WINE TASMANIA
PROPOSAL INTO IMPROVING VINEYARD PRODUCTIVITY

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Project Title: Improving the Productivity of Tasmanian Vineyards.

Project Aim: To support targeted growth of the Tasmanian wine sector to 1.5M cases by 2020, by developing grower decision support tools to better manage fruitfulness for stabilised and / or increased vineyard yields, whilst maintaining or building wine quality.

Background
The Tasmanian wine sector is an important and growing contributor to trade and the economy, regional employment, tourism and the overall Tasmanian brand. The Tasmanian wine region is regarded as one of the strongest in the country, with demand outstripping supply and attracting some of the highest prices for wine grapes and bottled wine.

The sector directly employs 1,400 full time equivalent positions throughout the island’s regions and attracted 210,000 visitors to its cellar doors in 2015, 18% of all visitors.

Over the past five years, the Tasmanian vineyard area has grown by more than 25% - almost 500 hectares, with more planting occurring in 2016/17. This has included expansion by existing wine producers, who are continuing to experience high demand for their premium quality wines, and has also included significant external investments in Tasmania’s wine sector. In addition to the significant increase in vineyard plantings, expansion by existing wine producers and new investors has included new processing facilities (winery), packaging / bottling, cellar door, restaurant and tourism infrastructure.
The Opportunity
The strong interest in and performance of the Tasmanian wine sector is expected to increase, supporting growth in wine sales, expansion of existing wine businesses, investment by new entrants and resultant employment increases. Wine Tasmania is supportive of and proactive in encouraging growth, with initiatives to support growth outlined in its Strategic Plan and including partnership with the Tasmanian Government on relevant initiatives.

In its Strategic Plan, updated in March 2015, Wine Tasmania articulated the opportunity to triple the availability of Tasmanian wine over the next five years from 500,000 cases (dozen) to 1.5M cases (dozen) annually, pursuing a market-led strategy combined with increasing vineyard area and stabilising yields.

Supporting Agricultural & Tourism Growth
The targeted growth is aligned with the AgriVision 2050 strategy, delivering practical on-the-ground applications to align research with the sector’s needs and contribute towards improvements in on-farm productivity, sustainable farming practices and reduced costs. It also supports the targeted growth in agricultural value ten-fold to $10 billion per year by 2050.

Growth in the Tasmanian wine sector also supports the recently-released T21 Strategy. Wine is an integral part of the visitor economy and visitor experience, and a key motivation for visitation to Tasmania. More than 210,000 people visited our cellar doors in 2015, representing 18% of all visitors and an increase of 20% on the previous year. Of the 160 licensed wine producers, more than 100 producers sell only within Tasmania and are therefore reliant on the tourism market and direct sales to customers through cellar door and events.

As outlined in Wine Tasmania’s Strategic Plan, all promotional activities - including those on the Australian mainland and in export markets - are focused on driving visitation to Tasmania.

Tourism Tasmania research shows that 56% of the people who have been to Tasmania, or are considering travelling to Tasmania in the next 12 months, believe that the state is known for its great food and beverage offerings. A further 41% indicated that Tasmania was a destination they would travel to specifically for its food and beverage offering (just behind Victoria). This was particularly evident in the 25 to 39 year age group. The survey has revealed that when talking about Tasmania’s food and beverage offering, the state’s seafood, cheese and wine were top of mind.

The Challenge
One of the identified obstacles to securing this targeted growth relates to productivity and dramatic wine grape yield variability year by year. The productivity and yield variability challenge is much greater for cool climate wine growing areas, due to a limited post-harvest period for vine reserve replenishment, challenges with optimising fruit set and lower temperatures resulting in a slower development and ripening.

Whilst vineyard area has steadily grown over the past two decades, from 318 hectares to over 1,800 hectares, the volume of wine produced has greatly varied year by year. In fact, the low 2014 vintage (6,624 tonnes) was just three times larger than the 1995 vintage (2,154 tonnes), despite there being more than five times the vineyard area.

