and staff is essential for the high quality, multidisciplinary research which is a trademark of the AWRI, and for collaborative projects with other research organisations and industry partners. This is especially the case where projects require access to highly specialised technical and scientific skills, such as those of a synthetic organic chemist or sensory scientist. In addition, the provision of sensory analysis requires a pool of screened, trained and experienced sensory assessors operating under the leadership and supervision of a professional sensory specialist who tracks performance and assesses training needs. Before and after a sensory experiment, abilities in experimental design, software for the acquisition of complex sensory data, data analysis and interpretation are required. Similarly, complex chemical analysis requires specialised analytical chemists with expertise in modern chromatography and

mass spectrometry as well as method development, optimisation and validation to produce reliable, accurate and precise data, and to ensure instrumentation remains operational around the clock.

### Sensory analysis

The AWRI runs four main types of sensory evaluation: an expert technical quality panel, trained sensory descriptive analysis, difference testing and consumer hedonic testing.

The technical quality panel provides detailed tasting notes and fault scores for wines submitted through AWRI helpdesk investigations, as preliminary screenings for research projects, and for clients of AWRI Commercial Services. During 2016/2017, the panel evaluated 205 wines, as well as numerous training samples and research-scale wines in preliminary bench tastings. The judges on this panel have extensive general technical wine tasting expertise and deep knowledge of wine production and composition, with most having commercial industry experience, wine show judging experience, formal oenology qualifications and/or having completed the AWRI Advanced Wine Assessment Course. All judges, no matter how experienced, are required to pass a probationary period before being admitted as reportable judges.

In 2016/2017 24 major descriptive analysis studies were completed using the AWRI's highly trained part-time external sensory panel. The judges rated the intensity of carefully selected, defined appearance, aroma and flavour attributes over multiple replicated occasions. The sensory profiles generated provided information regarding the effect of viticultural or winemaking treatments; knowledge of key wine components giving rise to flavour characteristics; consumers' drivers of liking; and the influence of closures or storage on wine sensory properties. Assessor performance was continually monitored after completion of each project, with the ability to discriminate, degree of agreement with other panellists, and repeatability carefully assessed and tracked over time. In addition, training exercises including identification, ranking and rating tests with tastes and odours were conducted at regular intervals, with the performance of individuals in these tasks recorded and monitored. The studies in 2016/2017 included two very large projects with SARDI assessing the effect of grapevine clone on wine flavour, with Chardonnay and Shiraz wines made from grapes from vineyards in Victoria, South Australia and Western Australia. Several studies on smoke taint and ongoing projects assessing closure performance were completed, as well as studies assessing alternatives to bentonite, and studies assessing viticultural treatments with DPI Victoria and SARDI.

Difference testing, generally using the method of triangle testing, is also an important sensory technique at the AWRI to find if a treatment has had a perceptible effect on wine aroma or flavour. Approximately 60 AWRI staff have been screened and are qualified to perform this task, usually assessing two or three sets per session. Thirty-six tests were completed during the year.



Annette Freeman, Kate Beames, Shiralee Dodd, Andrea Francis

### Synthetic organic chemistry

The synthesis of important analytical standards and other chemical compounds required for mechanistic studies or sensory investigations is of great benefit to the AWRI's research. When compounds are not available commercially, or are prohibitively expensive, the ability to produce them in-house is invaluable. Several projects have used in-house synthesised standards in sensory and chemical analyses this year, including the projects on in-mouth flavour release from precursors and 'stone fruit' flavour in white wine.

### Aroma compound analysis

State-of-the-art analytical instruments, including gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS), are carefully looked after to ensure they are in optimal operational order and capable of being used continuously in periods of high demand to give timely results. Accurate and precise analytical methods for targeted aroma compounds have been applied in many projects. Important compounds such as norisoprenoids ('fruity', 'violets', 'kerosene'), thiols ('tropical fruit', 'struck match', 'box hedge'), monoterpenes ('citrus', 'floral'), rotundone ('pepper'), oxidative compounds ('honey', 'bruised apple') and C<sub>6</sub> compounds ('green', 'grassy') have been quantified in more than 500 samples. These analyses are also available on a fee-for-service basis through AWRI Commercial Services.

### Metabolomics [South Australian Metabolomics Facility]

The AWRI established the South Australian node of Metabolomics Australia in 2008 with funding from Bioplatforms Australia and the Government of South Australia that enabled the purchase of five dedicated GC-MS and HPLC-MS instruments. The South Australian Metabolomics Facility is part of a national network with partners in WA, Victoria and Queensland who support and service private and public sector R&D in their respective states. It operates as a collaborative service platform, providing access to infrastructure and specialist expertise to academia and industry across all interested sectors.

In 2016/2017 the SA Metabolomics facility provided 8,500 sample analyses for researchers and industry personnel across agriculture, biomedical science, food/beverage and nutrition. The number of new external clients serviced during the year doubled and new collaborations were established with external researchers working in the areas of model organisms, nutrition and health, agriculture and biomedical science. This led to new methods and capabilities being built over the year, including central carbon metabolite profiling using GC-MS for studies of the gut microbiome and targeted and non-targeted approaches using LC-MS to investigate the bioavailability of key bioactive compounds in humans.

The bioinformatics data processing workflow was expanded and now provides automated data normalisation, QC metrics calculations and multivariate analysis.

Dr Natoiya Lloyd was awarded the 2017 Science and Innovation Award for Young People in Agriculture, including a grant towards investigating smoke taint in wine using a non-targeted metabolomics approach.

### Wine Innovation Cluster Winemaking Services

#### Background

Wine Innovation Cluster (WIC) Winemaking Services (WWS) is based at the Hickinbotham-Roseworthy Wine Science Laboratory, and is a joint venture between the AWRI and the University of Adelaide that was established in 2010. Its location within the University of Adelaide's purpose-built small-lot and pilot-scale winemaking facility enables the delivery of high quality research and small-scale commercial winemaking services.

#### Vintage 2017

WIC Winemaking Services processed a total of 354 (6 - 150 kg) ferments during the 2017 vintage, with a further 30-40 ferments to be conducted over the period between July and October from fruit or juice that was frozen during vintage. This vintage also saw seven clients divide ferment batches to conduct multiple trials from the one ferment, resulting in an additional 68 batches of wine to manage.

The 2017 vintage presented some planning and management challenges, with the last ferments being pressed on 29 May, eight weeks later than in 2016.

The season also produced some unusual phenological and analytical observations. Metabolism of malic acid in fruit occurred very late, with in some cases up to 90% of the titratable acid component at crushing being malic acid. This, combined with the buffering capacity of the wines, saw tartaric acid additions having a much more significant impact on pH and TA adjustment than is usually seen.

Investments in new storage vessels and a small batch crossflow filtration system were crucial in increasing flexibility and capability of the services offered. WIC Winemaking Services has recently taken possession of a new screw capping machine, which allows much greater consistency and precision when capping bottled wine. This year it is planned to invest in additional stainless steel kegs to minimise wine storage in plastic vessels post-fermentation and during secondary fermentation.



**Dimitra Capone**

WIC Winemaking Services' customers include all of the WIC partners, industry research bodies and commercial wine companies. Grapes were sourced from many South Australian wine regions as well as from Victoria and Western Australia.

### Efficient management and administration

#### Background

The AWRI's management and administration is carried out by a dedicated team of specialists who work together to provide leadership, infrastructure, financial, human resources, legal, contract management, work health and safety (WHS), corporate governance and IT services in a seamless manner. The team's objective is to enable AWRI staff to focus on their core capabilities to ensure that the organisation is able to meet its business objectives and in turn the expectations of its stakeholders. The team works closely with the AWRI Board, which provides additional leadership and oversight to all of the AWRI's activities.

#### Finance

Significant finance-related activities over the year focused on financial modelling to support the development of both a new long-term AWRI Research, Development and Extension Plan and a new Investment Agreement with Wine Australia. A new and more diversified (but nevertheless conservative) portfolio of financial assets including equities, interest rate securities and term deposits became fully implemented over the year under the guidance of the AWRI's investment manager Ord Minnett, the returns from which will allow the AWRI to further invest in critical capabilities and activities to support the Australian grape and wine industry. Other activities encompassed financial management, budgeting and reporting to the AWRI Board, funding organisations (particularly Wine Australia) and various arms of government. Back office support was also provided for other entities such as the Australian Wine Industry Technical Conference, Interwinery Analysis Group and Wine Innovation Cluster.

#### Human resources

This capability maintains responsibility for a broad range of functions including recruitment, employment contract management, visas, payroll and compliance activities. The AWRI's positive working environment was well reflected in the results of a staff survey conducted in June 2017, where 90% of respondents confirmed that 'all things considered, the AWRI is a great place to work'. In that survey employees reflected positively on the diversity of their work, the collaborative, productive and passionate workplace culture and their engagement with industry. Support for undertaking professional development was another area shown to be greatly appreciated – many of the AWRI's

directors make a substantial contribution to this by nominating for their directorship fees to instead be made available for such activities, and their support is gratefully acknowledged.

#### Operations

This capability manages and attends to all AWRI infrastructure, equipment and engineering requirements and represents the AWRI's interests, in partnership with the other occupants of the WIC building, on the WIC Management Committee. Cost-effective custom designed and manufactured engineering solutions are provided to support a range of AWRI projects, with recent examples including sparging for pilot-scale tanks to support research on the role of oxygen during red winemaking, supporting infrastructure for new instrumentation, and overseeing the design, manufacture and installation of a new small-scale crusher and platform assembly, as well as structural modifications to a section of the AWRI's open plan office environment and storage areas.

#### Corporate governance

This capability assists the effective functioning of the AWRI Board while providing legal support to all teams within the organisation and ensuring that the AWRI continues to meet its legal obligations. Activities this year focused on maintaining good corporate governance practices, particularly in relation to risk management, policy review and contract management. Electronic elections for the Board of Directors were held for the second time, with a pleasing increase noted in nominations and voter participation compared to the first electronic election held in 2014.

#### Information technology

This capability defines and manages the AWRI's strategic and technical IT requirements, and administers the organisation's IT infrastructure. This year saw the implementation of a number of significant initiatives contained within the recently developed IT Strategic Plan – supported and enabled by the IT Strategic Reserve previously created by the AWRI Board – with particular emphasis on expanded storage capabilities, enhanced virtual server infrastructure, implementation of new and updated Microsoft platforms and applications (including migration of the AWRI's intranet to SharePoint Online), improved back-up procedures, and strengthening of various aspects of network security. Such enhancements continue to add considerable value to almost every aspect of the AWRI's operations.

### International scientific exchange program

#### Background

This project builds on the many formal and informal collaborations occurring between the AWRI and scientists in other countries to formalise institution-level links, facilitate data exchange on pre-competitive topics, develop joint projects and encourage world-class scientists to conduct sabbaticals at the AWRI.

#### The BAG Alliance

The BAG Alliance is a trilateral partnership with L'Institut des Sciences de la Vigne et du Vin (ISVV) in Bordeaux, France and Hochschule Geisenheim (HSG), Germany, and the AWRI, that aims to enhance research capability, accelerate research and improve the quality of technical outcomes for the wine industry.

Key areas of activity for the AWRI as part of the BAG Alliance during the year focused on genotyping and phenotyping of *Brettanomyces* strains by visiting PhD student, Marta Avramova (Université de Bordeaux) and a collaborative study with HS Geisenheim on likely climate change impacts, temperature and light effects on Riesling aroma and aroma precursors by Yevgeniya Grebneva with Prof. Manfred Stoll and Prof. Doris Rauhut.

# Commercial Services

## Staff

Tadro Abbott, Melissa Aitchison, Elyce Batchelor (to 3 February 2017), Josh Clift (from 20 February 2017), Robyn Gleeson, Jesse Hall (from 23 January 2017), Kieran Hirlam, Leanne Hoxey, Jillian Lee, Brigitte Lynch, Jacinta McAskill (from 20 February 2017), Bryan Newell, Dr Simon Nordestgaard, Dr Kerry Pinchbeck, Tim Reilly, Dr Amy Rinaldo, Marco Schoeman, Neil Scrimgeour, Pamela Solomon, Alana Spears (to 15 July 2016), Randell Taylor, Heather Tosen, Dr Matthew Wheal, Dr Eric Wilkes.

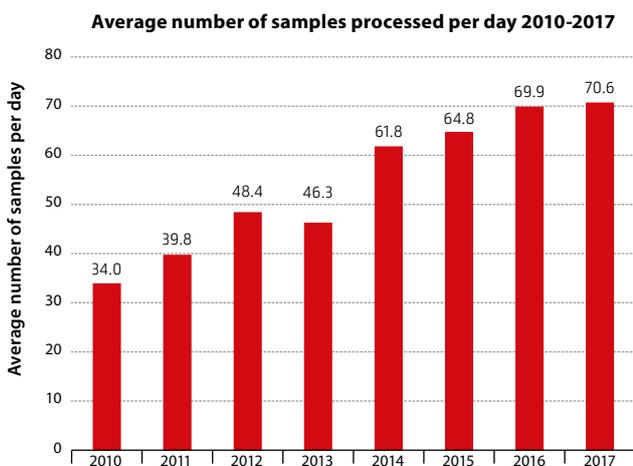
## Collaborators

International Wine Challenge (Chris Ashton); Weincampus Neustadt, Germany (Prof. Ulrich Fischer).

## Service provision

AWRI Commercial Services continues to serve an important role in the wine industry, providing internationally recognised and accredited reference laboratory services, proof-of-performance testing, consulting services, microbiological auditing and the design and implementation of trials and research for industry. Commercial Services also continues to be actively involved in pre-competitively funded research projects in applied areas such as bulk wine transport, assessment of winery practices and management of solids in the winery.

This year was another successful one for the analytical component of Commercial Services, underpinned by continued increases in the number of samples processed and the number of clients. Continuing the trend of the last seven years, the laboratories once again exceeded last year's result for samples processed, the figure of 23,511 samples representing an increase of 2% over the previous year. This ongoing trend reflects the increased efficiency seen in the laboratories, with the average daily sample throughput in the analytical lab increasing from 34 samples per day in 2010 to 69.6 in 2016 (Figure 11) and more than 71 in the first half of 2017 (data not shown) with no significant changes in staff numbers. The year also saw the customer base using Commercial Services increase with 148 new customers over the year.



**Figure 11.** Average number of samples processed per day in the Commercial Services analytical laboratory, broken down by calendar year, from 2010 to 2016 and the first half of 2017

## New laboratory computer systems

This year AWRI Commercial Services went live with its new laboratory information management system (LIMS). The implementation of this complex project required significant resources from within the existing laboratory and customer service teams and the successful completion of the first stage of the project in January 2017 without any major disruption to customer services was a major achievement. The new system has seen immediate improvements in sample management, results reporting and invoicing processes. Going forward it will give customers much greater flexibility in ordering services and monitoring the progress of analysis.

## Technology assessment and development

AWRI Commercial Services continues to be the provider of choice for major international packaging suppliers wishing to gain acceptance for their products in the marketplace. A range of independent studies are continuing to provide objective information on the performance of wine closures and their impact on wine development. Much of the current focus is on closure products with defined oxygen transmission rates and on functional closures that have the ability to modulate wine composition by enhancing positive attributes or controlling negative characters during bottle ageing. Commercial Services also continues to manage a number of consortium-style trials for wine producers and industry suppliers, in order to benchmark the performance of commonly available commercial products.

In terms of product development, the group is actively involved in evaluating a range of technologies, such as new vineyard treatments, innovative winemaking equipment and new additives. These trials are typically undertaken in conjunction with both wine producers and suppliers, to ensure that the products perform as intended and have no detrimental impact on grape or wine quality. Some of these trials provide performance data which is used directly to support submissions to Food Standards Australia and New Zealand (FSANZ) for inclusion in the Food Standards Code. AWRI Commercial Services has also been commissioned to carry out evaluations of existing technologies or products to provide independent expertise for ongoing industry reviews or legal investigations.

A significant driver of Commercial Services' continued role in these fields is the depth of industry-relevant knowledge it offers, aligned with historic understanding of the requirements of wine customers. This provides an important avenue for the development of new and relevant technologies, ensuring they meet industry demands.

# Financial statements – Directors' report

The directors present this report to the members of The Australian Wine Research Institute Limited (the Company) for the year ended 30 June 2017.

## Directors

The names of each person who has been a director during the year and to the date of this report are:

	Date of appointment	Cessation date	Board meetings	
			A	B
Ms Louisa E. Rose (Chair)	1 Jan 2011	–	4	4
Mr Toby J. Bekkers	1 Jan 2014	–	3	4
Mr Ben Bryant	1 Jan 2017	–	2	2
Dr John S. Harvey	1 Jan 2016	–	4	4
Mr Kim R. Horton	1 Jan 2015	–	3	4
Dr Daniel L. Johnson	1 Dec 2011	–	4	4
Prof. Kiaran D. Kirk	1 Jan 2017	–	2	2
Mr Brett M. McKinnon	1 Jan 2008	31 Dec 2016	0	2
Dr Stuart C. McNab	1 Jan 2015	–	4	4
Ms Elizabeth A. Riley	1 Jan 2012	–	4	4
Prof. Brian P. Schmidt	25 Feb 2014	31 Dec 2016	1	2
Mr Mark R. Watson	24 Jun 2008	–	4	4

**A** - Number of meetings attended

**B** - number of meetings held during the time the director held office during the year

Directors have been in office since the start of the financial year to the date of this report unless otherwise stated.

## Overview of result

For the year ended 30 June 2017 the Company recorded a deficit of \$481,302 (2016: deficit of \$657,423). This deficit primarily relates to the Company's annual depreciation and amortisation expense recorded in relation to its property, plant, equipment and intangible assets (including its interest in the Wine Innovation Cluster Central building), net of funding received for such items during the period. The directors note that the reported 2017 and 2016 accounting deficits are consistent with internal expectations, and reflective of a number of strategic investments made by the Company in order to further support its stakeholders in view of the capacity afforded by the Company's reserves position.

## Objectives and strategy

The organisation's long-term objective is to support the Australian grape and wine industry through world class research, practical solutions and knowledge transfer.

The organisation's short-term objectives are reflected in its 5 Year Research, Development and Extension Plan *The AWRI 2013-2018*. This plan articulates fifty research projects designed to contribute to the achievement of the Company's vision, grouped within four main researchable themes:

- *Environment and sustainability*
- *Consumers, customers and markets*
- *Improving products and processes*
- *Extension and adoption.*

A fifth theme *Service capabilities and foundational datasets* supports the delivery of the above researchable themes.

For each active project a project plan specifies relevant objectives, outputs, milestones and expected outcomes of benefit to the Australian wine industry as well as approaches and methodologies for their achievement.

The Company's strategy for achieving the above objectives is to maximise its available funding to enable the delivery of projects within its Research, Development and Extension Plan, while optimising its internal operations and resources to ensure that such funding is applied as effectively and efficiently as possible. This strategy is implemented through a suite of initiatives, collectively described in the internal document *AWRI Directions – Business and Operational Initiatives 2014-2018*, clustered into six projects:

- Best practice governance
- Execute the AWRI's mission, values and behaviours
- Increase the funding base and economic flexibility of the AWRI
- Improve infrastructure, systems and processes
- Build/retain capabilities and services in areas of strategic importance
- World class people and culture.

The 5 Year Research, Development and Extension Plan *The AWRI 2013-2018* is available online at [awri.com.au](http://awri.com.au).

## Principal activities

The Company's principal activities during the year were:

**Research** activities that strive for scientific excellence and industry relevance;

**Development** activities that seek to bridge the gap between scientific discovery and value-adding technology or processes;

**Extension** activities that seek to disseminate research and development outcomes to facilitate rapid uptake by the viticultural and winemaking sectors; and

**Commercial** services aimed at providing competitive specific and/or tailored solutions for individual entities across all industry sectors which leverage the other key activities of the AWRI.

These activities collectively constitute a mechanism to implement the strategies outlined in *AWRI Directions - Business and Operational Initiatives 2014-2018*, enabling the achievement of the long- and short-term objectives of the organisation as articulated above.

## Performance measures

The Company measures its performance through considering the number, quality and impact of the AWRI's scientific publications; its research and development outcomes; the extent to which those outcomes have been adopted by industry practitioners to improve the quality and consistency of wine produced in Australia; and the extent to which that new knowledge has enabled the Australian wine industry to be successful in new and emerging markets. Progress against specific objectives is monitored through the achievement of specific milestones, outputs and performance targets as articulated in *AWRI Directions - Business and Operational Initiatives 2014-2018*, the 5 Year Research, Development and Extension Plan *The AWRI 2013-2018* and individual project plans, combined with measures of use of the AWRI's extension platforms and feedback provided through surveys distributed to service end-users. Financial performance measures include the value of funding and grants received, demand for the organisation's commercial services and contract research capabilities and performance relative to budget. From time to time the Company or parts of its operations are subject to independent review against externally established criteria, with the outcome of such reviews contributing to the Company's assessment of its own performance.

## Information on directors

### Ms Louisa E. Rose

Chair (non-executive)

**Qualifications:** BAppSc (Oenology) BSc GAICD

**Experience:** Head of Winemaking The Yalumba Wine Company and Hill-Smith Family Vineyards, Chair of the Alumni Council of the University of Adelaide and member of the Council of Barons of Barossa. Previously director of the Barossa Grape and Wine Association, member of Wine Barossa and Co-Chair of the South Australian Wine Industry Council. National wine show judge, 26 years' technical, winemaking, viticultural and commercial experience in the Australian wine industry.

**Special Responsibilities:** Ms Rose is the Chair of the Personnel committee.

### Mr Toby J. Bekkers

Non-executive director

**Qualifications:** BAppSc (Ag) (Hons) GCertMgt

**Experience:** Principal of Bekkers Consulting and Bekkers Wine. Active as a viticulture and wine business consultant across Australia. Twenty-three years' experience in viticulture and wine business. Formerly General Manager/Senior Viticulturist of Paxton Wines and former Board member of McLaren Vale Grape, Wine and Tourism Association. Graduate of the Australian Wine Industry Future Leaders Program and Nuffield Farming Scholar (2017).

**Special Responsibilities:** Mr Bekkers is a member of the Audit committee.

### Mr Ben Bryant

Non-executive director (from 1 January 2017)

**Qualifications:** BSc (Oenology)

**Experience:** Chief Winemaker and Director of Pernod Ricard Winemakers Australia, over 17 years' experience in winemaking, viticulture, commercial business, international marketing and international business development. Member of the Executive of the South Australian Wine Industry Association and actively involved in the Wine Barossa Committee since 2015.

**Special Responsibilities:** Mr Bryant is a member of the Personnel committee.

### Dr John S. Harvey

Non-executive director

**Qualifications:** BSc (Hons) PhD MBA GAICD

**Experience:** Owner of Bathe Wines Pty Ltd. Former Australian Grape and Wine Authority regional mentor for McLaren Vale, past President of the Adelaide Hills Wine Region and Member of the South Australian Wine Industry Association Executive. Former Executive Director of the Grape and Wine Research and Development Corporation. Seventeen years' wine industry research, R&D management and commercial experience. Chair of the Can:Do Group, Non-Executive Director of Studio Nine Architects, Rural Business Support, Revenir Winemaking Pty Ltd and PaintPad Pty Ltd. SA Committee Member of the Winston Churchill Memorial Trust (Australia).

### Mr Kim R. Horton

Non-executive director

**Qualifications:** BAppSc (Wine Science)

**Experience:** Senior Winemaker Willow Bridge Estate, previously Chief Winemaker Ferngrove Vineyards Estate Pty Ltd. Twenty-three years' technical and winemaking experience in the Australian wine industry.

### Dr Daniel L. Johnson

Managing Director

**Qualifications:** BSc (Hons) PhD MBA GAICD

**Experience:** Chair of the Australian Wine Industry Technical Conference, Director of the National Wine Foundation, member of the International Scientific Council of L'Institut des Sciences de la Vigne et du Vin (ISVV) Bordeaux (France), member of the Australian Journal of Grape and Wine Research Journal Advisory Committee, member of the World of Fine Wine Editorial Board, member of the Wine Innovation Cluster Leadership Group, member of the Waite Strategic Leadership Group, member of the South Australian Food Innovation Centre partners group, graduate of the Harvard Business School Authentic Leadership Development Program, graduate of the Australian Wine Industry Future Leaders Program, graduate of the INSEAD Blue Ocean Strategy Program, graduate of the IESE Creative Negotiation program, graduate of the Oxford Advanced Management and Leadership Program, Honorary Adjunct Professor at the Macquarie Graduate School of Management, 20 years' experience in research, development and innovation.

**Prof. Kieran D. Kirk**

Non-executive director (from 1 January 2017)

**Qualifications:** BSc (Hons) PhD DPhil

**Experience:** Dean of the College of Medicine, Biology and Environment at the Australian National University (ANU), Chair of Clonakilla Wines. Previously Director of ANU Research School of Biology, Head of ANU Department of Biochemistry and Molecular Biology, and Research Fellow at University of Oxford. More than 20 years' experience in the Australian research sector with a publication record of over 150 research papers in the field of biochemistry.

**Special Responsibilities:** Prof. Kirk is a member of the Personnel committee.

**Mr Brett M. McKinnon**

Non-executive director (to 31 December 2016)

**Qualifications:** BAgSc (Oenology) (Hons)

**Experience:** Global Operations Director Pernod Ricard Winemakers, 29 years' technical, winemaking, viticulture and commercial experience, Chair of WFA Innovation Policy Committee, director of Barossa Grape and Wine Association, professional member of the ASVO, graduate of the Leadership in Innovation Program INSEAD (France).

**Dr Stuart C. McNab**

Non-executive director

**Qualifications:** BAgSc (Hons) PhD

**Experience:** Wine industry and agribusiness consultant, 25 years' experience in the Australian and global wine sectors across technical, winemaking, viticulture, marketing, logistics, operations, commercial and research functions. Director of the National Wine Centre. Previously Chief Supply Officer for Treasury Wine Estates managing global wine production, with past roles including Chair of the Wine Innovation Cluster, member of the Executive Committee and President of the South Australian Wine Industry Association, member of the South Australian Wine Industry Council and member of the WFA Board.

**Special Responsibilities:** Dr McNab is a member of the Audit committee.

**Ms Elizabeth A. Riley**

Non-executive director

**Qualifications:** BAppSc (Wine Science)

**Experience:** Nuffield Farming Scholar, Managing Director and Viticulturist Vitibit Pty Ltd, professional member of the ASVO, associate member of the Hunter Valley Wine and Tourism Association and member of the Viticulture Subcommittee, Executive member of the New South Wales Wine Industry Association and Chair of the Research and Development Committee. Previously a Viticulturist with Southcorp Wines between 1993 and 1999 in national and NSW-based roles, 25 years' experience in the Australian wine industry.

**Prof. Brian P. Schmidt**

Non-executive director (to 31 December 2016)

**Qualifications:** BS BS AM PhD

**Experience:** Owner and operator of Maipenrai Vineyard and Winery, Vice Chancellor and Distinguished Professor of the Australian National University, member of the Intergovernmental Australian – German Advisory Group, member of the Commonwealth Science Council, member of 1 Disease at a Time Advisory Board, member of the Canberra District Vignerons Association and member of Life Letters Advisory Board. Previously Australian Research Council Laureate Professor, Chair of Astronomy Australia Limited, member of the Questacon Advisory Board and member of the Australian Academy of Science Council. Recipient of the 2011 Nobel Prize in Physics.

**Mr Mark R. Watson**

Non-executive director

**Qualifications:** MBA BEc CA RITP MAICD

**Experience:** Managing Director of Blue Sky Alternative Investments (Adelaide office), Chief Executive Officer of Water Utilities Australia, previously Partner Corporate Finance KPMG, Chief Financial Officer Wirra Wirra and Manager, Corporate Strategy and Development FH Faulding & Co Ltd.

**Special Responsibilities:** Mr Watson is the Chair of the Audit committee.

## Indemnification of officers and auditors

During the financial year, the Company paid a premium in respect of a contract insuring the directors of the Company (named above), the Company Secretary, all members of the Company's Executive Management Group and members of the Biosafety Committee (a committee including two representatives who are not employees of the Company, charged with oversight of matters pertaining to the development and use of genetically modified organisms and required to be appropriately indemnified by the Office of the Gene Technology Regulator) against a liability incurred in their capacity as a director, secretary, executive or committee member to the extent permitted by the *Corporations Act 2001*. The contract of insurance prohibits disclosure of the nature of the liability and the amount of the premium.

The Company has not otherwise, during or since the end of the financial year, except to the extent permitted by law, indemnified or agreed to indemnify an officer or auditor of the Company or of any related body corporate against a liability incurred as such an officer or auditor.

## Members' guarantee

In accordance with the Company's constitution, each member (both during the time he or she is a member and within one year afterwards) is liable to contribute \$2 in the event that the Company is wound up. The total amount members would contribute is \$24 (2016: \$22).

## Auditor's independence

The auditor's independence declaration as required under section 60-40 of the *Australian Charities and Not-for-profits Commission (ACNC) Act 2012* is attached and forms part of the directors' report for the financial year ended 30 June 2017.

Dated at Urrbrae on this the 19<sup>th</sup> day of September 2017.

This report is made in accordance with a resolution of the directors, pursuant to subsection 60.15(2) of the *Australian Charities and Not-for-profits Commission Regulation 2013*.



**Louisa E. Rose**

Chair



**Daniel L. Johnson**

Managing Director

## Declaration of independence under section 60-40 of the Australian Charities and Not-for-profits Commission Act 2012 by Paul Gosnold

### To the responsible entities of The Australian Wine Research Institute Limited

As lead auditor of The Australian Wine Research Institute Limited for the year ended 30 June 2017, I declare that, to the best of my knowledge and belief, there have been:

1. No contraventions of the auditor independence requirements of the *Australian Charities and Not-for-profits Commission Act 2012* in relation to the audit; and
2. No contraventions of any applicable code of professional conduct in relation to the audit.



**Paul Gosnold**  
Director  
BDO Audit (SA) Pty Ltd  
Adelaide, 19 September 2017

## Financial statements

### The Australian Wine Research Institute Limited

A Company limited by guarantee

### Statement of profit or loss and other comprehensive income

#### For the year ended 30 June 2017

	Note	2017	2016
<b>Revenue from operating activities</b>			
Wine Australia			
Investment agreement project funding		6,106,546	5,860,889
Investment agreement capital funding		104,064	157,624
Other project funding		2,944,516	2,019,980
Other capital funding		8,181	-
Capital specific grant funding		5,283	7,355
Other grant funding		1,006,777	1,346,883
Commercial services analytical and consulting income		2,549,043	2,832,878
Contract research and other commercial income		1,405,050	1,140,081
Other revenue		301,197	161,899
Total revenue		<u>14,430,657</u>	<u>13,527,589</u>
Other income	2	60,029	31,206
<b>Expenses from operating activities</b>			
Personnel expenses	3	10,070,985	9,623,777
Analytical and project operating expenses		2,607,873	2,126,129
Infrastructure and general services expenses		1,402,392	1,400,350
Depreciation and amortisation expense	8,9	951,678	1,009,644
Travel expenses		392,003	400,881
Total expenses		<u>15,424,931</u>	<u>14,560,781</u>
<b>Results from operating activities</b>		<u>(934,245)</u>	<u>(1,001,986)</u>
<b>Finance income</b>		<u>452,943</u>	<u>344,563</u>
<b>Profit (loss) for the period</b>		<u>(481,302)</u>	<u>(657,423)</u>
<b>Other comprehensive income</b>			
<b>Items that will be reclassified subsequently to profit or loss when specific conditions are met</b>			
Net change in fair value of available-for-sale financial assets		<u>262,995</u>	<u>3,793</u>
<b>Total comprehensive income for the period</b>		<u>(218,307)</u>	<u>(653,630)</u>

The notes on pages 58 to 65 are an integral part of these financial statements.

# The Australian Wine Research Institute Limited

A Company limited by guarantee

## Statement of changes in equity

For the year ended 30 June 2017

	Retained earnings	Co-investment reserve	Strategic IT investment reserve	Fair value reserve	Total equity
Balance at 1 July 2015	15,217,769	1,000,000	350,000	-	16,567,769
<b>Total comprehensive income for the period</b>					
Profit or loss	(657,423)	-	-	-	(657,423)
<i>Other comprehensive income</i>					
Net change in fair value of available-for-sale financial assets				3,793	
Total other comprehensive income	-	-	-	3,793	3,793
Total comprehensive income for the period	(657,423)	-	-	3,793	(653,630)
<b>Transfers between retained earnings and other reserves</b>					
Transfers to (from) reserves	-	(12,500)	(207,257)	-	(219,757)
Transfers to (from) retained earnings	219,757	-	-	-	219,757
Balance at 30 June 2016	14,780,103	987,500	142,743	3,793	15,914,139
Balance at 1 July 2016	14,780,103	987,500	142,743	3,793	15,914,139
<b>Total comprehensive income for the period</b>					
Profit or loss	(481,302)	-	-	-	(481,302)
<i>Other comprehensive income</i>					
Net change in fair value of available-for-sale financial assets	-	-	-	262,995	262,995
Total other comprehensive income	-	-	-	262,995	262,995
Total comprehensive income for the period	(481,302)	-	-	262,995	(218,307)
<b>Transfers between retained earnings and other reserves</b>					
Transfers to (from) reserves	-	(122,551)	(94,451)	-	(217,002)
Transfers to (from) retained earnings	217,002	-	-	-	217,002
Balance at 30 June 2017	14,515,803	864,949	48,292	266,788	15,695,832

### Nature and purpose of reserves

#### Co-investment reserve

The objective of the co-investment reserve is to provide funds for co-investment in specific funding opportunities, enabling the Company to access certain funding programmes subject to the following requirements:

- (i) That any co-investment be matched on at least an equal basis from externally-sourced funds
- (ii) That co-investments create value over the medium to long term for the ultimate benefit of the Australian grape and wine sector
- (iii) That co-investments be made only in instances whereby the overall grant funds available to the Australian grape and wine sector are expanded – that is, excluding grant funding programmes which already exist for the benefit of that industry.

#### Strategic IT investment reserve

The objective of the strategic information technology (IT) investment reserve is to ensure that sufficient funds are available for appropriate strategic investment in the Company's IT capabilities, consistent with relevant strategic plans as developed and amended from time to time, approved by the Board of Directors. Resourcing to meet the Company's day-to-day operational IT requirements, as distinct from its strategic IT requirements, is provided by other funding sources as identified within the Statement of profit or loss and other comprehensive income.

#### Fair value reserve

The fair value reserve comprises the cumulative net change in the fair value of available-for-sale financial assets until the investments are derecognised or impaired.

*The notes on pages 58 to 65 are an integral part of these financial statements.*

## The Australian Wine Research Institute Limited

A Company limited by guarantee

### Statement of financial position

As at 30 June 2017

	Note	2017	2016
<b>Assets</b>			
Cash and cash equivalents	4	1,334,701	3,714,688
Held-to-maturity investments	5	2,115,292	3,725,000
Trade and other receivables	6	2,108,833	1,551,038
Inventories	7	92,000	91,902
Prepayments		260,340	299,348
<b>Total current assets</b>		<u>5,911,166</u>	<u>9,381,976</u>
Available-for-sale financial assets	5	8,968,608	6,210,688
Property, plant and equipment	8	2,264,824	1,950,951
Intangible assets	9	4,841,958	5,073,043
<b>Total non-current assets</b>		<u>16,075,390</u>	<u>13,234,682</u>
<b>Total assets</b>		<u>21,986,556</u>	<u>22,616,658</u>
<b>Liabilities</b>			
Payables and accruals	10	4,110,971	4,497,146
Project funds not expended	11	258,409	372,228
Provisions	12	1,658,612	1,504,693
<b>Total current liabilities</b>		<u>6,027,992</u>	<u>6,374,067</u>
Provisions	12	262,732	328,452
<b>Total non-current liabilities</b>		<u>262,732</u>	<u>328,452</u>
<b>Total liabilities</b>		<u>6,290,724</u>	<u>6,702,519</u>
<b>Net assets</b>		<u>15,695,832</u>	<u>15,914,139</u>
<b>Equity</b>			
Retained earnings		14,515,803	14,780,103
Co-investment reserve		864,949	987,500
Strategic IT investment reserve		48,292	142,743
Fair value reserve		266,788	3,793
<b>Total equity</b>		<u>15,695,832</u>	<u>15,914,139</u>

The notes on pages 58 to 65 are an integral part of these financial statements.

## The Australian Wine Research Institute Limited

A Company limited by guarantee

### Statement of cash flows

For the year ended 30 June 2017

	Note	2017	2016
<b>Cash flows from operating activities</b>			
Cash receipts from project grants and other income		13,125,675	14,371,620
Cash paid to suppliers and employees		(14,008,861)	(13,438,138)
<b>Net cash from operating activities</b>		<u>(883,186)</u>	<u>933,482</u>
<b>Cash flows from investing activities</b>			
Cash receipts from capital specific funding		109,347	242,877
Interest received		318,359	412,066
Dividends received		63,558	-
Proceeds from sale of property, plant and equipment		71,310	1,364
Acquisition of property, plant, equipment and intangibles		(1,107,287)	(1,210,845)
Proceeds from disposal of held-to-maturity investments		1,609,708	5,048,958
Acquisition of available-for-sale investments		(2,517,500)	(6,206,895)
Payment of transaction costs related to financial investments		(44,296)	(5,736)
<b>Net cash used in investing activities</b>		<u>(1,496,801)</u>	<u>(1,718,211)</u>
<b>Net increase (decrease) in cash and cash equivalents</b>		<u>(2,379,987)</u>	<u>(784,729)</u>
Cash and cash equivalents at 1 July		3,714,688	4,499,417
<b>Cash and cash equivalents at 30 June</b>	4	<u>1,334,701</u>	<u>3,714,688</u>

The notes on pages 58 to 65 are an integral part of these financial statements.

# Notes to and forming part of the financial statements

## 1. Significant accounting policies

The Australian Wine Research Institute Limited (the Company) is a company limited by guarantee, domiciled in Australia, incorporated under the *Corporations Act 2001* and registered as a charity under the *Australian Charities and Not-for-profits Commission Act 2012* (ACNC Act). The address of the Company's registered office is the corner of Hartley Grove and Paratoo Road, Urrbrae, South Australia.

The financial statements were authorised for issue by the Board of Directors on the 19<sup>th</sup> day of September 2017.

Australian Accounting Standards set out accounting policies that the AASB has concluded would result in financial statements containing relevant and reliable information about transactions, events and conditions. Material accounting policies adopted in the preparation of these financial statements are presented below and have been applied consistently to all periods presented in these financial statements, and have been applied consistently by the Company.

Where necessary, comparative information has been reclassified to achieve consistency in disclosure with current financial year amounts and disclosures.

### (a) Basis of preparation

#### (i) Statement of compliance

The financial statements of the Company are Tier 2 general purpose financial statements which have been prepared in accordance with Australian Accounting Standards - Reduced Disclosure Requirements (AASB-RDRs) (including Australian Interpretations) adopted by the Australian Accounting Standards Board (AASB) and the *Australian Charities and Not-for-profits Commission Act 2012* and *Regulation 2013*. The Company is a not-for-profit entity for financial reporting purposes under Australian Accounting Standards.

The Company is exempt from income tax under Section 50-5 of the *Income Tax Assessment Act 1997*, and accordingly no provision for income tax is included in these financial statements.

#### (ii) Basis of measurement

The financial statements, except for the cash flow information, have been prepared on an accruals basis and are based on historical costs except for available-for-sale financial assets which are measured at fair value, and do not take into account changing money values.

#### (iii) Functional and presentation currency

The financial statements are presented in Australian dollars, which is the Company's functional currency.

The Company is of a kind referred to in ASIC Legislative Instrument 2016/191 dated 1 April 2016 and, in accordance with that Legislative Instrument, all financial information presented has been rounded to the nearest dollar unless otherwise stated.

#### (iv) Use of estimates and judgements

The preparation of financial statements in conformity with Australian Accounting Standards requires management to make judgements, estimates and assumptions that affect the application of accounting policies and the reported amount of assets, liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances, the results of which form the basis of making judgements about the carrying value of assets and liabilities that are not readily apparent from other sources.

The estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimates are revised. The Company has identified the allowance for impairment in respect of trade receivables (note 6), the useful lives of property, plant and equipment (note 8), amortisation period of intangible assets including its interest in the WIC building (note 9) and provisions for employee entitlements (note 12) and their respective note 1 accounting policies as areas under which significant judgements, estimates and assumptions are made, and where actual results may differ from those estimates under different assumptions and conditions.

#### (v) Changes in accounting classification

Due to a computer software item which became ready for use during the year, starting as of 1 July 2016 the Company has begun to separately account for and disclose computer software within its intangible assets (note 9).

### (b) Financial instruments

The Company initially recognises loans and receivables and deposits on the date that they are originated. All other financial assets are recognised initially on the trade date at which the Company becomes a party to the contractual provisions of the instrument.