Over the past five years, the average yield from Tasmanian vineyards has been 5.45 tonnes per hectare. The highest yields were from the record 2013 vintage, averaging 7.5 tonnes per hectare,
and there have been very positive comments regarding quality from this vintage. The lowest yields in the last 10 years were 3.74 tonnes per hectare in 2009.

There is currently, however, very limited ability to accurately predict fruitfulness, often leading to unnecessary pruning of cane bud numbers, crop (bunch) thinning and winemaking inefficiencies. There is also limited scientific information on exactly how yields impact on quality at differing levels in cool climates, by variety and by varying conditions. Given this, growers tend to take conservative approaches - for example, targeting a rule of thumb for a set yield per hectare, rather than an annual measurement of vine balance (vegetative growth measured by pruning weights generating a hypothetical carrying capacity) set against seasonal forecasts for weather. This obviously impacts on profitability, as there are very few practical ways for wine producers to tailor and reduce vineyard management costs based on anticipated yields.

**Solutions**

1. Do as they do in old world cool climate areas (e.g. Burgundy) - set a minimum price to protect profitability (set by the French Government), and put the price up when yields are low and quality is high or put the price down when yields are high and / or quality is low (noting, this has taken several centuries to implement!)
2. Investigate ways to reliably achieve higher yields of premium quality wine grapes in our cool climate - continue to build the overall value of the Tasmanian wine sector, in line with growth in production

It is Wine Tasmania’s belief, supported by consultation with wine producers and based on technical input and the previous experience of the Tasmanian Institute of Agriculture (TIA), that viticultural practices and improved yield prediction can play a major role in increasing quality and yields.

*If improvements in yields and yield stability cannot be achieved, the Tasmanian wine sector will continue to struggle with productivity and profitability. We will also struggle to realise the significant global opportunity and existing interest in the profile, sales and visitation associated with the Tasmanian wine sector.*

*If improvements in yields and yield stability can be achieved, Wine Tasmania is confident the target of trebling Tasmanian wine production by 2020 will be realised, and possibility exceeded. Not only will productivity improvements assist and encourage existing producers to improve and increase their vineyard yields, it will also assist attraction of new investors. It will support the global profile of the Tasmanian wine sector and build wine-related visitation.*

There are two important considerations to be noted in the context of stabilising and improving yields:

1. The need for a market-led strategy to ensure demand remains ahead of supply, as this is critical to ensure that growth is not only productive but profitable.
2. The important relationship between yield and quality, and the need for an evidence-based approach to stabilising and increasing yields in line with maintaining and building wine quality.

**Wine Sector Support**

Wine Tasmania is the peak body representing Tasmania’s grape growers and winemakers, with a focus on promoting Tasmania as a benchmark wine region of world renown. Wine Tasmania represents more than 98% of Tasmanian wine production, through voluntary membership, with 95 state-wide producer members and 50 associated member businesses.
All activities undertaken by the industry body are designed to generate value for our members, in line with Wine Tasmania’s Strategic Plan, which is available at [www.winetasmania.com.au](http://www.winetasmania.com.au). As appropriate for an agricultural sector, Wine Tasmania and its producers maintain a clear and proactive focus on a clear, long term, market-led, collaborative strategy. Wine Tasmania’s Strategic Plan is developed on behalf of members and in close consultation with wine producers.

Wine Tasmania’s active Technical Committee, comprising broad representation from viticulturists, winemakers, researchers and educators, provides specialist input on topics relating to production and technical issues, research priorities, extension activities and initiatives to support best practice viticulture and oenology.

At its annual planning session in January 2015, the Wine Tasmania Board recommended undertaking specific research into optimum yields and the relationship between yields and quality as a priority activity. This was based on input from the Technical Committee and from individual wine producers. Wine Tasmania also undertook a formal survey of producers on its priority activities recommended through this planning session, including the yield research, and received positive support from respondents. There have been numerous discussions with wine producers at workshops, individual vineyard visits and conferences. It has the broad support of Tasmanian wine operators, which is why it is being progressed by Wine Tasmania.