The Company derecognises a financial asset when the contractual right to the cash flows from the asset expire, or it transfers the rights to receive the contractual cash flows in a transaction in which substantially all the risks and rewards of ownership of the financial asset are transferred.

Financial assets and liabilities are offset and the net amount presented in the statement of financial position when, and only when, the Company has a legal right to offset the amounts and intends either to settle on a net basis or to realise the asset and settle the liability simultaneously.

The Company has the following financial assets: held-to-maturity financial assets, loans and receivables and available-for-sale financial assets.

### **Held-to-maturity financial assets**

If the Company has the positive intent and ability to hold debt securities to maturity, then such financial assets are classified as held-to-maturity. Held-to-maturity financial assets are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition, held-to-maturity financial assets are measured at amortised cost using the effective interest method, less any impairment losses.

### **Loans and receivables**

Loans and receivables are financial assets with fixed or determinable payments that are not quoted in an active market. Such assets are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition, loans and receivables are measured at amortised cost using the effective interest method, less any impairment losses. Loans and other receivables comprise trade and other receivables (see note 6).

Cash and cash equivalents comprise cash balances and call deposits with original maturities of three months or less. Bank overdrafts that are repayable on demand and form an integral part of the Company's cash management are included as a component of cash and cash equivalents for the purpose of the statement of cash flows.

### **Available-for-sale financial assets**

Available-for-sale financial assets are non-derivative financial assets that are designated as available-for-sale and that are not classified in any of the previous categories. The Company's investments in equity securities and certain debt securities are classified as available-for-sale financial assets. Subsequent to initial recognition, they are measured at fair value and changes therein, other than impairment losses (see note 1(g)(i)) are recognised in other comprehensive income and presented within equity in the fair value reserve. When an investment is derecognised, the cumulative gain or loss in equity is transferred to profit or loss.

The fair value of investments that are actively traded in organised financial markets is determined by reference to quoted market bid prices at the close of business on the reporting date.

## **(c) Property, plant and equipment**

### **(i) Recognition and measurement**

Items of property, plant and equipment are measured at cost less accumulated depreciation and accumulated impairment losses. Cost includes expenditure that is directly attributable to the acquisition of the asset, including borrowing costs directly attributable to the acquisition, construction or production of a qualifying asset. Cost also may include transfers from other comprehensive income of any gain or loss on qualifying cash flow hedges of foreign currency purchases of property, plant and equipment. Purchased software that is integral to the functionality of the related equipment is capitalised as part of that equipment.

When parts of an item of property, plant and equipment have different useful lives, they are accounted for as separate items (major components) of property, plant and equipment.

Gains and losses on disposal of an item of property, plant and equipment are determined by comparing the proceeds from disposal with the carrying amount of property, plant and equipment and are recognised net within other income in profit or loss.

### **(ii) Subsequent costs**

The cost of replacing a part of an item of property, plant and equipment is recognised in the carrying amount of the item if it is probable that the future economic benefits embodied within the part will flow to the Company, and its cost can be measured reliably. The carrying amount of the replaced part is derecognised. The costs of the day-to-day servicing of property, plant and equipment are recognised in profit or loss as incurred.

### **(iii) Depreciation**

Depreciation is calculated over the depreciable amount, which is the cost of an asset, or other amount substituted for cost, less its residual value.

Depreciation is recognised in profit or loss on a straight-line basis over the estimated useful lives of each part of an item of property, plant and equipment, since this most closely reflects the expected pattern of consumption of the future economic benefits embodied in the asset. Leased assets are depreciated over the shorter of the lease term and their useful lives unless it is reasonably certain that the Company will obtain ownership by the end of the lease term.

The estimated useful lives for the current and comparative periods are as follows:

• buildings and improvements	30 years
• plant and machinery	3 - 10 years
• office furniture and IT	3 - 10 years
• laboratory equipment	3 - 10 years

Depreciation methods, useful lives and residual values are reviewed at each financial year-end and adjusted if appropriate.

## **(d) Intangible assets**

Intangible assets that are acquired by the Company and have finite useful lives are measured at cost less accumulated amortisation and accumulated impairment losses.

Amortisation is calculated over the cost of the asset, or another amount substituted for cost, less its residual value. Amortisation is recognised in profit or loss on a straight-line basis over the estimated useful lives of intangible assets from the date that they are available for use, since this most closely reflects the expected pattern of consumption of the future economic benefits embodied in the asset. Amortisation methods, useful lives and residual values are reviewed at each financial year-end and adjusted if appropriate.

## **(e) Leased assets**

The Company has entered into leases of motor vehicles and office equipment as disclosed in note 13. Management has determined that all of the risks and rewards of ownership of these motor vehicles and equipment remain with the lessor and has therefore classified the leases as operating leases, and the leased assets are not recognised in the Company's statement of financial position. The Company's commitments at reporting date in regards to operating leases are disclosed in note 13.

## (f) Inventories

Inventories are measured at the lower of cost and net realisable value. The cost of inventories includes expenditure incurred in acquiring the inventories and other costs incurred in bringing them to their existing location and condition. Net realisable value is the estimated selling price in the ordinary course of business, less selling expenses.

## (g) Impairment

### (i) Financial assets (including receivables)

Financial assets are assessed at each reporting date to determine whether there is objective evidence that they are impaired. A financial asset is impaired if objective evidence indicates that a loss event has occurred after the initial recognition of the asset, and that the loss event had a negative effect on the estimated future cash flows of that asset that can be estimated reliably.

Objective evidence that financial assets (including equity securities) are impaired can include default or delinquency by a debtor, restructuring of an amount due to the Company on terms that the Company would not consider otherwise, indications that a debtor or issuer will enter bankruptcy and the disappearance of an active market for a security. In addition, for an investment in an equity security, a significant or prolonged decline in its fair value below its cost is objective evidence of impairment.

The Company considers evidence of impairment for receivables and held-to-maturity investments at both a specific asset and collective level. All individually significant receivables and held-to-maturity investments are assessed for specific impairment. All receivables and held-to-maturity investments found not to be specifically impaired are then collectively assessed for impairment by grouping together similar receivables and held-to-maturity investments with similar risk characteristics.

In assessing collective impairment, the Company uses historical trends of the probability of default, timing of recoveries and the amount of loss incurred, adjusted for management's judgement as to whether current economic and credit conditions are such that the actual losses are likely to be greater or less than suggested by historical trends.

An impairment loss in respect of a financial asset measured at amortised cost is calculated as the difference between its carrying amount and the present value of the estimated future cash flows discounted at the asset's original effective interest rate. Losses are recognised in profit or loss and reflected in an allowance account against receivables. When a subsequent event causes the amount of impairment loss to decrease, the decrease in impairment loss is reversed through profit or loss.

Impairment losses on available-for-sale investment securities are recognised by transferring the cumulative loss that has been recognised in other comprehensive income, and presented to the fair value reserve in equity, to profit or loss. The cumulative loss that is removed from other comprehensive income and recognised in profit or loss is the difference between the acquisition cost and the current fair value, less any impairment loss previously recognised in profit or loss.

If, in a subsequent period, the fair value of an impaired available-for-sale debt security increases and the increase can be related objectively to an event occurring after the impairment

loss was recognised in profit or loss, then the impairment loss is reversed, with the amount of the reversal recognised in profit or loss. However, any subsequent recovery in the fair value of an impaired available-for-sale equity security is recognised in other comprehensive income.

### (ii) Non-financial assets

The carrying amounts of the Company's non-financial assets are reviewed at each reporting date to determine whether there is any indication of impairment. If any such indication exists, then the asset's recoverable amount is estimated.

The recoverable amount of an asset is the greater of its value in use and its fair value less costs to sell. Value in use is determined as the depreciated replacement cost of an asset.

An impairment loss is recognised if the carrying amount of an asset exceeds its estimated recoverable amount. Impairment losses are recognised in profit or loss. Impairment losses recognised in prior periods are assessed at each reporting date for any indications that the loss has decreased or no longer exists. An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount. An impairment loss is reversed only to the extent that would have been determined, net of depreciation or amortisation, if no impairment loss had been recognised.

## (h) Employee benefits

### (i) Defined contribution plans

A defined contribution plan is a post-employment benefit plan under which an entity pays fixed contributions into a separate entity and will have no legal or constructive obligation to pay further amounts. Obligations for contributions to defined contribution plans are recognised as an employee benefit expense in profit or loss in the periods during which services are rendered by employees.

### (ii) Other long-term employee benefits

The Company's net obligation in respect of long-term employee benefits is the amount of future benefit that employees have earned in return for their service in the current and prior periods plus related on-costs. The liability is measured such that it is not materially different from the estimate determined by discounting using market yields at the reporting date on corporate bonds with terms to maturity and currencies that match, as closely as possible, the estimated future cash outflows.

### (iii) Termination benefits

Termination benefits are recognised as an expense when the Company is demonstrably committed, without realistic probability of withdrawal, to a formal detailed plan to either terminate employment before the normal retirement date, or to provide termination benefits as a result of an offer made to encourage voluntary redundancy. Termination benefits for voluntary redundancies are recognised as an expense if the Company has made an offer of voluntary redundancy, it is probable that the offer will be accepted, and the number of acceptances can be estimated reliably. If benefits are payable more than 12 months after the reporting period, then they are discounted to their present value.

### (iv) Short-term benefits

Short-term employee benefit obligations are measured on an undiscounted basis and are expensed as the related service is provided.

A liability is recognised for the amount expected to be paid under short-term bonus plans if the Company has a present legal or constructive obligation to pay this amount as a result of past service provided by the employee and the obligation can be measured reliably. Such liabilities represent the best estimate of the amounts required to settle the obligation at the end of the reporting period.

## (i) Revenue

### (i) Goods sold

Revenue from the sale of goods in the course of ordinary activities is measured at the fair value of the consideration received or receivable, net of any applicable discounts or rebates. Revenue is recognised when persuasive evidence exists, usually in the form of an executed sales agreement, that the significant risks and rewards of ownership have been transferred to the buyer, recovery of the consideration is probable, the associated costs and possible return of goods can be estimated reliably, there is no continuing management involvement with the goods, and the amount of revenue can be measured reliably.

### (ii) Services

Revenue from services rendered is recognised in profit or loss in proportion to the stage of completion of the transaction at the reporting date. The stage of completion is assessed by reference to an estimation of the work performed.

### (iii) Grants

The company receives a number of grants in the course of its operations. Once the company has been notified of the successful outcome of a grant application, the terms and conditions of each grant are reviewed to determine whether the funds relate to a reciprocal grant (i.e. payment for services rendered), in which case it is accounted for under AASB 118 *Revenue*, or a non-reciprocal grant, in which case it is accounted for under AASB 1004 *Contributions*.

## (j) Finance income

Finance income comprises interest income and dividends. Interest income is recognised as it accrues in profit or loss using the effective interest rate method. Dividend income is recognised in profit or loss on the date on which the Company's right to receive payment is established.

Finance costs comprise interest expense on borrowings and impairment losses recognised on financial assets other than trade receivables. Borrowing costs that are not directly attributable to the acquisition, construction or production of a qualifying asset are recognised in profit or loss using the effective interest rate method.

## (k) Lease payments

Payments made under operating leases are recognised in profit or loss on a straight-line basis over the term of the lease.

### *Determining whether an arrangement contains a lease*

At inception of an arrangement, the Company determines whether such an arrangement is or contains a lease. A specific asset is the subject of a lease if fulfilment of the arrangement is dependent upon the use of that specified asset. An arrangement conveys the right to use the asset if the arrangement conveys to the Company the right to control the use of the underlying asset. At inception or upon reassessment of the arrangement, the

Company separates payments and other consideration required by such an arrangement into those for the lease and those for other elements on the basis of their relative fair values.

## (l) Goods and services tax

Revenue, expenses and assets are recognised net of the amount of goods and services tax (GST), except where the amount of GST incurred is not recoverable from the taxation authority. In these circumstances, the GST is recognised as part of the cost of acquisition of the asset or as part of the expense.

Receivables and payables are stated with the amount of GST included. The net amount of GST recoverable from, or payable to, the ATO is included as a current asset or current liability in the statement of financial position.

Cash flows are included in the statement of cash flows on a gross basis. The GST components of the cash flows arising from investing and financing activities which are recoverable from, or payable to, the ATO are classified as operating cash flows.

## 2. Other income

	2017	2016
Net gain/(loss) on sale of property, plant and equipment	60,029	(2,996)
Reimbursement of State taxes	-	34,202
	<u>60,029</u>	<u>31,206</u>

## 3. Personnel expenses

	2017	2016
Wages and salaries	8,801,641	8,418,583
Other associated personnel expenses	446,626	414,072
Contributions to defined contribution plans	822,718	791,122
	<u>10,070,985</u>	<u>9,623,777</u>

## 4. Cash and cash equivalents

	2017	2016
Cash on hand	280	193
Bank deposits at-call	1,334,421	3,714,495
Cash and cash equivalents in the statement of cash flows	<u>1,334,701</u>	<u>3,714,688</u>

## 5. Other investments

	2017	2016
<b>Current</b>		
Held-to-maturity investments	<u>2,115,292</u>	<u>3,725,000</u>
<b>Non-current</b>		
Available-for-sale financial assets, comprising listed investments at fair value in:		
Interest rate securities	5,676,867	5,405,052
Equity securities	<u>3,291,741</u>	<u>805,636</u>
	<u>8,968,608</u>	<u>6,210,688</u>

Held-to-maturity investments consist of term deposits with interest rates between 2.55 and 2.75 percent (2016: between 2.75 and 3.05 percent) and mature within 6 months of balance date (2016: within 6 months of balance date).

All available-for-sale investments are quoted on the Australian Securities Exchange. Interest rate securities include corporate bonds, subordinated notes and convertible and reset preference securities.

## 6. Trade and other receivables

	2017	2016
Trade receivables due from those other than related parties	717,718	745,727
Trade receivables due from related parties	30,281	3,717
Other receivables	<u>1,360,834</u>	<u>801,594</u>
	<u>2,108,833</u>	<u>1,551,038</u>

Trade receivables are shown net of impairment losses amounting to \$4,431 (2016: \$5,694) at reporting date. This allowance account is used to record impairment losses until the Company is satisfied that no recovery of the amount owing is possible; at that point the amounts are considered irrecoverable and are written off against the financial asset directly.

The movement in the allowance for impairment in respect of trade receivables during the year was as follows:

	2017	2016
Balance at 1 July	5,694	-
Payments received in relation to previously impaired balances	(2,000)	-
Impairment charge for the year	737	5,694
Written off during the year	<u>-</u>	<u>-</u>
Balance at 30 June	<u>4,431</u>	<u>5,694</u>

## 7. Inventories

	2017	2016
Course materials on hand - wine	<u>92,000</u>	<u>91,902</u>
	<u>92,000</u>	<u>91,902</u>

## 8. Property, plant and equipment

	Plant and machinery	Office furniture and IT	Laboratory equipment	Capital WIP	Total
<b>Cost</b>					
Balance at 1 July 2016	464,265	1,161,090	9,327,063	13,750	10,966,168
Additions	87,573	131,425	780,696	-	999,694
Transfers	13,750	-	-	(13,750)	-
Disposals	(11,000)	(124,401)	(551,962)	-	(687,363)
Balance at 30 June 2017	554,588	1,168,114	9,555,797	-	11,278,499
<b>Depreciation and impairment losses</b>					
Balance at 1 July 2016	290,931	804,866	7,919,420	-	9,015,217
Depreciation charge for the year	48,208	137,978	488,354	-	674,540
Transfers	-	-	-	-	-
Disposals	(11,000)	(113,754)	(551,328)	-	(676,082)
Balance at 30 June 2017	328,139	829,090	7,856,446	-	9,013,675
<b>Carrying amounts</b>					
at 1 July 2016	173,334	356,224	1,407,643	13,750	1,950,951
at 30 June 2017	226,449	339,024	1,699,351	-	2,264,824

## 9. Intangible assets

	Interest in WIC building	Computer software	Intangible assets under development	Total
<b>Cost</b>				
Balance at 1 July 2016	6,100,140	78,762	494,868	6,673,770
Additions	-	46,053	-	46,053
Transfers	-	494,868	(494,868)	-
Balance at 30 June 2017	6,100,140	619,683	-	6,719,823
<b>Amortisation and impairment losses</b>				
Balance at 1 July 2016	1,544,189	56,538	-	1,600,727
Amortisation charge for the year	203,338	73,800	-	277,138
Balance at 30 June 2017	1,747,527	130,338	-	1,877,865
<b>Carrying amounts</b>				
at 1 July 2016	4,555,951	22,224	494,868	5,073,043
at 30 June 2017	4,352,613	489,345	-	4,841,958

### Interest in WIC building

The Company has a 50 year nominal occupancy right to approximately 53% of the space in the Wine Innovation Cluster (WIC) Central building owned by the University of Adelaide. The other occupants are currently the University of Adelaide and Australian Grain Technologies. The term of occupancy is reviewable after 30 years based on the remaining economic life of the building. The value assigned to the AWRI's interest in the building is net of amounts contributed by Wine Australia (WA). The building cost is being amortised over a period of 30 years from the date of practical completion (26 November 2008).

### Computer software

Computer software assets are recognised as the attributable software licence and development costs paid to third parties, and do not include employee costs or an attribution of relevant overheads, as only an immaterial component of software development and testing processes are performed in-house. These software assets are amortised over periods of between three and five years, based upon their estimated useful lives and expected technical obsolescence.

## 10. Payables and accruals

	2017	2016
<b>Current</b>		
Trade payables due to those other than related parties	194,270	194,345
Trade payables due to related parties	-	-
Income received in advance	898,657	1,565,217
PAYG and GST	406,744	469,084
Non-trade payables and accrued expenses	<u>2,611,300</u>	<u>2,268,500</u>
	<u>4,110,971</u>	<u>4,497,146</u>

## 11. Project funds not expended

Any unexpended WA funding is reimbursable to WA, except where WA agrees that amounts can be retained by the AWRI for purposes approved by WA, at which point such amounts are considered to be committed towards that purpose. Project underspends recorded in the year ended 30 June 2017 may be reduced or eliminated by overspends recorded within those projects in prior years - where applicable, the unexpended funds detailed below have been reduced by such amounts.

The unexpended investment agreement funds for the current year totalled \$82,349 (2016: \$23,443). The unexpended funds from other WA contracts for the current year totalled \$176,060 (2016: \$347,304).

During the year WA approved the retention by the Company of unspent prior years' funds totalling \$1,481 for the purpose of capital purchases (2016: \$65,349) and \$370,747 for other purposes (2016: \$84,115). During the year no unspent prior years' funds relating to WA projects were returned to WA (2016: none).

	2017	2016
WA current year's investment agreement funding unexpended	82,349	23,443
WA current year's other contract funding unexpended	176,060	347,304
WA prior years' funding unexpended and uncommitted	-	1,481
	<u>258,409</u>	<u>372,228</u>

## 12. Provisions

	2017	2016
<b>Current</b>		
Employee entitlements	<u>1,658,612</u>	<u>1,504,693</u>
<b>Non-current</b>		
Employee entitlements	<u>262,732</u>	<u>328,452</u>
Number of employees (full time equivalents)	95.5	96.0

## 13. Operating leases

### Leases as lessee

Non-cancellable operating lease rentals are payable as follows:

	2017	2016
Within one year	13,697	19,961
One year or later and no later than five years	13,699	27,396
Later than five years	<u>-</u>	<u>-</u>
	<u>27,396</u>	<u>47,357</u>

The Company did not enter into any new operating lease agreements during the year.

During the year ended 30 June 2017 an amount of \$19,961 was recognised as an expense in respect of operating leases (2016: \$21,451).

### Leases as lessor

The Company leases out part of its interest in the WIC building (refer note 9) to the Australian Wine Industry Technical Conference Incorporated. Associated lease payments are included within the transactions with related parties disclosed within note 15. The future minimum lease payments under non-cancellable leases are receivable as follows:

	2017	2016
Within one year	8,000	8,000
One year or later and no later than five years	17,333	25,333
Later than five years	<u>-</u>	<u>-</u>
	<u>25,333</u>	<u>33,333</u>

During the year ended 30 June 2017 an amount of \$8,143 was recognised as rental income (2016: \$8,082).

## 14. Capital commitments

	2017	2016
<b>Property, plant and equipment</b>		
<i>Contracted but not provided for and payable</i>		
Within one year	18,893	19,468
One year or later and no later than five years	-	-
Later than five years	<u>-</u>	<u>-</u>
	<u>18,893</u>	<u>19,468</u>

## 15. Related parties

### Key management personnel compensation

Key management personnel comprises the directors of the Company and other persons having authority and responsibility for planning, directing and controlling the activities of the Company. Key management personnel compensation comprised:

	2017	2016
Total remuneration	1,625,458	1,675,654

During the year non-executive directors became entitled to compensation totalling \$83,000 (2016: \$82,500). A number of directors voluntarily elected not to receive \$51,000 of this entitlement (2016: \$53,000), instead redirecting such amounts to support otherwise unfunded activities of the Company relating to individual and group professional development for AWRI staff, undertaken both domestically and internationally.

### Key management personnel and director transactions

A number of key management personnel, or their related parties, hold positions in other entities that result in them having control or significant influence over the financial or operating policies of these entities.

A number of these entities transacted with the Company in the reporting period. The terms and conditions of the transactions with key management personnel and their related parties were no more favourable than those available, or which might reasonably be expected to be available, on similar transactions to non-key management personnel related entities on an arm's length basis.

Related parties arising through relationships with key management personnel:

Bathe Wines Pty Ltd  
Maipenrai Vineyard and Winery  
Revenir Winemaking Pty Ltd  
Vitibit Pty Ltd

### Other related party transactions

During the year the Company provided administrative services and leased office premises to a jointly controlled entity, The Australian Wine Industry Technical Conference Incorporated.

Other related parties:

The Australian Wine Industry Technical Conference Incorporated

	Transactions with related parties			
	Transactions value for the year ended 30 June		Balance outstanding as at 30 June	
	2017	2016	2017	2016
Services received from related parties	64,665	4,681	-	-
Services provided to related parties	274,612	177,502	30,281	3,717

## 16. Contingencies

In the opinion of the Directors, there were no material or significant contingent liabilities at 30 June 2017 (2016: none).

## 17. Subsequent events

On 4 September 2017 the AWRI and its principal funding provider Wine Australia entered into an agreement providing a material level of funding to the AWRI between July 2017 and June 2025 (subject to certain review points). There has not arisen in the interval between the end of the financial year and the date of this report any other item, transaction or event of a material and unusual nature likely to significantly affect the operations of the Company, the results of those operations, or the state of affairs of the Company, in subsequent financial years.

## 18. Limited liability

In accordance with the Company's constitution, each member (both during the time he or she is a member and within one year afterwards) is liable to contribute \$2 in the event that the Company is wound up. The total amount members would contribute is \$24 (2016: \$22).

## Responsible persons' declaration

The directors of The Australian Wine Research Institute Limited (the Company) declare that, in the directors' opinion:

- the financial statements, comprising the statement of profit or loss and other comprehensive income, statement of financial position, statement of cash flows, statement of changes in equity, and accompanying notes, are in accordance with the *Australian Charities and Not-for-profits Commission Act 2012* and:
  - comply with Australian Accounting Standards – Reduced Disclosure Requirements and the *Australian Charities and Not-for-profits Commission Regulation 2013*; and
  - give a true and fair view of the entity's financial position as at 30 June 2017 and of its performance for the year ended on that date; and
- there are reasonable grounds to believe that the Company will be able to pay all of its debts, as and when they become due and payable.

Signed in accordance with subsection 60:15(2) of the *Australian Charities and Not-for-profits Commission Regulation 2013*.



**Louisa E. Rose**  
Chair



**Daniel L. Johnson**  
Managing Director

Dated at Urrbrae on this the 19<sup>th</sup> day of September 2017.

## Independent auditor's report to the members of The Australian Wine Research Institute Limited

### Report on the Audit of the Financial Report Opinion

We have audited the financial report of The Australian Wine Research Institute Limited, which comprises the statement of financial position as at 30 June 2017, the statement of profit or loss and other comprehensive income, the statement of changes in equity and the statement of cash flows for the year then ended, and notes to the financial report, including a summary of significant accounting policies, and the responsible entities' declaration.

In our opinion the accompanying financial report of The Australian Wine Research Institute Limited, is in accordance with Division 60 of the *Australian Charities and Not-for-profits Commission Act 2012*, including:

- (i) Giving a true and fair view of the registered entity's financial position as at 30 June 2017 and of its financial performance for the year ended on that date; and
- (ii) Complying with Australian Accounting Standards – Reduced Disclosure Requirements and Division 60 of the *Australian Charities and Not-for-profits Commission Regulation 2013*.

### Basis for opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Report* section of our report. We are independent of the registered entity in accordance with the *Australian Charities and Not-for-profits Commission Act 2012 (ACNC Act)* and the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other ethical responsibilities in accordance with the Code.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

### Other information

Those charged with governance are responsible for the other information. The other information obtained at the date of this auditor's report is the Chair's Report, Managing Director's Report and Directors' Report included in The Australian Wine Research Institute Limited's annual report.

Our opinion on the financial report does not cover the other information and accordingly we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial report, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial report or our knowledge obtained in the audit or otherwise appears to be materially misstated.

If, based on the work we have performed on the other information obtained prior to the date of this auditor's report, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

### Responsibilities of the responsible entities for the Financial Report

The responsible entities of the registered entity are responsible for the preparation of the financial report that gives a true and fair view in accordance with Australian Accounting Standards – Reduced Disclosure Requirements and the *ACNC Act* and for such internal control as the responsible entities determine is necessary to enable the preparation of the financial report that gives a true and fair view and is free from material misstatement, whether due to fraud or error.

In preparing the financial report, the responsible entities are responsible for assessing the registered entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the directors either intend to liquidate the registered entity or to cease operations, or has no realistic alternative but to do so.

The responsible entities of the registered entity are responsible for overseeing the registered entity's financial reporting process.

### Auditor's responsibilities for the audit of the Financial Report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of this financial report.

A further description of our responsibilities for the audit of the financial report is located at the Auditing and Assurance Standards Board website (<http://www.auasb.gov.au/Home.aspx>) at: [http://www.auasb.gov.au/auditors\\_files/ar3.pdf](http://www.auasb.gov.au/auditors_files/ar3.pdf).

This description forms part of our auditor's report.

### BDO Audit (SA) Pty Ltd



### Paul Gosnold

Director

Adelaide, 16 October 2017

# Memorial funds

Consisting of (and collectively the "Trusts"):  
The John Fornachon Memorial Library Endowment Fund  
The Thomas Walter Hardy Memorial Trust Fund  
The H. R. Haselgrove Memorial Trust Fund  
The Stephen Hickinbotham Memorial Research Trust

## Statement by directors of the trustee company

The Australian Wine Research Institute Limited (the "Trustee") acts as unrewarded trustee for the above listed Trusts. As detailed in note 2 to these financial statements, the Trusts are not reporting entities because, in the Trustee's opinion, it is unlikely that users exist who are unable to command the preparation of reports tailored so as to satisfy, specifically, all of their information needs. This is a special purpose financial report that has been prepared to meet the reporting obligations of the Trustee.

In the opinion of the directors of The Australian Wine Research Institute Limited (the Trustee):

- (a) (i) the Statements of profit or loss and other comprehensive income give a true and fair view of each Trust's profit or loss for the year ended 30 June 2017; and  
  
(ii) the Statements of financial position give a true and fair view of each Trust's state of affairs as at 30 June 2017.
- (b) at the date of this statement, there are reasonable grounds to believe that the Trusts will be able to pay their debts as and when they fall due.

This statement is made in accordance with a resolution of the directors of the trustee company and is signed for and on behalf of the directors by:



**Louisa E. Rose**

Chair

Dated at Urrbrae on this the 19<sup>th</sup> day of September 2017.

## Notes to the financial statements

### 1. Nature and purpose of the Trusts

- (a) The John Fornachon Memorial Library Endowment Fund was established on 30 September 1970, to provide for the establishment and maintenance of the Fornachon Memorial Library, for the promotion of study and general knowledge of the wine industry. The Fund was established by way of public appeal on a memorial to the late John Charles Macleod Fornachon, the Director of Research of The Australian Wine Research Institute Limited from 1955 to 1968.
- (b) The Thomas Walter Hardy Memorial Trust Fund was established on 29 June 1993 to assist in the communication of information within the wine industry and associated activities, allied to the wine industry on behalf of the Trust. The Trust was established in memory of the late Thomas Walter Hardy.
- (c) The H.R. Haselgrove Memorial Trust Fund was established on 12 December 1979 to provide for the promotion and encouragement of wine research by, or under the direction of, The Australian Wine Research Institute Limited as a memorial to the late Harry Ronald Haselgrove.
- (d) The Stephen Hickinbotham Memorial Research Trust was established on 7 October 1986 to provide financial assistance and support in the pursuit of scientific research and associated activities, allied to the wine industry. The Trust was established in memory of the late Stephen John Hickinbotham. The Australian Wine Research Institute Limited assumed responsibility for the Trust on 25 May 1992.

### 2. Statement of accounting policies

In the opinion of the Trustee, the Trusts are of a type identified in Statement of Accounting Concepts 1 as non-reporting entities. Accordingly, the financial statements constitute 'special purpose financial reports' which have been prepared solely to meet the reporting obligations of the Trustee, and the limited information needs of the Trusts' members.

The financial statements have been prepared in accordance with accounting standards, except as stated below, and other mandatory professional reporting requirements.

The following accounting standards have not been adopted because, in the opinion of the Trustee, the cost of compliance outweighs the benefit of the resultant information:

- AASB 7 Financial Instruments: Disclosures
- AASB 107 Statement of Cash Flows
- AASB 124 Related Party Disclosures
- AASB 132 Financial Instruments: Presentation

The financial statements have been prepared on an accrual basis.

Accounting policies have been consistently applied, with the only significant policy being in relation to investments.

Investments comprise money on deposit, and are recorded at their nominal value. Interest is brought to account as earned, with accrued interest at balance date being included in the Statement of financial position as receivables.

STATEMENTS OF PROFIT OR LOSS AND OTHER COMPREHENSIVE INCOME	The John Fornachon Memorial Library Endowment Fund		The Thomas Walter Hardy Memorial Trust Fund		The H.R. Haselgrove Memorial Trust Fund		The Stephen Hickinbotham Memorial Research Trust	
	2017	2016	2017	2016	2017	2016	2017	2016
<b>For the year ended 30 June 2017</b>								
<b>Income</b>								
Interest	1,035	1,713	715	1,278	675	1,113	821	1,424
Donations and other income	-	-	-	-	-	-	-	-
<b>Total income</b>	<b>1,035</b>	<b>1,713</b>	<b>715</b>	<b>1,278</b>	<b>675</b>	<b>1,113</b>	<b>821</b>	<b>1,424</b>
<b>Expenses</b>								
Bank charges	3	-	3	-	3	-	3	-
Sponsorship	-	-	10,000	-	-	-	7,000	-
<b>Total expenses</b>	<b>3</b>	<b>-</b>	<b>10,003</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>7,003</b>	<b>-</b>
<b>Profit/(loss) from ordinary activities</b>	<b>1,032</b>	<b>1,713</b>	<b>(9,288)</b>	<b>1,278</b>	<b>672</b>	<b>1,113</b>	<b>(6,182)</b>	<b>1,424</b>
Other comprehensive income	-	-	-	-	-	-	-	-
<b>Total comprehensive income for the period</b>	<b>1,032</b>	<b>1,713</b>	<b>(9,288)</b>	<b>1,278</b>	<b>672</b>	<b>1,113</b>	<b>(6,182)</b>	<b>1,424</b>
<b>STATEMENTS OF FINANCIAL POSITION</b>								
<b>As at 30 June 2017</b>	<b>2017</b>	<b>2016</b>	<b>2017</b>	<b>2016</b>	<b>2017</b>	<b>2016</b>	<b>2017</b>	<b>2016</b>
<b>Assets</b>								
Cash at bank	-	-	-	-	-	-	-	-
Investments	132,882	131,823	89,127	98,388	86,365	85,676	103,433	109,589
Receivables	87	114	59	86	57	74	68	94
<b>Total current assets</b>	<b>132,969</b>	<b>131,937</b>	<b>89,186</b>	<b>98,474</b>	<b>86,422</b>	<b>85,750</b>	<b>103,501</b>	<b>109,683</b>
Investments	-	-	-	-	-	-	-	-
<b>Total non-current assets</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Total assets</b>	<b>132,969</b>	<b>131,937</b>	<b>89,186</b>	<b>98,474</b>	<b>86,422</b>	<b>85,750</b>	<b>103,501</b>	<b>109,683</b>
<b>Liabilities</b>								
Sundry creditors	-	-	-	-	-	-	-	-
<b>Total current liabilities</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Net assets</b>	<b>132,969</b>	<b>131,937</b>	<b>89,186</b>	<b>98,474</b>	<b>86,422</b>	<b>85,750</b>	<b>103,501</b>	<b>109,683</b>
<b>Trust funds</b>								
Settled sum	12,785	12,785	50	50	20,000	20,000	50	50
Founders donation	-	-	25,000	25,000	-	-	-	-
	12,785	12,785	25,050	25,050	20,000	20,000	50	50
<b>Accumulated surplus</b>								
Opening balance	119,152	117,439	73,424	72,146	65,750	64,637	109,633	108,209
Profit/(loss) for the year	1,032	1,713	(9,288)	1,278	672	1,113	(6,182)	1,424
Closing balance	120,184	119,152	64,136	73,424	66,422	65,750	103,451	109,633
<b>Total trust funds</b>	<b>132,969</b>	<b>131,937</b>	<b>89,186</b>	<b>98,474</b>	<b>86,422</b>	<b>85,750</b>	<b>103,501</b>	<b>109,683</b>

# External presentations and talks

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	How does the environmental performance of Langhorne Creek stack up?	Opportunities in a new climate workshop, Langhorne Creek, SA	5 Jul 16
	Entwine Australia – demonstrating environmental performance of Australian vineyards and wineries		
P.R. Petrie	Smarter farming on Adelaide's doorstep	National Climate Change Adaptation Research Facility (NCCARF) Climate Adaptation 2016, Adelaide, SA	6 Jul 16
M.L. Longbottom	Time to renew – how to enter and interpret your Entwine data	AWRI webinar	13 Jul 16
M.Z. Bekker	Effectiveness of copper remediation. Can you get your freshness back?	16 <sup>th</sup> Australian Wine Industry Technical Conference, Workshop Program, Adelaide, SA	24 Jul 16
	Factors influencing volatile sulfur compound formation in wines post-bottling		
I.L. Francis	Characterisation of undesirable aroma compounds in Shiraz wines produced from high vigour rootstocks		
	Exogenous sources of flavour compounds including 'green' aroma in red wines		
S. Nordestgaard	History and developments in heating of red grapes for extraction		
C.S. Stockley	Things you need to know		
	Evolving evidence for the role of wine in reducing the risk of four primary causes of death in Australia		
A.G. Cordente	Let the sunshine in		
P.O. Williamson	The right message: increasing choice of Australian wine in China		
P.R. Petrie	Vintage advancement and compression		
M.L. Longbottom	Sustainable wine-grape production in Australia – drivers and measures		
	Entwine Australia – promoting a sustainable grape and wine community		
M. Essling	Grazing sheep in vineyards – saving fuel and making money		
T.J. Abbott	Harnessing the sun at De Bortoli Wines		
P.A. Smith	Emerging applications of oenological enzymes in red and white winemaking		
D.L. Capone	Determining the role of polyfunctional thiols in Chardonnay wine aroma		
M.P. Day	The impact of air exposure during fruit processing		
S.A. Schmidt	Oxygen use during winemaking		
A.G. Cordente	Modulation of sulfur compound formation by yeast during fermentation		
T.E. Siebert	'Stone fruit' aroma and flavour in wine		
M. Parker	In-mouth flavour release		
K.C. Hirlam	Active scavenging of volatile sulfur compounds		
N. Scrimgeour	The impact of different closure technologies on wine development		
	The impact of oxygen management on wine shelf life		

Staff	Title of presentation	Presented to and where	Date	
E.N. Wilkes	Copper: the good, the bad and the ugly	16 <sup>th</sup> Australian Wine Industry Technical Conference, Workshop Program, Adelaide, SA	24 Jul 16	
P.J. Costello	High-throughput phenotyping of malolactic bacteria strains			
E.J. Bartowsky	The diversity of <i>Oenococcus oeni</i> – what it can mean for MLF			
J.R. Bellon	Breeding new life into the ancient art of winemaking			
G.A.P. Patacq	An evaluation of luxury wine businesses in South Australia			
P.A. Smith	Overview of molecular drivers of sensory characteristics			
P.A. Smith, K.A. Bindon	Grape composition and allocation grade relationships in Cabernet Sauvignon, Shiraz and Chardonnay			
K.A. Bindon	Relationships between grape composition and wine style in Chardonnay and Shiraz			
P.J. Chambers	Microbial diversity at work in vineyards and wine			
M. Parker	In-mouth flavour release from non-volatile grape-derived precursors			
P.J. Costello	High-throughput phenotypic profiling of malolactic bacteria			
S.A. Schmidt	Genetic diversity in clones of Chardonnay			
P.R. Petrie	Practical options to manage vintage compression			
S. Nordestgaard	Sources and properties of lees			27 Jul 16
M.J. Herderich	Biological and environmental factors relating to rotundone formation			
T.E. Siebert	History of rotundone research			
M.P. Krstic	Using precision viticultural tools to better understand flavour variation in the vineyard			
J.M. McRae	Hot news in heat tests!			
E.N. Wilkes	CMCs: more than just cold comfort			
P.W. Godden	Clearing the haze with aspergillopepsin enzymes			
A.R. Borneman	The genomics of wine			
C.S. Stockley	Wine labelling – the growing influence of the anti-alcohol lobby on health warning labels			
E.N. Wilkes	Analytical approaches – challenges for compliance			
K.A. Bindon	Objective measures of grape quality	16th Australian Wine Industry Technical Conference, Fresh Science session, Adelaide, SA	28 Jul 16	
N. Scrimgeour	Using cross-linked polymers to scavenge metals and extend shelf life of wine			
G.D. Cowey	Wine faults and taints and new wine flavours and wine threshold determination	Wine faults, taints, flavours and thresholds workshop, Pernod Ricard Winemakers, Barossa Valley, SA	29 Jul 16	
A.R. Borneman	A tale of shipwrecks, yeast and beer	Waite in the Spotlight, Waite Campus, SA		
D.L. Capone	Tropical flavours in Chardonnay wines	Workshop on varietal thiols in wine, AWRI, Adelaide, SA	1 Aug 16	
M.P. Krstic	Effect of rootstock on Pinot Noir and Chardonnay performance	Post-vintage ‘work in progress’ tasting and rootstock seminar, Yarra Valley, Vic	11 Aug 16	
S. Dillon, A.R. Rinaldo	Wine fermentation	‘A big glass of wine science’, National Science Week event, North Adelaide, SA	16 Aug 16	
J.L. Hixson, M.P. Day, M.Z. Bekker	Wine processes			
T.E. Siebert, P.O. Williamson, E. Kristianto	Wine flavours and aromas			
C.S. Stockley, V.F. Phillips	Wine and health			