More than 15 individual wine producers have already indicated their interest in participating in the proposed research, and it is expected there will be interest from more, once the specific program details are communicated. Each of the participating producers will take an active role in the research, providing a significant investment in supporting, conducting trials and reporting findings to TIA and wine colleagues.

Many of these producers have previously participated in research trials and regularly conduct their own onsite trials. They have appropriate qualifications, experience and reporting mechanisms to be integrated into research programs. A recent example is the three-year research in 2008-2012 into improving cool climate sparkling and Pinot Noir. This project was funded by a Tasmanian-based consortium and AusIndustry’s Industry Cooperative Innovation Program (ICIP), with Consortium members including Wine Tasmania, TIA, the Australian Wine Research Institute, Tamar Ridge and wine sector suppliers. Wine producer contributors were Frogmore Creek Wines, Meadowbank Estate, Moorilla, Tolpuddle Vineyard, Pooley Wines, Jansz Tasmania, Josef Chromy Wines, Winemaking Tasmania and Clover Hill. Subsequent to this project, Brown Brothers and TIA have continued collaboration with a project investigating ‘factors that underpin the certainty of yield and quality for cool climate viticulture’ which forms the basis of many of the research questions proposed here.

**Practical Application**

With such a diversity of vineyard sites around Tasmania, including variation in rainfall volume and timing, temperature, humidity, soil type, access to water and disease pressure, research is only practical where it is undertaken across a variety of sites around the island, and has much greater rigour when conducted over a number of vintages to take into account seasonal variability. Not only will this develop a depth of findings, it will also ensure the research is practical, applied and adopted.

Research at a single site or across a small sample size will struggle to have relevance to the broader wine sector, which is different to some agricultural sectors.
It is expected that this integrated model of research, development, extension and practical adoption will be of relevance and interest to other sectors. This will be proactively communicated and discussed with complementary sectors and organisations, such as Fruit Growers Tasmania and the Tasmanian Farmers and Graziers Association.

Wine Tasmania has a dedicated development and extension resource, an active Technical Committee and an effective and supported program of workshops, field days, one-on-one visits and extension, and comprehensive two-way communication with wine producers. Extension will not wait until after the research has been undertaken, it will be an integrated part of the research project from the commencement.

The topic of yield stabilisation is frequently discussed at Wine Tasmania’s workshops and events. It has been confirmed as the topic of the 2016 Wine Tasmania Technical Field Day in September.

In order to ensure relevance, the research project will focus on the following key wine grapes of high relevance to wine producers, representing 64% of total wine production (2015):

- Pinot Noir - table = 2,255 tonnes (23%)
- Pinot Noir - sparkling = 1,600 tonnes (16%)
- Chardonnay - sparkling = 1,464 tonnes (15%)
- Sauvignon Blanc = 996 tonnes (10%)

Extension activities associated with the yield research will include the following:

- Wine Tasmania Ferment event, June
- Wine Tasmania Annual Technical Field Day, September / October - dedicated focus in 2016 and at conclusion of research
- Wine Tasmania regular workshops, including vineyard walks, demonstration of techniques, findings and practical tools, and benchmark tastings including trial wines
- Wine Tasmania’s Harvest newsletter - monthly updates
- Fact sheets, posters and support tools - provided at workshops, broader agricultural events such as Agfest and on the publically-available section of the Wine Tasmania and TIA websites
- Individual vineyard visits and discussions
- Integration with the Tasmanian Sustainable Winegrowing program
- Articles in wine sector publications, including the Grapegrower & Winemaker and Wine Business Monthly
- Broader media communication, including Tasmanian Country and ABC Country Hour
- Publication of detailed research findings, directly distributed to Tasmanian wine producers and included in peer-reviewed publications
- Articulation and promotion of the RD&E model utilised for this project, to assist translation to other agricultural sectors.