Staff	Title of presentation	Presented to and where	Date
J.M. McRae, E.N. Wilkes	Wine myth-busting	'A big glass of wine science', National Science Week event, North Adelaide, SA	16 Aug 16
G.A.P. Patacq	Do you really understand luxury in wine?	AWRI webinar	18 Aug 16
E.N. Wilkes	Copper: the good, the bad and the ugly	New Zealand Winegrowers Romeo Bragato Conference, Blenheim, NZ	25 Aug 16
M.P. Day	Use of early oxygen exposure to modify style in white and red wines		
P.A. Smith	Understanding how and why oxygen impacts on molecular drivers of taste and texture in wines		
A.D. Coulter	Stuck ferments, what can you do?	AWRI webinar	1 Sep 16
M.L. Longbottom	Sustainable wine-grape production in Australia – drivers and measures	Sustainability and alternative energy options workshop, Padthaway, SA	5 Sep 16
	Natural capital management – impacts on the bottom line		
C.A. Simos, P.O. Williamson	How spice character makes Australian Shiraz unique	Wine Australia, Australian Wine Grand Tasting 2016, Seoul, Republic of Korea	6 Sep 16
S. Nordestgaard	Innovations and options for grape sorting	Winery Engineering Association conference, McLaren Vale, SA	7 Sep 16
M.G. Holdstock	Shiraz and its regional differences		
S. Nordestgaard	Rapid extraction techniques for red wine production		
T.J. Abbott	Real-time fermentation monitoring		
E.N. Wilkes	Closures – our changing understanding		
M.J. Herderich	New smoke taint R&D	Accolade Wines viticulturists annual meeting, McLaren Vale, SA	8 Sep 16
A.D. Coulter	Smoke taint		
C.A. Simos, P.O. Williamson	How spice character makes Australian Shiraz unique	Wine Australia, Australian Wine Grand Tasting 2016, Tokyo, Japan	
G.D. Cowey	Simulated flavours, faults, taints and mouth-feel tasting	Sommeliers Australia – staff training, Melbourne, Vic	12 Sep 16
M.G. Holdstock		Sommeliers Australia – staff training, Sydney, NSW	19 Sep 16
P.O. Williamson	The right message: increasing choice of Australian wine in China	Creating consumer value workshop, Barossa Valley, SA	22 Sep 16
W.P. Pearson	Defining 'green' flavour in Cabernet Sauvignon wines using projective mapping and descriptive analysis	Cool Climate Oenology & Viticulture Institute, Brock University, St Catherines, Ontario, Canada	
M. Parker	Flavour precursors: contribution to wine flavour through in-mouth flavour release	University of South Australia, School of Pharmacy and Medical Science Postgraduate Symposium, Adelaide, SA	30 Sep 16
N.D.R. Lloyd	SA Metabolomics Facility capabilities	University of Adelaide, School of Agriculture, Food and Wine Research Day, Adelaide, SA	2 Oct 16
E.N. Wilkes	Performance of international laboratories for wine analysis, 2016 ring test results	APEC Wine Regulatory Forum, Ottawa, Canada	6 Oct 16
	Regulatory practices in wine – the example of methanol		7 Oct 16
M.P. Day	Measuring up authentication: analytical tools to test wine provenance	AWRI webinar	13 Oct 16
M.P. Krstic	Soil health – what is it and how can we manage it?	AWRI roadshow seminar, Geelong, Vic	
P.R. Petrie	Earlier, shorter, hotter? Is vintage compression really happening and what can you do about it?		
	How to improve fruit set in cool climates?		
E.N. Wilkes	Cold stability, hitting a moving target		
	Copper: the good, the bad and the ugly		
P.O. Williamson	Australian flavours	Tourism Australia staff conference, Sydney, NSW	19 Oct 16
G.D. Cowey	How spice character makes Australian Shiraz unique	Wine Australia China Awards & Best of Australia Showcase, Shanghai, China	24 Oct 16
P.W. Godden	Overview of the AWRI's RDEC capabilities	Wine Australia – UK and EU media group visit, AWRI, Adelaide, SA	25 Oct 16



Staff	Title of presentation	Presented to and where	Date
E.N. Wilkes	Impact of closures on wine	Wine Australia – UK and EU media group visit, AWRI, Adelaide, SA	25 Oct 16
P.O. Williamson	Linking the AWRI's wine flavour research with regionality		
P.J. Costello	Wine fermentation	Australian Institute of Food Science and Technology Microbiology Community of Interest Event, Professor Graham Fleet Memorial, Sydney, NSW	26 Oct 16
S. Nordestgaard	Hot extraction: a tool to manage compressed vintages?	AWRI webinar	27 Oct 16
M.P. Krstic	Smoke taint – update	Smoke taint Q&A, Milawa, Vic	29 Oct 16
C.A. Simos	Introduction to the Advanced Wine Assessment Course	Advanced Wine Assessment Course (AWAC 40), AWRI, Adelaide, SA	31 Oct 16
G.D. Cowey	Flavour, taints, faults and thresholds		
P.W. Godden	Introduction to wine show judging		
C.A. Simos, P.O. Williamson	Overview of the AWRI's RDEC capabilities	Wine Australia – Heads of market visit, AWRI, Adelaide, SA	1 Nov 16
V.T. O'Brien	Panel discussion on creating product premiums subject to country of origin perceptions of Australian wine	2016 Wine Australia exporter update, Adelaide, SA	2 Nov 16
R. Gawel	Palate performance and statistical evaluation	Advanced Wine Assessment Course (AWAC 40), AWRI, Adelaide, SA	3 Nov 16
P.W. Godden, C.A. Simos	Overview of the AWRI's RDEC capabilities	Wine Australia – WSET group visit, AWRI, Adelaide, SA	7 Nov 16
C.A. Simos	Introduction to the Advanced Wine Assessment Course		
W.P. Pearson	Flavour, taints, faults and thresholds		
P.W. Godden	Introduction to wine show judging		
R. Gawel	Palate performance and statistical evaluation		
P.R. Petrie	Soil health – what is it and how can we manage it?	AWRI roadshow seminar, Mornington Peninsula, Vic	15 Nov 16
M. Essling	What are the positives and pitfalls of grazing sheep in your vineyard?		
	Organic vs conventional practices compared – what's stopping you from going organic?		
P.J. Costello	Can you influence your wine styles through MLF?	AWRI roadshow seminar, Gippsland, Vic	16 Nov 16
I.L. Francis	Struck match and tropical fruit: the role of varietal thiols in Australian Chardonnay		
P.R. Petrie	How to improve fruit set in cool climates?		
	Soil health – what is it and how can we manage it?		
I.L. Francis	Hidden flavour unlocked by saliva during tasting: a key to wine quality?	AWRI roadshow seminar, Yarra Valley, Vic	17 Nov 16
	Struck match and tropical fruit: the role of varietal thiols in Australian Chardonnay		
P.J. Costello	Avoiding spoilage issues caused by wine bacteria: prevention is better than cure		
T.J. Abbott	Ferment simulator	AWRI webinar	17 Nov 16
P.R. Petrie	Earlier, shorter, hotter? Is vintage compression really happening and what can you do about it?	AWRI roadshow seminar, Yarra Valley, Vic	17 Nov 16
	Soil health – what is it and how can we manage it?		
I.L. Francis	Struck match and tropical fruit: the role of varietal thiols in Australian Chardonnay		
	Complexity, texture and flavour... or green, hard and herbal? Incorporation of stems and leaves in cool climate Shiraz fermentation	AWRI roadshow workshop, Clare Valley, SA	22 Nov 16
P.J. Costello	Can you influence your wine styles through MLF?		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends	AWRI roadshow workshop, Clare Valley, SA	22 Nov 16
	Sugar and estimating potential alcohol		

Staff	Title of presentation	Presented to and where	Date
G.D. Cowey	Filtration and impact on colour and wine quality	AWRI roadshow workshop, Clare Valley, SA	22 Nov 16
M. Essling	Entwine Australia sustainability data – your regional position		
	Smart tools to manage vineyard variation		
P.R. Petrie	Canopy management		
A.D. Coulter	Saturation temperature cold stability test		
	Sulfides and copper treatment		
	Flotation to clarify juice		
M.G. Holdstock	Optimising MLF and preventing spoilage		
T.E. Siebert	Black pepper flavour in Shiraz: does the clone have any influence?	DPI NSW Shiraz clonal workshop, Majura, ACT	24 Nov 16
		DPI NSW Shiraz clonal workshop, Hunter Valley, NSW	
S. Nordestgaard	The AWRI and the Australian wine sector	DLR Neustadt, Germany	25 Nov 16
	Wine movements and lees		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends	AWRI roadshow workshop, McLaren Vale, SA	29 Nov 16
	Brett monitoring – aroma, chemical, micro and molecular tests		
	Brett – new treatment options		
M.L. Longbottom	Entwine Australia sustainability data – your regional position		
M. Essling	Benchmarking spray programs – how chemicals are used in your region versus other regions		
	Smart tools to manage vineyard variation		
V.T. O'Brien	Building product premiums through creating emotive appeal		
M.G. Holdstock	Update on manganese, water additions and nutrition labelling		
	pH and TA – getting it right		
P.R. Petrie	Soil health – what is it and how can we manage it?	AWRI roadshow seminar, Mount Barker, WA	
	Organic vs conventional practices compared – what's stopping you from going organic?		
K.A. Bindon	How can I predict wine tannin and colour in the vineyard?	AWRI roadshow seminar, Pemberton, WA	30 Nov 16
	How to maximise the phenolic potential of grapes through innovative winemaking		
P.R. Petrie	Soil health – what is it and how can we manage it?		
	What can I do to protect my vineyard from climate change?		
	What are the strategies to better manage the risk of <i>Botrytis</i> bunch rot?		
K.A. Bindon	How can I predict wine tannin and colour in the vineyard?	AWRI roadshow seminar, Margaret River, WA	1 Dec 16
P.R. Petrie	Earlier, shorter, hotter? Is vintage compression really happening and what can you do about it?		
	Soil health – what is it and how can we manage it?		
C.A. Simos	Causes and management of slow and stuck fermentations		
I.L. Francis	Wine glycoconjugates as flavour precursors during consumption	Australasian Association for Chemosensory Science 17 <sup>th</sup> Annual Meeting, Sydney, NSW	2 Dec 16
P.R. Petrie	Organic vs conventional practices compared – what's stopping you from going organic?	AWRI roadshow seminar, Swan Valley, WA	
C.A. Simos	What are the causes of and management strategies for dealing with <i>Brettanomyces</i> ?		
	Causes and management of slow and stuck fermentations		



Staff	Title of presentation	Presented to and where	Date	
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking	AWRI roadshow seminar, Swan Valley, WA	2 Dec 16	
E.N. Wilkes	Can we get closure? Shining new light on the role of closures in wine faults	Wine Vision 2016, California, USA	5 Dec 16	
M.P. Krstic	New smoke taint research via R&D for profit program	Annual Wine Victoria DEWLP planned burn meeting, Melbourne, Vic	14 Dec 16	
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir	Pinot Noir winemaking trials tasting, Geelong, Vic	18 Jan 17	
G.D. Cowey	Overview of the AWRI's RDE&C capabilities	Wine Australia – visit by Jim Gore, Principal, WSET school, London and William Lowe, WSET spirits tutor, AWRI, Adelaide, SA	20 Jan 17	
P.O. Williamson	Linking the AWRI's wine flavour research with regionality			
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir	Pinot Noir winemaking trials tasting, Yarra Valley, Vic	23 Jan 17	
		Pinot Noir winemaking trials tasting, Mount Barker, WA		
M.P. Krstic	Vineyard mechanisation: move to the 'no touch vineyard' – Australian perspective	Unified Symposium, California, USA	24 Jan 17	
S.J. Nordestgaard	Grape sorting	Cabernet hang-time forum, Curtin University, Margaret River, WA	30 Jan 17	
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir	Pinot Noir winemaking trials tasting, Adelaide, SA		
		Pinot Noir winemaking trials tasting, Canberra, ACT		
		Pinot Noir winemaking trials tasting, Orange, NSW		
P.R. Dry	Sourcing planting material, import requirements	Alternative varieties Research to Practice workshop, Limestone Coast, SA		
	Red varietal description			
M.P. Krstic, M.J. Herderich	Smoke taint	Smoke taint Rural R&D for Profit update, Yarra Valley, Vic	7 Feb 17	
M.L. Longbottom	Soil health – what is it and how can we manage it?	AWRI roadshow seminar, Launceston, Tas		
	How to improve fruit set in cool climates			
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking			
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir			
P.W. Godden	Overview of the AWRI's RDE&C capabilities			Wine Australia – RDC Business Managers, AWRI, Adelaide, SA
	How regionality and environmental factors drive wine style			
C.J. Day	AWRI business functions			
M.L. Longbottom	Soil health – what is it and how can we manage it?			
	How to improve fruit set in cool climates			
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking			
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir			
M.P. Krstic	Mornington Peninsula Pinot Noir project – 2017 update	Mornington Peninsula Pinot Noir Celebration, Mornington Peninsula, Vic	10 Feb 17	
C.S. Stockley	Changing the upper limits of moderate alcohol consumption. The need for a worldwide politic on alcohol consumption	WineHealth 2017, Logroño, Spain	17 Feb 17	
	Round table innovation and future			
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir	Pinot Noir winemaking trials tasting, Adelaide, SA	21 Feb 17	
A.D. Coulter	Industry development and support overview	Visitors from the University of Yamanashi, Japan, AWRI, Adelaide, SA	28 Feb 17	
M. Essling	Viticulture in Australia			
S.A. Schmidt	Overview of AWRI bioscience research			

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P.J. Costello	Malolactic fermentation	Visitors from the University of Yamanashi, Japan, AWRI, Adelaide, SA	28 Feb 17
P.A. Smith	Opportunities for creating value in wine production		
T.E. Siebert	What influences 'black pepper' flavour in Shiraz?		
C.S. Stockley	Dimethylpolysiloxane as a processing aid in winemaking	OIV expert group meetings, Paris, France	30 Mar 17
W.P. Pearson	Benchmarking Australian Shiraz terroir	Wine Australia 50 world sommeliers event, Australian Shiraz regional tasting, Melbourne, Vic	3 Apr 17
C.S. Stockley	Sub-Commission on Methods of Analysis question to Commission I on phthalates – draft response	OIV expert group meeting, Paris, France	4 Apr 17
M.J. Herderich	Terroir effects on grape and wine aroma compounds	DLR Neustadt, Germany	7 Apr 17
E.N. Wilkes	Closures – latest understanding of their impact	AWRI webinar	20 Apr 17
M.J. Herderich	Old friends in new bottles: aroma precursors in grapes and wine and the complexities of wine flavour	Denis Dubourdieu Symposium, Hochschule Geisenheim, Germany	26 Apr 17
J.M. McRae	Wine science in every glass	South Australian Science Teachers Association Annual Conference, Adelaide, SA	27 Apr 17
C.A. Simos	<i>Brettanomyces</i> – causes and management strategies	AWRI roadshow seminar – Hunter Valley, NSW	3 May 17
P.R. Petrie	What can I do to protect my vineyard from climate change?		
E.N. Wilkes	Sulfur dioxide – what are we really measuring? Copper: the good, the bad and the ugly		
M.G. Holdstock	Industry outcomes of emissions reduction and carbon sequestration for resilience and sustainability in the grape and wine sector Wine faults and flavours	The Ag Climate Forum, Bunyah Mountains, QLD	10 May 17
C.A. Simos	Struck match and tropical fruit: the role of varietal thiols in Australian Chardonnay	AWRI roadshow winemaking seminar – Griffith, NSW	
M.Z. Bekker	The beneficial style and performance effects of oxygen addition during fermentation Copper: the good, the bad and the ugly		
S. Nordestgaard	Rapid extraction techniques for red wine production		
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking		
P.R. Petrie	What are the strategies to better manage the risk of <i>Botrytis</i> bunch rot? Scale and mealybug – what can I do to control these sap-sucking insects?		
K.A. Bindon	How can I predict wine tannin and colour in the vineyard?		
M.P. Krstic	Soil health – what is it and how can we manage it?	AWRI roadshow viticulture seminar – Irymple, Vic	11 May 17
P.R. Petrie	Canopy management		
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking	AWRI roadshow winemaking seminar – Irymple, Vic	
S. Nordestgaard	Rapid extraction techniques for red wine production		
M.Z. Bekker	Copper: the good, the bad and the ugly		
E.N. Wilkes	Winemaking education, common wine faults and their impacts	7 <sup>th</sup> APEC Wine Regulatory Forum, Hanoi, Vietnam	12 May 17
	2016-17 ring test results and comparison to international proficiency test results		
	Core elements of a strong laboratory quality management system		
	Presentation of the Methods of Analysis Compendium Naturally occurring components in wine, including metals, and regulatory limits that are imposed on such components		



Staff	Title of presentation	Presented to and where	Date
M.P. Krstic	Best practice approaches to assessing harvest time – grape maturity and pest and disease levels	AWRI roadshow viticulture seminar – Riverland, SA	12 May 17
	Soil health – what is it and how can we manage it?		
P.R. Petrie	Organic vs conventional practices compared – what's stopping you from going organic?	AWRI roadshow winemaking seminar – Riverland, SA	
S. Nordestgaard	Rapid extraction techniques for red wine production		
K.A. Bindon	How to maximise the phenolic potential of grapes through innovative winemaking		
M.Z. Bekker	Sulfur dioxide – what are we really measuring?		
T.J. Abbott	How to predict the performance of your ferments: using the new AWRI Ferment Simulator		
V.T. O'Brien	How to build demand and premiums paid for Riverland wine		
E.N. Wilkes	APEC Wine Regulatory Forum Report- laboratory capacity	6 <sup>th</sup> APEC Food Safety Cooperation Forum, Hanoi, Vietnam	13 May 17
M. Essling	Organic vs conventional practices compared – what's stopping you from going organic?	AWRI roadshow seminar – Langhorne Creek, SA	17 May 17
P.R. Petrie	Soil health – what is it and how can we manage it?		
C.A. Simos	Evaluation of winemaking treatments in Australian Pinot Noir	Pinot Noir winemaking trials tasting, Adelaide, SA	18 May 17
C.A. Simos	Introduction to the Advanced Wine Assessment Course	Advanced Wine Assessment Course (AWAC 42), AWRI, Adelaide, SA	29 May 17
W.P. Pearson	Flavour, taints, faults and thresholds		
P.W. Godden	Introduction to wine show judging		
I.L. Francis	Struck match and tropical fruit: the role of varietal thiols in Australian Chardonnay	NSW DPI Chardonnay seminar, Orange, NSW	31 May 17
R. Gawel	Palate performance and statistical evaluation	Advanced Wine Assessment Course (AWAC 42), AWRI, Adelaide, SA	1 Jun 17
C.A. Simos	Introduction to the Advanced Wine Assessment Course	Advanced Wine Assessment Course (AWAC 43), AWRI, Adelaide, SA	3 Jun 17
W.P. Pearson	Flavour, taints, faults and thresholds		
P.W. Godden	Introduction to wine show judging		
C.S. Stockley	National Health & Medical Research Council's alcohol drinking guidelines	Wine Victoria Board, Melbourne, Vic	6 Jun 17
	Alcohol and its effects on the human body	Treasury Wine Estates, Melbourne, Vic	
R. Gawel	Palate performance and statistical evaluation	Advanced Wine Assessment Course (AWAC 43), AWRI, Adelaide, SA	7 Jun 17
T.E. Siebert	Determination of the potent flavour compound rotundone in grapes and wine using MDGC-MS and membrane-assisted solvent extraction	Gerstel automated sample preparation & innovation throughout 50 years, Celebration Seminar Day, Singapore	
P.W. Godden	Tour of the AWRI and overview of RDE&C capabilities	Wine Australia – visit by George Gresty, AWRI, Adelaide, SA	13 Jun 17
D.L. Capone	Thiols and tropical flavour in Chardonnay, rosé wine flavour and green flavour in red wine.	E. & J. Gallo Winery National Meeting, Lodi, California, USA	
P.R. Petrie	Smart tools to manage vineyard variation	AWRI roadshow workshop – Barossa Valley, SA	14 Jun 17
	Yield regulation – cost-benefit and the impact on quality		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends		
	Brett monitoring – aroma, chemical, micro and molecular tests		
	Filtration and impact on colour and wine quality		
	Avoiding stuck fermentations		
M.G. Holdstock	Colour and tannin		
	Smoke taint analysis and interpretation		

Staff	Title of presentation	Presented to and where	Date		
M.G. Holdstock	Carboxymethylcellulose (CMC) tartrate inhibitor	AWRI roadshow workshop – Barossa Valley, SA	14 Jun 17		
A.D. Coulter	Avoiding stuck fermentations	AWRI roadshow workshop – Mornington Peninsula, Vic	20 Jun 17		
	Carboxymethylcellulose (CMC) tartrate inhibitor				
	Sulfides and copper treatment				
K.A. DeGaris	Yield regulation – cost-benefit and the impact on quality				
M.G. Holdstock	Colour and tannin				
	New <i>Brettanomyces</i> treatment				
	Optimising MLF and preventing spoilage				
M.P. Krstic	Benchmarking spray programs – how chemicals are used in your region versus other regions				
E.N. Wilkes	Review of laboratory workshops and 2017 ring test program			International Wine Technology Summit, Seattle, USA	21 Jun 17
	Best practice in total SO <sub>2</sub> measurement				
	Sugar free extract and the impact of sugar testing method				
M.G. Holdstock	Colour and tannin	AWRI roadshow workshop – Gippsland, Vic			
	pH and TA – getting it right				
	Oxygen use in winemaking				
K.A. DeGaris	Canopy management				
A.D. Coulter	Carboxymethylcellulose (CMC) tartrate inhibitor				
	Filtration and impact on colour and wine quality				
	Sulfides and copper treatment				
M.P. Krstic	Benchmarking spray programs – how chemicals are used in your region versus other regions				
A.D. Coulter	Filtration and impact on colour and wine quality			AWRI roadshow workshop – Yarra Valley, Vic	22 Jun 17
	Flotation to clarify juice				
	Sulfides and copper treatment				
M.G. Holdstock	pH and TA – getting it right				
	Optimising MLF and preventing spoilage				
	Oxygen use in winemaking				
M.P. Krstic	Stretching water further				
	Yield regulation – cost-benefit and the impact on quality				
S.A. Schmidt	The fight for dominance in grape juice and the genetics underpinning yeast strain performance	33 <sup>rd</sup> International Specialised Symposium on Yeast, Cork, Ireland	27 Jun 17		
M.Z. Bekker	The effects of oxygen on ‘reductive aroma’ compounds during fermentation, remediation, and post-bottling	New understandings in wine oxidation chemistry symposium, ASEV Annual Meeting, Bellevue, Washington, USA			
A.D. Coulter	Carboxymethylcellulose (CMC) tartrate inhibitor	AWRI roadshow workshop – Mt Barker, WA			
	Sulfides and copper treatment				
	Flotation to clarify juice				
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends				
	New <i>Brettanomyces</i> treatment				
	Oxygen use in winemaking				
	Sugar and estimating potential alcohol				
M. Essling	Benchmarking spray programs – how chemicals are used in your region versus other regions				
K.A. DeGaris	Yield regulation – cost-benefit and the impact on quality				
C.A. Varela	Extensive genomic diversity and its effect on sulfite tolerance in the industrial yeast <i>Brettanomyces bruxellensis</i>	33 <sup>rd</sup> International Specialised Symposium on Yeast, Cork, Ireland	28 Jun 17		
M.J. Herderich	Metabolomics tools and approaches for characterising flavours, phenolics and quality markers in grapes and wine	International Metabolomics Conference, Brisbane, QLD			