**Can Yields Be Stabilised / Improved?**

Climate, particularly the weather at the time of bunch initiation and fruit set, is a significant contributor to quality and yields and there will be some aspects that are unable to be completely controlled. However, preliminary research (see below) has indicated that viticultural practices and improved yield prediction can also play a major role in effecting quality and yields, and this will be the focus of the research.
Most of the recent but limited research into cool climate, high quality vineyard yields has been undertaken by TIA. For this reason, Wine Tasmania has approached TIA, in particular Drs Joanna Jones and Fiona Kerslake, to develop a detailed research proposal on improving vineyard productivity.

TIA has the required knowledge, experience, complementary research projects and interaction with the wine sector to support and maximise practical outcomes of this project, in conjunction with Wine Tasmania. Complementary projects previously or currently undertaken by TIA will benefit the yield research by providing additional insights and historical data to support the project’s findings.

Wine Tasmania has a demonstrated track record in managing research projects, such as the ICIP AusIndustry project, ensuring they are outcomes-focused and aligned with the sector’s Strategic Plan, engaging individual wine producers, and disseminating and facilitating practical adoption of research.

Wine Tasmania, in association with TIA, has developed four research, development and extension themes as a result of findings from previous and current research:

1. Building a greater understanding of the weather conditions, through local weather stations, and the influence on yield in Tasmania to enable prediction of fruitfulness.
2. Nitrogen and irrigation of vines pre- and post-harvest, through winter and into early spring to maximise productivity. This will include trials of nutrient and water status and cane selection.
3. Making best-practice pruning decisions based on improved knowledge of pruning style. This will include large scale trials of both hand and mechanised pruning, with detailed analysis of the resulting bud fruitfulness and wine quality.
4. Industry awareness, development and extension plan for practice change relating to understanding and application arising from the work in Themes 1-3.

Viticultural research at TIA over the past ten years has highlighted the potential impact of vineyard management practices and climate during the critical reproductive phases of bunch initiation and differentiation on the resulting yield and quality. Dr Jones’ early research at TIA highlighted the importance of sunlight and rain-free days during bunch formation and Dr Kerslake’s early research showed that weather events had a greater role in determining wine quality than viticultural practices within a season. More recently the two researchers combined to work on a project investigating sparkling wine viticulture under the successful Wine Tasmania-led consortium project supported by AusIndustry in 2008-2012.

It was found that climate, combined with viticultural practices including leaf removal, crop load management and pruning method contributed to act as drivers of base wine quality. This team approach gave local industry increased opportunity to be involved in trials due to the northern and southern location of the research trials and gave more local relevance to results produced.

As control of weather conditions is not possible, management of vines in response to these conditions is the principal method of yield regulation in cool climates for optimal wine quality. A relationship between weather conditions around flowering (December) in the 1st year, and yields in the 2nd year has also been found (Kerslake et al 2015).

The primary approach to stabilising yield in Tasmania is to monitor and achieve a balance between the vegetative and reproductive growth of the vine, which is best achieved through informed pruning. Informed pruning will require more reliable yield prediction, for which Dr Jones and
colleagues have just received funding from Wine Australia for a proof of concept, non-destructive and in situ bud scanning method (see further details in the section ‘Leveraging Existing and Recent Investment’ below). This method could potentially replace the skill-requiring and expensive method of bud dissection.

Once a reliable measure of bud fruitfulness has been obtained, vines must be suitably managed to maximise the productivity of the buds by maintaining adequate vine nutrient and water status through winter and the early spring growth stages (Jones et al 2009). The current proposal will build on this project by establishing nutrient and irrigation treatments with the aim of stabilising yield across seasons. Some of the methodology is the same, allowing for comparison across studies and thus value adding to the data set. Preliminary work by University of Tasmania Honours students over the past two years has established that nutrient application in vineyards could well be contributing to the lack of yield consistency. These findings were recently disseminated to Tasmanian producers through state-wide workshops.