Staff	Title of presentation	Presented to and where	Date
V. Hysenaj	Targeted metabolomics to provide insights into the role of trace sulfur compounds in wine aroma and quality	International Metabolomics Conference, Brisbane, QLD	28 Jun 17
K.A. DeGaris	Canopy management	AWRI roadshow workshop – Pemberton, WA	
M. Essling	Yield regulation – cost-benefit and the impact on quality		
A.D. Coulter	Smoke taint		
	Carboxymethylcellulose (CMC) tartrate inhibitor		
	Removal/reduction of TCA/TBA, alcohol, VA, 4-EP and smoke taint compounds		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends		
	Sugar and estimating potential alcohol		
	Update on manganese, water additions and nutrition labelling		
	Filtration and impact on colour and wine quality		
M.P. Krstic	Seeing through the haze – insights into smoke taint management in wines		ASEV Annual Meeting, Bellevue, Washington, USA
M.Z. Bekker	Myths and facts about the role of precursors in the formation of 'reductive aromas' in wines post-bottling	Enology – Wine Aroma Session, ASEV Annual Meeting, Bellevue, Washington, USA	
M.P. Krstic	Outreach seminar – smoke taint	Smoke taint outreach seminar, ASEV Annual Meeting, Bellevue, Washington, USA	29 Jun 17
P.R. Petrie	A thermal camera-based smart phone application to measure vine water status	ASEV Annual Meeting, Bellevue, Washington, USA	
K.A. DeGaris	Yield regulation – cost-benefit and the impact on quality	AWRI roadshow workshop – Margaret River, WA	
M. Essling	Smart tools to manage vineyard variation		
A.D. Coulter	Analysis correlation with quality?		
	Colour and tannin		
	Removal/reduction of TCA/TBA, alcohol, VA, 4-EP and smoke taint compounds		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends		
	Brett monitoring – aroma, chemical, micro and molecular tests		
	Oxygen use in winemaking		
A.D. Coulter	Bulk wine transport	AWRI roadshow workshop – Swan Valley, WA	30 Jun 17
	Oxygen use in winemaking		
G.D. Cowey	Your regional position – helpdesk, climate and wine composition trends		
	Brett monitoring – aroma, chemical, micro and molecular tests		
	Sugar and estimating potential alcohol		
	Update on manganese, water additions and nutrition labelling		
	Filtration and impact on colour and wine quality		
M. Essling	Benchmarking spray programs – how chemicals are used in your region versus other regions		
K.A. DeGaris	Yield regulation – cost-benefit and the impact on quality		

# Events organised by AWRI staff

Staff	Title of event	Held	Date	
M.L. Longbottom	Opportunities in a new climate workshop	Langhorne Creek, SA	5 Jul 16	
P.O. Williamson	Consumer insights in China – Wo1	16 <sup>th</sup> Australian Wine Industry Technical Conference, Adelaide, SA	24 Jul 16	
S. Nordestgaard	New degrees of freedom: red winemaking with novel maceration technologies – Wo2			
P.R. Petrie	Vineyard management to adapt to climate change – Wo5			
J.R. Bellon, A.G. Cordente	Novel yeast for new wine styles – Wo6			
M.L. Longbottom	Entwine Australia: demonstrating the Australian wine industry's environmental performance – Wo9			
C.S. Stockley	A comprehensive review of the wine and health landscape – W11			
N. Scrimgeour, M.Z. Bekker, K.C. Hirlam	The impact of packaging on wine development and shelf life – W13			
D.L. Capone, I.L. Francis	Recent advances in flavour research: new understanding of key volatile compounds and their sensory significance – W17			
M.P. Day, M.E. Smith	Oxygen and sulfur: a breath of fresh air? – W19			
P.J. Costello	Malolactic fermentation: pushing the boundaries to improve strains, reliability and wine quality – W20			
V.T. O'Brien	Creating product premiums using luxury and design thinking business strategies – W22			
K.A. Bindon, P.A. Smith, I.L. Francis	Grape quality: objective measures and impacts on wine style – W26			
J.M. McRae, E.N. Wilkes	Wine clarity: managing hot and cold stability in white wines – W27			27 Jul 16
P.W. Godden	An exploration of Australian and Portuguese vintage and tawny fortified wines – W29			
T.E. Siebert, M.P. Krstic	Black pepper flavour in wines from around the world – W30			
S. Nordestgaard	Lees: minimising volumes and recovering better juice and wine – W37			
C.S. Stockley	The changing regulatory environment of Australian wine – W39			
G.D. Cowey	Wine faults, taints, flavours and thresholds workshop, Pernod Ricard Winemakers	Barossa Valley, SA	29 Jul 16	
D.L. Capone	Workshop on varietal thiols in wine	AWRI, Adelaide, SA	1 Aug 16	
C.A. Simos, V.F. Phillips, A. Loschiavo	Lean production workshop	Renmark, SA	9 Aug 16	
M.P. Krstic	Post-vintage 'work in progress' tasting and rootstock seminar	Yarra Valley, Vic	11 Aug 16	
J.M. McRae, E.N. Wilkes, J.L. Hixson, M.P. Day, M.Z. Bekker, T.E. Siebert, P.O. Williamson, E. Kristianto, C.S. Stockley, V.F. Phillips	'A big glass of wine science', National Science Week event	North Adelaide, SA	16 Aug 16	
M.L. Longbottom, M.G. Holdstock, V.F. Phillips	Sustainability and alternative energy options workshop	Padthaway, SA	5 Sep 16	
M.F. Calabrese, G.D. Cowey	Sommeliers Australia – staff training	Melbourne, Vic	12 Sep 16	
C.A. Simos, M.F. Calabrese, M.G. Holdstock, F. Blefari	Wine show judging – an insider's view of panel tastings	AWRI, Adelaide, SA	17 Sep 16	
M.F. Calabrese, M.G. Holdstock	Sommeliers Australia – staff training	Sydney, NSW	19 Sep 16	
V.T. O'Brien, G. Patacq, P.O. Williamson	Creating consumer value workshop	Barossa Valley, SA	22 Sep 16	

Staff	Title of event	Held	Date	
M.P. Krstic	Phylloxera workshop	Mornington Peninsula, Vic	4 Oct 16	
C.A. Simos, V.F. Phillips, M.P. Krstic, P.R. Petrie, E.N. Wilkes	AWRI roadshow seminar	Geelong, Vic	13 Oct 16	
A. Loschiavo, V.F. Phillips	Spray application workshop	Irymple, Vic	14 Oct 16	
V.T. O'Brien, G.A.P. Patacq	Design thinking workshop	Barossa Valley, SA	18 Oct 16	
A. Loschiavo, V.F. Phillips	Spray application workshop		19 Oct 16	
			McLaren Vale, SA	20 Oct 16
			Langhorne Creek, SA	21 Oct 16
A.M Barker	Aroma Bar	Wine Australia China Awards & Best of Australia Showcase, Shanghai, China	24 Oct 16	
C.A. Simos, F. Blefari, P.W. Godden, E.N. Wilkes, P.O. Williamson	Wine Australia – UK and EU media group visit	AWRI, Adelaide, SA	25 Oct 16	
A. Loschiavo, V.F. Phillips	Spray application workshop	King Valley, Vic		
		Mornington Peninsula, Vic		26 Oct 16
		Yarra Valley, Vic	27 Oct 16	
M.P. Krstic	Smoke taint Q&A	Milawa, Vic	29 Oct 16	
F. Blefari, C.A. Simos, G.D. Cowey, M.F. Calabrese, M.G. Holdstock, V.F. Phillips	Advanced Wine Assessment Course (AWAC 40)	AWRI, Adelaide, SA	31 Oct – 3 Nov 16	
C.A. Simos, F. Blefari	Wine Australia – Heads of market visit		1 Nov 16	
C.A. Simos, F. Blefari, P.W. Godden, M.F. Calabrese	Wine Australia – WSET visit		7 Nov 16	
F. Blefari, C.A. Simos, G.D. Cowey, M.F. Calabrese, M.G. Holdstock, V.F. Phillips	Advanced Wine Assessment Course (AWAC 41)		7-10 Nov 16	
V.T. O'Brien, G.A.P. Patacq	Luxury business strategy workshop		Adelaide, SA	14 and 23 Nov 16
V.F. Phillips, C.A. Simos, P.R. Petrie, M. Essling, P.J. Costello, I.L. Francis	AWRI roadshow seminar	Mornington Peninsula, Vic	15 Nov 16	
V.F. Phillips, C.A. Simos, P.R. Petrie, I.L. Francis, P.J. Costello		Gippsland, Vic		
V.T. O'Brien, G.A.P. Patacq	Luxury business strategy workshop	Barossa Valley, SA	16 Nov 16	
V.F. Phillips, C.A. Simos, P.R. Petrie, I.L. Francis, P.J. Costello	AWRI roadshow seminar	Yarra Valley, Vic		
V.T. O'Brien, G.A.P. Patacq	Luxury business strategy workshop	Adelaide, SA	18 and 24 Nov 16	
V.T. O'Brien, G.A.P. Patacq	Ideation workshop to build product premiums	Barossa Valley, SA	21 Nov 16	
G.D. Cowey, V.F. Phillips, M. Essling, P.R. Petrie, A.D. Coulter, M.G. Holdstock	AWRI roadshow workshop	Clare Valley, SA	22 Nov 16	
V.F. Phillips, C.A. Simos, P.R. Petrie, K.A. Bindon	AWRI roadshow seminar	Mount Barker, WA	29 Nov 16	
G.D. Cowey, V.F. Phillips, M.L. Longbottom, M. Essling, M.G. Holdstock, V.T. O'Brien	AWRI roadshow workshop	McLaren Vale, SA		
V.F. Phillips, C.A. Simos, P.R. Petrie, K.A. Bindon	AWRI roadshow seminar	Pemberton, WA		30 Nov 16
		Margaret River, WA	1 Dec 16	
		Swan Valley, WA	2 Dec 16	
V.T. O'Brien, G.A.P. Patacq	Product and service innovation workshop	Barossa Valley, SA	13 Dec 16	
M.P. Krstic	Annual Wine Victoria DEWLP planned burn meeting	Melbourne, Vic	14 Dec 16	
M.P. Krstic, C.A. Simos	Smoke taint Q&A	Coal River Valley, Tas	16 Jan 17	
		Swansea, Tas		

Staff	Title of event	Held	Date
M.P. Krstic, C.A. Simos	Smoke taint Q&A	Tamar Valley, Tas	17 Jan 17
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trials tasting	Geelong, Vic	18 Jan 17
		Yarra Valley, Vic	20 Jan 17
C.A. Simos, F. Blefari, G.D. Cowey, P.O. Williamson	Wine Australia visit – Jim Gore, Principal, WSET school, London and William Lowe, WSET spirits tutor	AWRI, Adelaide, SA	
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trials tasting	Mount Barker, WA	23 Jan 17
		AWRI, Adelaide, SA	30 Jan 17
		Canberra, ACT	2 Feb 17
M.L. Longbottom, V.F. Phillips, P.R. Dry	Alternative varieties Research to Practice workshop	Limestone Coast, SA	3 Feb 17
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trials tasting	Orange, NSW	
C.A. Simos, V.F. Phillips, M.L. Longbottom, K.A. Bindon	AWRI roadshow seminar	Launceston, Tas	7 Feb 17
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trial tasting		
C.A. Simos, V.F. Phillips, M.L. Longbottom, K.A. Bindon	AWRI roadshow seminar	Hobart, Tas	8 Feb 17
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trial tasting		
C.A. Simos, F. Blefari, P.W. Godden, C.J. Day, P.O. Williamson	Wine Australia visit – RDC Business Managers	AWRI, Adelaide, SA	
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trials tasting		21 Feb 17
W.P. Pearson, I.L. Francis	Wine Australia 50 world sommeliers event, Australian Shiraz regional tasting	Melbourne, Vic	3 Apr 17
M.P. Krstic	Yarra Valley soils masterclass	Yarra Valley, Vic	20-21 Apr 17
M.P. Krstic, V.F. Phillips	Victorian trunk disease and Chardonnay and Shiraz clonal tasting workshop	Mornington Peninsula, Vic	2 May 17
		Yarra Valley, Vic	
		King Valley, Vic	3 May 17
C.A. Simos, V.F. Phillips, P.R. Petrie, E.N. Wilkes	AWRI roadshow seminar	Hunter Valley, NSW	
M.P. Krstic, V.F. Phillips	Victorian trunk disease and Chardonnay and Shiraz clonal tasting workshop	Great Western, Vic	4 May 17
C.A. Simos, V.F. Phillips, P.R. Petrie, K.A. Bindon	AWRI roadshow viticulture seminar	Griffith, NSW	10 May 17
C.A. Simos, V.F. Phillips, S. Nordestgaard, M.Z. Bekker, K.A. Bindon	AWRI roadshow winemaking seminar		
C.A. Simos, V.F. Phillips, M.P. Krstic, P.R. Petrie	AWRI roadshow viticulture seminar	Irymple, Vic	11 May 17
C.A. Simos, V.F. Phillips, K.A. Bindon, M.Z. Bekker, S. Nordestgaard	AWRI roadshow winemaking seminar		
C.A. Simos, V.F. Phillips, M.P. Krstic, K.A. Bindon, P.R. Petrie,	AWRI roadshow viticulture seminar	Riverland, SA	12 May 17
C.A. Simos, V.F. Phillips, K.A. Bindon, S. Nordestgaard, M.Z. Bekker, T.J. Abbott, V.T. O'Brien	AWRI roadshow winemaking seminar		
C.A. Simos, V.F. Phillips, P.W. Godden, P.R. Petrie, M. Essling	AWRI roadshow seminar	Langhorne Creek, SA	17 May 17
C.A. Simos, V.F. Phillips	Pinot Noir winemaking trials tasting	University of Adelaide, Adelaide, SA	18 May 17
C.A. Simos, V.F. Phillips, A. Loschiavo	Lean production workshop	McLaren Vale, SA	23 May 17
I.L. Francis, D. Espinase-Nandorfy, V.T. O'Brien	Wine sensory experience	Inventure Partners, Adelaide, SA	26 May 17
C.A. Simos, F. Blefari, M.F. Calabrese, G.D. Cowey, M.G. Holdstock, V.F. Phillips, A.M. Barker, W.P. Pearson, P.W. Godden, R. Gawel	Advanced Wine Assessment Course (AWAC 42)	AWRI, Adelaide, SA	29 May – 1 Jun 17



Staff	Title of event	Held	Date
C.A. Simos, F. Blefari, M.F. Calabrese, G.D. Cowey, M.G. Holdstock, V.F. Phillips, A.M. Barker, W.P. Pearson, P.W. Godden, R. Gawel	Advanced Wine Assessment Course (AWAC 43)	AWRI, Adelaide, SA	3-6 Jun 17
C.A. Simos, M.F. Calabrese, F. Blefari, M.G. Holdstock	Wine show judging – an insider's view of panel tastings		7 Jun 17
G.D. Cowey, V.F. Phillips, P.R. Petrie, M.G. Holdstock	AWRI roadshow workshop	Barossa Valley, SA	14 Jun 17
G.D. Cowey, V.F. Phillips, M.P. Krstic, K.A. DeGaris, M.G. Holdstock, A.D. Coulter		Mornington Peninsula, Vic	20 Jun 17
		Gippsland, Vic	21 Jun 17
		Yarra Valley, Vic	22 Jun 17
G.D. Cowey, V.F. Phillips, M. Essling, K.A. DeGaris, A.D. Coulter		Mount Barker, WA	27 Jun 17
		Pemberton, WA	28 Jun 17
		Margaret River, WA	29 Jun 17
		Swan Valley, WA	30 Jun 17

## APPENDIX 3

### Posters

Staff	Title of poster	Presented at	Date
A. Mierczynska-Vasilev, J.M. McRae, A. Schulkin, P.A. Smith	A novel technology for the rapid, selective, magnetic removal of pathogenesis-related proteins from wines	16 <sup>th</sup> Australian Wine Industry Technical Conference, Adelaide, SA	24-28 Jul 16
J.M. McRae, N.I. Warnock <sup>1</sup> , S.A. Schmidt, P. Anderson <sup>1</sup> , P.A. Smith	Preventing white wine haze with <i>Botrytis cinerea</i> enzyme, BcAP8, addition and grape juice pasteurisation		
J.M. McRae, A. Mierczynska-Vasilev, A. Soden <sup>2</sup> , M.P. Day, P.A. Smith	Assessment of industrial-scale serial filtration on red wine macromolecules		
R. Gawel, A. Schulkin, W.P. Pearson, P.A. Smith	Murky winemaking: the effect of juice solids on the composition and taste/texture of white wine		
N. Scrimgeour, T.J. Abbott	Evaluating the viability of process sensor technologies for measurement of sugar levels during fermentation		
C.A. Varela, A. Contreras <sup>3</sup> , C. Hidalgo <sup>4</sup> , F. Sengler <sup>5</sup> , S.A. Schmidt, P.A. Henschke, P.J. Chambers, C.D. Curtin	Using non-conventional yeast for the production of reduced alcohol wines		
F. Tondini <sup>6</sup> , A. Hranilovic <sup>6</sup> , P. Grbin <sup>7</sup> , M.J. Herderich, T. Van der Westhuizen <sup>8</sup> , V. Jiranek <sup>6,7</sup>	Dealing with indigenous wine fermentation: wild yeast behaviour		
A.R. Borneman, A.H. Forgan, R. Kolouchova, J.A. Fraser <sup>9</sup> , S.A. Schmidt	Wine yeast genetic variation: fishing from a small and shallow gene pool		
C.A. Varela, A. Caudy <sup>10</sup> , M. Constanzo <sup>10</sup> , C. Boone <sup>10</sup>	Chemical-genetic interactions in a wine yeast deletion library		
P.R. Sternes, A.R. Borneman, P.J. Costello, P.J. Chambers, E.J. Bartowsky	Genetic diversity of <i>Oenococcus oeni</i> reveals the industrial implications of strains used in malolactic fermentation		
P.R. Sternes, D. Lee, D.R. Kutyna, A.R. Borneman	Wild wine: metagenomic analysis of microbial communities during wild fermentation		
A. Garcia Cordente, J.R. Bellon, C.E. Bartel, M.R. Solomon, P.R. Sternes, C.D. Curtin	Generation of non-genetically modified wine yeast strains that overproduce 'rose' aroma compounds 2-phenylethanol and 2-phenylethylacetate		

Staff	Title of poster	Presented at	Date
S.A. Schmidt, R. Kolouchova, A.H. Forgan, A.R. Borneman, P.A. Henschke, P.J. Chambers	Survival of the fittest: the fight between yeast for dominance in grape juice	16 <sup>th</sup> Australian Wine Industry Technical Conference, Adelaide, SA	24-28 Jul 16
J.R. Bellon, P.J. Chambers, F. Yang <sup>11</sup> , D.L. Inglis <sup>11</sup> , C.D. Curtin	Breeding new life into the ancient art of winemaking		
S.A. Schmidt, M.P. Day, R. Kolouchova, P.A. Smith	Winemaking in the air: the use and timing of oxygen during fermentation		
C. Bartel, J.R. Bellon, A.R. Borneman, A. Garcia Cordente, S.A. Schmidt, M.R. Solomon, D.L. Capone, C.A. Varela, C.D. Curtin	Comprehensive flavour profiling of <i>Saccharomyces cerevisiae</i> wine strains		
S. Dillon, E.J. Bartowsky	The AWRI Wine Microorganism Culture Collection: one-stop-shop for wine culture provision, identification and storage		
P.J. Costello, E.J. Bartowsky, P.J. Chambers	High-throughput phenotypic profiling of malolactic bacteria		
O. Geffroy <sup>12</sup> , O. Yobrégat <sup>12</sup> , T. Dufourcq <sup>12</sup> , T.E. Siebert, E. Serrano <sup>12</sup>	Certified clone and powdery mildew impact rotundone in Duras wines		
O. Geffroy <sup>12</sup> , T.E. Siebert, A. Silvano <sup>13</sup> , M.J. Herderich	Do different winemaking techniques and pressing conditions impact rotundone levels in red wine?		
D.L. Capone, A.M. Barker, P.O. Williamson, I.L. Francis	Tropical fruit flavour in Chardonnay wines		
M.Z. Bekker, A. Mierczynska-Vasilev, P.A. Smith, E.N. Wilkes	Relationship between wine pH, copper treatment, and 'reductive' aroma formation in wines post-bottling		
S. Reschke, T.M.T. Tran, M.Z. Bekker, E.N. Wilkes	Effective use of copper during winemaking		
T.E. Siebert, N. Zibi <sup>14</sup> , S.R. Barter, I.L. Francis, M.J. Herderich	Does light exposure in the vineyard affect the pepper flavour of Australian cool climate Shiraz?		
T.E. Siebert, W.P. Pearson, A.M. Barker, M.A. de Barros Lopes <sup>15</sup> , P. Darriet <sup>16</sup> , M.J. Herderich, I.L. Francis	Volatile aroma compounds related to 'stone fruit' aroma in Viognier and Chardonnay wines		
M. Parker, A.M. Barker, C.A. Black, W.P. Pearson, M.J. Herderich, I.L. Francis	In-mouth flavour release from non-volatile grape-derived precursors		
J.L. Hixson, M.A. Sefton <sup>7</sup> , C.D. Curtin, D. Taylor <sup>7</sup>	Novel precursors to <i>Brettanomyces</i> -derived off-flavour		
L. van der Hulst <sup>7</sup> , C.M. Ford <sup>7</sup> , R.A. Burton <sup>17</sup> , N.D.R. Lloyd, K.L. Wilkinson <sup>7</sup>	Potential for kaolin application to grapevines to mitigate smoke taint		
O.J. Schelezki <sup>6,7</sup> , K.A. Bindon, P.A. Smith, P.K. Boss <sup>18</sup> , D.W. Jeffery <sup>6,7</sup>	Optimisation of an early harvest regime – impact on grape and wine composition and quality		
M.P. Krstic, C.A. Black, Y. Grebneva <sup>19</sup> , K. Vollmer <sup>20</sup> , N. Glameyer <sup>21</sup> , M.R. Solomon, P.R. Petrie <sup>22</sup> , M. Stolf <sup>5</sup> , M.J. Herderich	The effects of exposure on TDN and precursors in South Australian Riesling		
W.P. Pearson, D.L. Capone, A.M. Barker, P.O. Williamson, I.L. Francis	Defining green flavour in Cabernet Sauvignon wines		
M.E. Smith, P.A. Smith, E.N. Wilkes	Impact of the timing of copper additions on the prevention of reductive aromas in wine		
D.L. Capone, A.M. Barker, W.P. Pearson, I.L. Francis	Compounds influencing the aroma differences of Shiraz wine with additions of grape leaves or stalks		
M.E. Smith, P.A. Smith, E.N. Wilkes	How does binding or removing metal ions in wine affect the volatile sulfur compounds?		
K.C. Hirlam, J.L. Hixson, E.N. Wilkes	Extending the 'shelf life' of a winery waste product		
J.L. Hixson, E.N. Wilkes, V.T. O'Brien	Mapping the potential applications for wine industry wastes		
P.O. Williamson, L. Lockshin <sup>23</sup> , I.L. Francis, S. Mueller Loose <sup>5,23</sup>	Can information about Australia affect Chinese consumers' wine choice?		
T. Pitt <sup>22</sup> , P. Nicholas <sup>24</sup> , R.M. Cirami <sup>24</sup> , M.G. McCarthy <sup>22</sup> , P.R. Petrie <sup>22</sup>	Rootstock effects on yield, maturity and the incidence of bunch stem necrosis in Cabernet Sauvignon		

Staff	Title of poster	Presented at	Date
M. Woods <sup>25</sup> , M.A. Whitty <sup>26</sup> , S. Cossell <sup>26</sup> , S. Liu <sup>26</sup> , J. Tang <sup>26</sup> , P.R. Petrie <sup>22</sup> , G.M. Dunn <sup>25</sup> , A. Davidson <sup>2</sup> , C. Wotton <sup>2</sup> , J. Jarrett <sup>27</sup>	An initial investigation into harvest efficiency	16 <sup>th</sup> Australian Wine Industry Technical Conference, Adelaide, SA	24-28 Jul 16
T. Pitt <sup>22</sup> , M.A. Skewes <sup>22</sup> , P. Nicholas <sup>24</sup> , R. Stevens <sup>2</sup> , M.G. McCarthy <sup>22</sup> , P.R. Petrie <sup>22</sup>	Does rootstock performance change with age?		
L.M. Bevin, M.L. Downie, A.D. Lord	eResources for the Australian grape and wine industry		
M. Hill <sup>28</sup> , G.D. Cowey	Communicating research results to industry		
S. Nordestgaard	Equipment evolution: destemming		
	Equipment evolution: sorting		
	Equipment evolution: crushing		
	Equipment evolution: pressing (batch)		
	Equipment evolution: pressing (continuous)		
	Equipment evolution: heating for rapid skin extraction in red wine production		
M.A. Skewes <sup>22</sup> , M.A. Whitty <sup>26</sup> , S. Liu <sup>26</sup> , P.R. Petrie <sup>22</sup>	Using smart phones to measure vine water status		
J. Tang <sup>26</sup> , A. Davidson <sup>2</sup> , P.R. Petrie <sup>22</sup> , M.A. Whitty <sup>26</sup>	Non-productive canopy detection from aerial imagery		
K.A. Bindon, S. Kassara, J.L. Hixson, P.A. Smith	A cap for red wine macromolecules? Defining limits for tannin and polysaccharide extraction during maceration		
A. Carew <sup>29</sup> , F.L. Kerslake <sup>29</sup> , K.A. Bindon, P.A. Smith, R.G. Damberg <sup>30</sup> , D. Close <sup>29</sup>	Innovative maceration for fine, fast Pinot Noir wines		
A. Carew <sup>29</sup> , K.A. Bindon, P.A. Smith, D. Close <sup>29</sup>	Can enzyme 'replace' cold soaking for more efficient cool climate Cabernet Sauvignon production?		
T.J. Abbott	The environmental footprint of Australian wine		
M. Bonada <sup>22</sup> , D.W. Jeffery <sup>7</sup> , P.R. Petrie <sup>22</sup> , M.A. Moran <sup>22</sup> , V.O. Sadras <sup>22</sup>	Warming and water deficit effects on Shiraz grapes and wines		
M. Bonada <sup>22</sup> , P.R. Petrie <sup>22</sup> , E. Edwards <sup>18</sup> , M.G. McCarthy <sup>22</sup>	Assessing the impact of winter drought on vine balance and root activity		
P.R. Petrie <sup>22</sup> , C.A. Black, M.P. Krstic, M.J. Herderich	Evaluating methods for measuring fruit exposure		
M.L. Longbottom	Entwine Australia: supporting a sustainable grape and wine community		
	Greenhouse gas abatement in viticulture		
M.P. Day, S.A. Schmidt, R. Kolouchova, M. Parker, D.L. Capone, W.P. Pearson, P.A. Smith	Making wine out of thin air: inert-pressing white grapes gives greater wine style diversity		
N. Scrimgeour, E.N. Wilkes, M.Z. Bekker	The formation and fate of volatile sulfur compounds in wine during bottle ageing		
N. Scrimgeour, K.C. Hirlam, E.N. Wilkes	Using cross-linked polymers to scavenge metals and extend shelf life of wine		
M.P. Day, E.N. Wilkes	Determination of Australian geographic indication by strontium isotope and selected trace element analysis		
N. Scrimgeour, E.N. Wilkes, A. Moreau <sup>31</sup>	Survey of elemental profile of white juice samples in Australia and New Zealand		
L. Macdonald <sup>32</sup> , P. Lye <sup>32</sup> , P.A. Smith, E.N. Wilkes	Investigating copper(II) complex formation with organic acids in aqueous and ethanolic solutions		
M.Z. Bekker, A. Mierczynska-Vasilev, P.A. Smith, E.N. Wilkes	Effects of pH and H <sub>2</sub> S on copper-tartrate particles in model wine systems		
K.A. Pinchbeck, B. Newell, E.N. Wilkes	Breaking down titratable acidity		
K.A. Pinchbeck, R.L. Taylor, E.N. Wilkes	Agrochemical residue analysis in wine marc		
J.L. Hixson, P.A. Smith	Towards better use of waste: unravelling the composition of grape marc		
J.L. Hixson, E.N. Wilkes	Agrochemical residue survey of Australian grape marc		

Staff	Title of poster	Presented at	Date
Y. Hayasaka, C.A. Black, J.C. Hack, P.A. Smith	Identification of reaction products of caftaric acid and bisulfite present in a commercial wine	16 <sup>th</sup> Australian Wine Industry Technical Conference, Adelaide, SA	24-28 Jul 16
J.A. Culbert <sup>7</sup> , J.M. McRae, L.M. Schmidtke <sup>33</sup> , E.L. Nicholson <sup>18</sup> , P.K. Boss <sup>18</sup> , P.A. Smith, K.L. Wilkinson <sup>7</sup>	Compositional variation amongst Australian sparkling white wines		
S. Li <sup>6,7</sup> , K.A. Bindon, S.E.P. Bastian <sup>6,7</sup> , V. Jiraneck <sup>6,7</sup> , K.L. Wilkinson <sup>6,7</sup>	Selective use of winemaking supplements to modulate sensory properties in wine		
S. Li <sup>6,7</sup> , K.A. Bindon, K.L. Wilkinson <sup>6,7</sup>	A study of commercial tannin and mannoprotein products and their use in low-alcohol wine production		
K.A. Bindon, A. Schulkin, R.G. Damberg <sup>30</sup> , M.R. Solomon, S. Barter, D.L. Capone, S. Kassara, W.U. Cynkar, I.L. Francis, P.A. Smith	Objective measures of grape quality		
K.A. Bindon, N. Scrimgeour, R.G. Damberg <sup>30</sup> , S. Kassara, E.M.C. Robinson, W.U. Cynkar, E.N. Wilkes, P.A. Smith	Unravelling the relationship between grape extractability and wine composition		
M.Z. Bekker, M.P. Day, P.A. Smith, E.N. Wilkes	The impacts of oxidative winemaking practices on metal concentrations in a Chardonnay wine		
N.D.R. Lloyd, V. Hysenaj, E. Kristianto, M.J. Herderich	Targeting known and unknown amines in grape and wine		
Y. Hayasaka, A.D. Coulter, G.A. Baldock	Contamination of wine from a warehouse environment: a case study		
T.M.T. Tran, A.R. Rinaldo, C.D. Curtin, E.N. Wilkes	Validation of a rapid <i>Brettanomyces bruxellensis</i> detection test for wine: Veriflow® vinoBRETT		
M. Avramova <sup>16</sup> , A. Cibrario <sup>16</sup> , F. Salin <sup>34</sup> , M. Coton <sup>35</sup> , E. Coton <sup>35</sup> , W. Albertin <sup>16,36</sup> , C.D. Curtin, I. Masneuf-Pomarède <sup>16,37</sup>	Diversity of the species <i>Brettanomyces bruxellensis</i> : genotypic and phenotypic study		
Y. Hayasaka, G.A. Baldock	Development of a novel method for the analysis of wine phthalates		
K.C. Hirlam, N. Scrimgeour, E.N. Wilkes	Impacts of entrained oxygen in cork-based closures on sparkling wines		
M. Parker, A.M. Barker, C.A. Black, W.P. Pearson, M.J. Herderich, I.L. Francis	Individual variability of in-mouth flavour release from non-volatile grape-derived precursors using time intensity		
W.P. Pearson, A.M. Barker, D.L. Capone, P.O. Williamson, I.L. Francis	Defining 'green' flavour in Cabernet Sauvignon wines using projective mapping and descriptive analysis		
M.J. Roach, S.A. Schmidt, A.R. Borneman	Curating the FALCON-Unzip Chardonnay <i>de novo</i> genome assembly	BioinfoSummer 2016, Adelaide, SA	1 Dec 16
N.D.R. Lloyd, J. Fernandes, F.A. Macrae <sup>38</sup> , V. Bird <sup>38</sup> , C.S. Stockley, M.J. Herderich	Wine, Health and Metabolomics: Consumption of dealcoholized wine with resveratrol changes the human plasma metabolite profile	International Metabolomics Conference, Brisbane, QLD	26-29 Jun 17
L. Nicolotti, J.C. Hack, N.D.R. Lloyd, M.J. Herderich	MStractor: An R Based Workflow for LC-MS and GC-MS Data Mining		
E. Kristianto, L. Nicolotti, N.D.R. Lloyd, M.J. Herderich	Volatile metabolite screen for beer and wine using large volume headspace GCMS analysis		
P.R. Petrie	Vintage advancement and compression in Australia due to climate change	ASEV conference, Bellevue, Washington, USA	28 Jun 17

Affiliations: <sup>1</sup>Flinders University, <sup>2</sup>Treasury Wine Estates, <sup>3</sup>Pontificia Universidad Católica de Chile, Santiago, Chile, <sup>4</sup>Instituto de Investigaciones Agropecuarias, Santiago, Chile, <sup>5</sup>Hochschule Geisenheim University, Germany, <sup>6</sup>ARC Training Centre for Innovative Wine Production, <sup>7</sup>University of Adelaide, <sup>8</sup>Laffort Australia Pty Ltd, <sup>9</sup>University of Queensland, <sup>10</sup>The Donnelly Centre, University of Toronto, Canada, <sup>11</sup>Cool Climate Oenology and Viticulture Institute, Brock University, Canada, <sup>12</sup>IFV Sud-ouest, France, <sup>13</sup>Lallemand SAS, France, <sup>14</sup>University of Erlangen-Nuremberg (FAU), Germany, <sup>15</sup>University of South Australia, <sup>16</sup>University of Bordeaux, Villenave d'Ornon, France, <sup>17</sup>ARC Centre of Excellence in Plant Cell Walls, <sup>18</sup>CSIRO <sup>19</sup>Technische Universität Dresden, Germany, <sup>20</sup>University of Hohenheim, Stuttgart, Germany, <sup>21</sup>Rheinsche Friedrich-Wilhelms-Universität Bonn, Germany, <sup>22</sup>South Australian Research and Development Institute, <sup>23</sup>Ehrenberg-Bass Institute for Marketing Science, University of South Australia, <sup>24</sup>Formerly South Australian Research and Development Institute, <sup>25</sup>NSW Department of Primary Industries, <sup>26</sup>UNSW, <sup>27</sup>See Saw Wine, Orange, NSW, <sup>28</sup>Victorian Department of Economic Development, Jobs, Transport and Resources, <sup>29</sup>Tasmanian Institute of Agriculture, <sup>30</sup>Wine TQ Consulting, <sup>31</sup>Sofralab, Magenta, France, <sup>32</sup>University of New England, <sup>33</sup>Charles Sturt University, <sup>34</sup>INRA, UMR Biodiversité Gènes et Ecosystèmes, Plateforme Génomique, Cestas, France, <sup>35</sup>Université de Brest, Laboratoire Universitaire de Biodiversité et Ecologie Microbienne, ESIAB, Technopôle Brest-Iroise, Plouzané, France, <sup>36</sup>ENSCBP, Bordeaux INP, Pessac, France, <sup>37</sup>Bordeaux Sciences Agro, Cradignan, France, <sup>38</sup>Royal Melbourne Hospital.

## Student supervision responsibilities of AWRI staff

Student	Supervisors	Source of funds
<b>PhD</b>		
Liang Chen	D.L. Capone, D.W. Jeffery <sup>1</sup>	Joint Scholarship from the University of Adelaide and China Scholarship Council and a supplementary scholarship from Wine Australia.
Jenny Bellon	P.J. Chambers, A.R. Borneman, C.M. Ford <sup>1</sup>	Wine Australia
Lisa Hartmann	A.R. Borneman, S.A. Schmidt	University of Adelaide and Wine Australia
Ryan Zeppel	A.R. Borneman, C.D. Curtin, J. Kelly <sup>1</sup>	
Sijing Li	K.A. Bindon, K.L. Wilkinson <sup>1</sup>	Australian Research Council Industrial Transformation Training Centre, University of Adelaide
Federico Tondini	V. Jiranek <sup>1</sup> , M.J. Herderich	
Olaf Schelezki	P.A. Smith, D.W. Jeffery <sup>1</sup>	
Tracey Siebert	I.L. Francis, M.J. Herderich, M.A. de Barros Lopes <sup>2</sup>	Wine Australia and University of South Australia, Australian Government Research Training Program Scholarship
Mango Parker	I.L. Francis, M.J. Herderich, J. Hixson, M.A. de Barros Lopes <sup>2</sup>	
Wes Pearson	I.L. Francis, J. Blackman <sup>3</sup> , L. Schmidtke <sup>3</sup>	Wine Australia
Patricia Williamson	I.L. Francis, S. Mueller-Loose <sup>2,4</sup> , L. Lockshin <sup>2</sup>	
Gail Gnoinski	S.A. Schmidt, D. Close <sup>5</sup> , F.L. Kerslake <sup>5</sup>	University of Tasmania
Yevgeniya Grebneva	M.J. Herderich, J. Hixson, M. Stoll <sup>4</sup> , D. Rauhut <sup>4</sup>	HS Geisenheim and the AWRI
Stipe Zekanovic	S.A. Schmidt, I. Dawes <sup>6</sup> , G. Perrone <sup>7</sup>	Wine Australia/Western Sydney University
Madeleine Way	R.G. Damberg, J. Jones <sup>5</sup> , N. Swarts <sup>5</sup>	Westpac Future Leaders scholarship
Julie Tang	P.R. Petrie, M.A. Whitty <sup>6</sup> , N.A. Lee <sup>6</sup>	UNSW and Wine Australia
Joana Fernandes	N.D.R. Lloyd, A.C. Gomes <sup>8</sup> , G. Moura <sup>9</sup>	Fundação para a Ciência e Tecnologia, Portugal
<b>Masters</b>		
Fangzhou Chen	K.A. Bindon, C.M. Ford <sup>1</sup>	University of Adelaide

Affiliations: <sup>1</sup>University of Adelaide, <sup>2</sup>University of South Australia, <sup>3</sup>Charles Sturt University, <sup>4</sup>Hochschule Geisenheim University, Germany, <sup>5</sup>University of Tasmania, <sup>6</sup>UNSW, <sup>7</sup>Western Sydney University, <sup>8</sup>Biocant, Portugal, <sup>9</sup>University of Aveiro, Portugal.

## APPENDIX 5

# Teaching responsibilities (lectures) of AWRI staff

Institution	Subject number	Subject name	No. of lectures	Staff member
Flinders University	MMED8205	Brain and behaviour – perspectives on alcohol and drug use	1	C.S. Stockley
University of Adelaide	3520WT/7520WT	Advances in wine science	3	E.J. Bartowsky
	3046WT/7046WT	Fermentation technology	2	I.L. Francis
	3005WT	Grape industry practice, policy and communication	1	C.S. Stockley
			1	P.A. Smith
			1	C.A. Simos
	7520WT	Advances in wine science	1	C.A. Simos
	7047WT/3047WT	Winemaking at vintage	1	M.P. Day, P.A. Smith
	3007WT/7010WT	Stabilisation and clarification	1	J.M. McRae
			3	A.D. Coulter
3500WT	Biotechnology in the food and wine industries	4	S.A. Schmidt	
	Grape industry practice, policy and communication III	1	N.D.R. Lloyd	
2500WT	Animal and plant biochemistry II	1	C.A. Varela	
University of Melbourne	UNIB10009	Food for a healthy planet	1	C.S. Stockley

## APPENDIX 6

# Media interviews

Date	Staff member	Discussed	Media
20 Jul 16	C.S. Stockley	Anthocyanins in wine and other commonly consumed foods	Tony Love, <i>The Advertiser</i>
25 Jul 16	D.L. Johnson	16 <sup>th</sup> Australian Wine Industry Technical Conference	<i>ABC Rural Country Hour</i>
	P.R. Petrie	Managing early harvest and vintage compression	Claire Peddie, <i>The Advertiser</i> Lauren Waldhuter, <i>ABC News</i>
26 Jul 16	M.P. Day	Wine authenticity	Gian de Poloni, <i>ABC South West</i>
	M.L. Longbottom	Entwine	Cassie Hough, <i>ABC SA Country Hour</i>
27 Jul 16	M. Parker	In-mouth flavour release from non-volatile grape-derived precursors	Nick Carne, <i>Wine Australia RD&amp;E News</i>
	A.R. Borneman	Shipwreck yeast	Claire Peddie, <i>The Advertiser</i>
28 Jul 16	W.P. Pearson	Sensory and wine	Dr Jamie Goode, <i>Wine Business International</i>
8 Aug 16	P.R. Petrie	Top ten early-season vineyard tips	Nick Carne, <i>Wine Australia RD&amp;E News</i>
11 Aug 16	J.M. McRae	Wine science research and national science week event	Brett Williamson, <i>ABC Radio Adelaide</i>
12 Aug 16	C.A. Simos	Organic wine	Tom Nancarrow, <i>ABC Riverland</i>
29 Aug 16	P.J. Chambers, A.R. Borneman	Metagenomics and the implications of research in this field to the understanding of terroir	Nick Carne, <i>Wine Australia RD&amp;E News</i>
	M.P. Krstic	Region in focus: Greater Victoria	

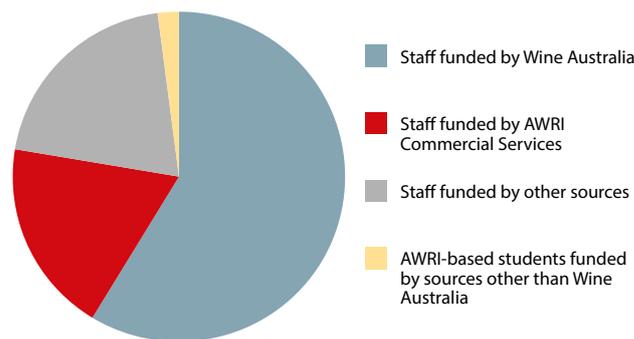
Date	Staff member	Discussed	Media
30 Aug 16	P.R. Petrie	Vintage compression and earlier harvests	Mike Cherney, <i>Wall Street Journal</i>
8 Sep 16	C.A. Simos	Wine flavour and pepper character in Shiraz	Miyuki Katori, <i>Winart</i> , Tokyo
		Rotundone and Australian Shiraz	Hiro Yoshino, <i>WANDS</i> , Tokyo
21 Sep 16	M. Essling	The 'Dog book'	Nick Carne, <i>Wine Australia RD&amp;E News</i>
27 Sep 16	P.R. Petrie	Yield prediction	Rosemary Ryan, <i>NAB Agribusiness View</i>
26 Oct 16	I.L. Francis	Volatile flavour compounds	Nick Carne, <i>Wine Australia RD&amp;E News</i>
27 Oct 16	G.D. Cowey	Research at the AWRI	Press conference, Wine Australia China Awards & Best of Australia Showcase, China
4 Nov 16	W.P. Pearson	Len Evans Tutorial	<i>Wine TV</i>
17 Nov 16	S.A. Schmidt	Chardonnay genome	Rebecca Puddy, <i>The Australian</i>
22 Nov 16	C.A. Simos	Smoke taint	John Power, <i>Munchies website</i>
29 Nov 16	M.Z. Bekker	ASVO winning article	Nick Carne, <i>Wine Australia RD&amp;E News</i>
30 Nov 16	D.L. Johnson	Profile for InDaily	Andrew Spence, <i>The Lead South Australia</i>
1 Dec 16	V.T. O'Brien	VALO	Nathan Gogoll, <i>Australian &amp; New Zealand Grapegrower &amp; Winemaker</i>
12 Dec 16	D.L. Capone	The effects of grape leaves and stems in ferments	Nick Carne, <i>Wine Australia RD&amp;E News</i>
	A.G. Cordente	Rose aroma yeast	
13 Dec 16	T.J. Abbott	Ferment simulator	Nick Carne, <i>Wine Australia RD&amp;E@work</i>
	D.L. Johnson	AWITC – plans for 2019	Nathan Gogoll, <i>Australian &amp; New Zealand Grapegrower &amp; Winemaker</i>
17 Jan 17	M.P. Krstic, C.A. Simos	Smoke taint and the sensory impact on wine	Sally Davies, <i>ABC Country Hour</i> , Tas
23 Feb 17	J.M. McRae	Bentonite fining and the proposed new heat test	Nick Carne, <i>Wine Australia RD&amp;E@work</i>
28 Feb 17	P.A. Smith	Adding water to must	Nick Carne, <i>Wine Australia RD&amp;E News</i>
	N.D.R. Lloyd	Science and Innovation Award	
10 Apr 17	S. Nordestgaard	Lees removal project	Nick Carne, <i>Wine Australia R&amp;D@work</i>
	W.P. Pearson	Researcher profile	
13 Apr 17	D.L. Johnson	Wine research at the AWRI	Robyn Williams, <i>ABC Science</i>
19 Apr 17	A.H. Forgan	The AWRI wine microorganism culture collection	Nick Carne, <i>Wine Australia RD&amp;E News</i>
	M. Essling	Sooty mould	
	D.L. Johnson	Synthetic biology, raspberry ketone project	
21 Apr 17	P.A. Smith	'Cutting edge' research in South Australia	Catherine Miller, <i>Stock Journal</i>
2 May 17	D.L. Johnson	Genome Project-Write	Ryan Cross, <i>Science</i>
5 May 17	E.N. Wilkes	Closures	Camellia Aebischer, <i>Australian &amp; New Zealand Grapegrower &amp; Winemaker</i>
8 May 17	M.L. Longbottom	Climate change impacts on viticulture	James Mitchell Crow, <i>Cosmos Magazine</i>
23 May 17	M.P. Krstic	New role as Business Development Manager at the AWRI	Nathan Gogoll, <i>Australian &amp; New Zealand Grapegrower &amp; Winemaker</i>
24 May 17	G.D. Cowey	Tips for stabilisation	Nick Carne, <i>Wine Australia RD&amp;E News</i>

# Papers published by AWRI staff recorded during 2016/2017

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- 1840** Sadras, P., Moran, M., Petrie, P. Delayed pruning: a tool to counteract warming effects. Barossa Shiraz vineyard and wine case study. *Aust. N.Z. Grapegrower Winemaker* (630): 48, 50-51; 2016.
- 1841** Bramley, R.G.V., Siebert, T.E., Herderich, M.J., Krstic, M.P. Patterns of within-vineyard spatial variation in the 'pepper' compound rotundone are temporally stable from year to year. *Aust. J. Grape Wine Res.* 23(1): 42-47; 2017.
- 1842** Sadras, V.O., Moran, M.A., Petrie, P.R. Wine as G x E: effect of temperature on vine and fruit phenotype. [Le vin comme G x E: effets de la température sur la vigne et le raisin.] *Prog. Agric. Vitic.* 133(5): 14-19; 2016.
- 1843** Cowey, G. Ask the AWRI: Not so pretty in pink. *Aust. N.Z. Grapegrower Winemaker* (631): p. 86; 2016.
- 1844** Luo, X., Smith, P., Raston, C.L., Zhang, W. Vortex fluidic device-intensified aqueous two phase extraction of C-Phycocyanin from *Spirulina maxima*. *ACS Sustainable Chem. Eng.* 4(7): 3905-3911; 2016.
- 1845** Muhlack, R.A., O'Neill, B.K., Waters, E.J., Colby, C.B. Optimal conditions for controlling haze-forming wine protein with bentonite treatment: investigation of matrix effects and interactions using a factorial design. *Food Bioprocess Technol.* 9(6): 936-943; 2016.
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- 1848** Hixson, J.L., Jacobs, J.L., Wilkes, E.N., Smith, P.A. A survey of the variation in grape marc condensed tannin composition and concentration, and analysis of key compositional factors. *J. Agric. Food Chem.* 64(38): 7076-7086; 2016.
- 1849** Bindon, K. A., Li, S., Kassara, S., Smith, P.A. The retention of proanthocyanidin in wine-like solution is conferred by a dynamic interaction between soluble and insoluble grape cell wall components. *J. Agric. Food Chem.* 64(44): 8406-8419; 2016.
- 1850** Bekker, M.Z., Smith, M.E., Smith, P.A., Wilkes, E.N. Formation of hydrogen sulfide in wine: interactions between copper and sulfur dioxide. *Molecules* 21(1214): 1-17; 2016.
- 1851** Mierczynska-Vasilev, A., Smith, P. A. Surface modification influencing adsorption of red wine constituents: The role of functional groups. *Appl. Surf. Sci.* 386: 14-23; 2016.
- 1852** Christo, S. N., Bachhuka, A., Diener, K. R., Mierczynska, A., Hayball, J. D., Vasilev, K. The role of surface nanotopography and chemistry on primary neutrophil and macrophage cellular responses. *Adv. Healthcare Mater.* 5(8): 956-965; 2016.
- 1853** Ramiasa-MacGregor, M., Mierczynska, A., Sedev, R., Vasilev, K. Tuning and predicting the wetting of nanoengineered material surface. *Nanoscale* 8(8): 4635-4642; 2016.
- 1854** Mierczynski, P., Mierczynska, A., Maniukiewicz, W., Maniecki, T. P., Vasilev, K. MWCNTs as a catalyst in oxy-steam reforming of methanol. *RSC Adv.* 6(84): 81408-81413; 2016.
- 1855** Mierczynski, P., Vasilev, K., Mierczynska, A., Ciesielski, R., Maniukiewicz, W., Rogowski, J., Szykowska, I. M., Trifonov, A. Y., Dubkov, S. V., Gromov, D., Maniecki, T. P. The effect of gold on modern bimetallic Au-Cu/MWCNT catalysts for oxy-steam reforming of methanol. *Catal. Sci. Technol.* 6(12): 4168-4183; 2016.
- 1856** Delalat, B., Mierczynska, A., Ghaemi, S. R., Vasilev, K., Voelcker, N.H. Materials displaying neural growth factor gradients and applications in neural differentiation of embryoid body cells. *Adv. Funct. Mater.* 25(18): 2737-2744; 2015.
- 1857** Ramiasa, M. N., Cavallaro, A. A., Mierczynska, A., Hayball, J. D., Vasilev, K. Plasma polymerised polyoxazoline thin films for biomedical applications. *Chem. Comm.* 51(20): 4279-4282; 2015.
- 1858** Zenoni, S., Fasoli, M., Guzzo, F., Dal Santo, S., Amato, A., Anesi, A., Commisso, M., Herderich, M., Ceoldo, S., Avesani, L., Pezzotti, M., Battista Tornielli, G. Disclosing the molecular basis of the post-harvest life of berry in different grapevine genotypes. *Plant Physiol.* 172(3): 1821-1843; 2016.
- 1859** Longbottom, M. ASVO prepares for November Awards night following 'one of the best conferences ever'. *Wine Vitic. J.* 31(5): p. 10; 2016.
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- 1861** Dry, P. Fiano. *Wine Vitic. J.* 31(5): p. 59; 2016.
- 1862** Holdstock, M. Ask the AWRI: Calcium and its predictable presence. *Aust. N.Z. Grapegrower Winemaker* (632): 68-69; 2016.
- 1863** Coulter, A., Cowey, G., Petrie, P., Essling, M., Holdstock, M., Stockley, C., Simos, C., Johnson, D. Vintage 2016 – observations from the AWRI helpdesk. *Wine Vitic. J.* 31(4): 43-45; 2016.
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- 1866** Geffroy, O., Siebert, T., Silvano, A., Herderich, M. Impact of winemaking techniques on classical enological parameters and rotundone in red wine at the laboratory scale. *Am. J. Enol. Vitic.* 68(1): 141-146; 2016.
- 1867** Dry, P. Kerner. *Wine Vitic. J.* 31(4): p. 59; 2016.
- 1868** Essling, M. Ask the AWRI: Re-entry periods after vineyard sprays. *Aust. N.Z. Grapegrower Winemaker* (633): p. 54; 2016.
- 1869** Caravia, L., Collins, C., Petrie, P.R., Tyerman, S.D. Application of shade treatments during Shiraz berry ripening to reduce the impact of high temperature. *Aust. J. Grape Wine Res.* 22(3): 422-437; 2016.
- 1870** Phogat, V., Skewes, M.A., McCarthy, M.G., Cox, J.W., Šimůnek, J., Petrie, P.R. Evaluation of crop coefficients, water productivity, and water balance components for wine grapes irrigated at different deficit levels by a sub-surface drip. *Agr. Water Manag.* 180(Part A): 22-34; 2017.
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- 1872** Varela, C. The impact of non-*Saccharomyces* yeasts in the production of alcoholic beverages. *Appl. Microbiol. Biotechnol.* 100(23): 9861-9874; 2016.
- 1873** Varela, C., Borneman, A.R. Yeasts found in wineries and vineyards. *Yeast* 34(3): 111-128; 2017.
- 1874** Hixson, J.L., Hayasaka, Y., Curtin, C.D., Sefton, M.A., Taylor, D.K. Hydroxycinnamoyl glucose and tartrate esters and their role in the formation of ethylphenols in wine. *J. Agric. Food Chem.* 64(49): 9401-9411; 2016.
- 1875** Kontoudakis, N., Smith, M., Guo, A., Smith, P.A., Scollary, G.R., Wilkes, E.N., Clark, A.C. The impact of wine components on fractionation of Cu and Fe in model wine systems: Macromolecules, phenolic and sulfur compounds. *Food Res. Int.* 98: 95-102; 2017.
- 1876** Stockley, C. Ask the AWRI: Wine consumption and brain health. *Aust. N.Z. Grapegrower Winemaker* (634): p. 82; 2016.
- 1877** Taylor, A.W., Shi, Z., Dal Grande, E., Stockley, C. The relationship between alcohol consumption and other risk factors assessed using an ongoing population-based surveillance system. *AIMS Public Health* 3(4): 985-1002; 2016.
- 1878** Longbottom, M. ASVO acknowledges industry excellence and exemplary contributions. *Wine Vitic. J.* 31(6): 10-11; 2016.
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- 1882** Pardo-Garcia, A.I., Wilkinson, K.L., Culbert, J.A., Lloyd, N.D.R., Alonso, G.L., Salinas, M.R. Accumulation of guaiacol glyconjugates in fruit, leaves and shoots of *Vitis vinifera* cv. Monastrell following foliar applications of guaiacol or oak extract to grapevines. *Food Chem.* 217: 782-789; 2017.
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**Figure 12.** Funding of AWRI staff and students, excluding visiting researchers and visiting students

# Staff of The Australian Wine Research Institute

- |                           |                                   |                          |                     |
|---------------------------|-----------------------------------|--------------------------|---------------------|
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| 2. Matthew Wheal          | 27. Gayle Baldock                 | 51. Ella Robinson        | 76. Dimitra Capone  |
| 3. Eleanor Bilogrevic     | 28. Marize Bekker                 | 52. Paul Henschke        | 77. Kylee Watson    |
| 4. Jelena Jovanovic       | 29. Stella Kassara                | 53. Jesse Hall           | 78. Leigh Francis   |
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| 8. Adrian Coulter         | 33. Naitoya Lloyd                 | 57. Ross Kolouch         | 82. Adam Holland    |
| 9. Kerry Pinchbeck        | 34. Leanne Hoxey                  | 58. Gurinder Khera       | 83. Darek Kutyra    |
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| 19. Pauline Jorgenson     | 44. Chris Day                     | 68. Yoji Hayasaka        | 93. Anne Lord       |
| 20. Natalie Burgan        | 45. Laura Bey                     | 69. Shiralee Dodd        | 94. Carrie Hill     |
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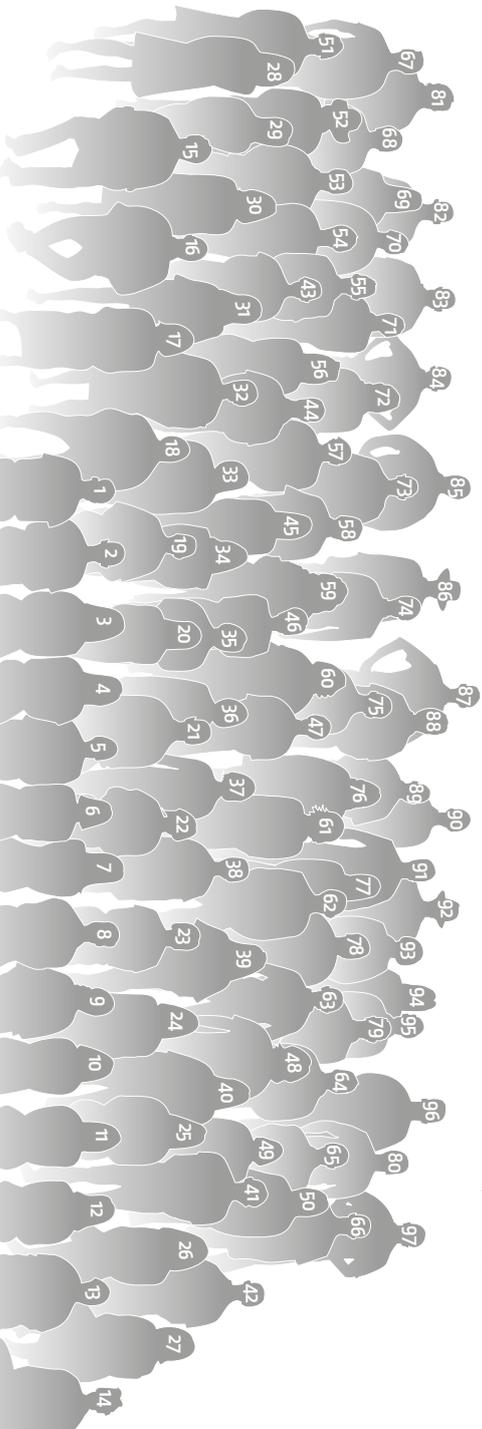
## Absent:

- |                |             |                  |                    |         |                   |            |              |              |                 |                |              |             |                     |                   |                 |                          |               |           |           |             |               |                   |                 |                  |             |
|----------------|-------------|------------------|--------------------|---------|-------------------|------------|--------------|--------------|-----------------|----------------|--------------|-------------|---------------------|-------------------|-----------------|--------------------------|---------------|-----------|-----------|-------------|---------------|-------------------|-----------------|------------------|-------------|
| Mark Braybrook | Kate Beames | Anthony Borneman | Catherine Borneman | Deborah | Thornton-Wakeford | Paul Smith | Keren Bindon | Bob Dambergs | Cristian Varela | Peter Costello | Jacqui McRae | Wes Pearson | Patricia Williamson | Yevgenia Grebneva | Caroline Bartel | Damian Espinase Nandorfy | June Robinson | Con Simos | Peter Dry | Paul Petrie | John Glechill | Francesca Biefari | Maria Calabrese | Jacinta McAskill | Ryan Zeppel |
|----------------|-------------|------------------|--------------------|---------|-------------------|------------|--------------|--------------|-----------------|----------------|--------------|-------------|---------------------|-------------------|-----------------|--------------------------|---------------|-----------|-----------|-------------|---------------|-------------------|-----------------|------------------|-------------|



**Cover story:** The 'key bottle' cover image reflects the important role played by metals in unlocking the provenance of wine. Recent research at the AWRI has shown that analysis of selected isotope ratios and trace metal concentrations, together with other measures, can be used to demonstrate the country of origin of a wine. This work is currently being expanded, with the aim of developing analytical tools to understand and communicate the provenance of Australian wine.

**Cover art:** Concept by Geoffrey Reed Communications, Designer/Illustrator Phil Easson, Art Director Geoffrey Reed. The artist behind the key bottle, Michael Moerkerk (MOERKEY), from Horsham Victoria, used over 60 re-purposed keys to hand craft this bottle sculpture. Each key is individually curved and silver soldered together, then polished to a high lustre.







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