An additional decision which faces growers is the choice around timing of pruning, and the style of pruning, either cane or spur pruning. This decision is further complicated by the introduction of mechanical cane and spur pruners to the state. Under cane pruning systems, knowledge about cane selection is also vital (Jones et al 2013). Results from the ICIP project showed that Chardonnay and Pinot Noir hand spur pruned vines had more even canopies with a larger number of smaller bunches but very few fruit quality differences were observed. Assessment of the base wines indicated significant sensory differences between the pruning systems, magnified in Chardonnay. A proposal is currently under review by Wine Australia to taste these wines after five years of aging on lees with an expert industry panel and to subject the wines to highly rigorous chemical analyses in conjunction with the Australian Wine Research Institute and the University of Adelaide. As well as analysis for known compounds, the research team is also hoping to identify new compounds which impact upon sparkling wine quality.

The focus for the proposed project is to improve understanding around the impact of weather conditions (utilising local weather stations) and vineyard management practices on bud fruitfulness, and possible tools for minimising the fluctuations between annual yields with the goal of stabilising yield. The proposed trials in the current project will build on the findings of the ICIP project, the Brown Brothers / TIA project and the new Wine Australia yield prediction project (see details below), thus value adding on previous investment and delivering industry-ready recommendations to Tasmanian growers.

Further details on the specific project methodology and processes are included in Attachment 1.

**Outputs and Outcomes**
The Project will deliver on the following outputs and outcomes:

**Outputs:**
- Peer-reviewed literature publications relating to 1) weather and fruitfulness 2) management of vines over winter and 3) pruning practice
- Information on the factors affecting fruitfulness and balance in Tasmanian wine grapes, together with details of research results / case studies, presented as workshops, field days, posters, fact sheets, through relevant media articles and benchmark tastings, in conjunction with Wine Tasmania
• Vineyard management decision support tools, including pruning, to aid producers in determining an ideal range of yields for their vineyards and adapting to challenging situations, including potential integration with the Sense-T program
• Articulation and promotion of the RD&E model utilised for this project and adoption of practice change by wine producers, to assist translation to other agricultural sectors

Outcomes:
• Contribution towards the Wine Tasmania target of trebling Tasmanian wine production by 2020
• Anticipated improvements in yields and yield stability, including evidence on linkages between yield and quality
  o Best case scenario: better decision making by growers to maximise yields in line with quality, better reliability of Tasmanian fruit and wine supply, building on and growing demand for Tasmanian wine and supporting increased sales and markets, therefore improving the economic sustainability of Tasmanian wine businesses
  o Worst case scenario: better decision making by growers to maximise yields in line with quality, but limited overall improvements in yields - for example, due to producers finding desired quality at lower than anticipated yields
• Assistance and encouragement for existing producers to improve and expand their vineyard yields, based on this evidence
• Upskilled industry members in on-farm research practice
• Evidence of practice change by individual viticulturists over the three years of the project, including as obtained through surveys and interviews
• Attraction of new vineyard investors on the basis of high productivity
• Contribution towards growth of the global profile of the Tasmanian wine sector and wine-related visitation
• Vineyard management tools, resources and efficiencies, including:
  o management of vines through winter and early spring for maximised bud fruitfulness
  o better informed pruning decisions through more precise and non-destructive fruitfulness measurements, including consideration to mechanised pruning in line with quality outputs
  o streamlined vineyard management and reduced costs through increased information on nutrient and water influence on fruitfulness, supporting more precise application
  o greater responsiveness to individual seasons through an increased understanding of weather conditions and their impact on fruitfulness and yield - supporting efficiencies and reduction in costs through avoiding unnecessary activities (eg leaf removal in low disease pressure years)
• Evaluation of the efficacy of cane and spur pruning both by hand and by machine on yield and wine quality
• A weather and yield prediction model to improve yield management
• Establishment of multiple demonstration sites through wine producer participation, including a whole block cane and spur pruning demonstration site for Wine Tasmania workshops - whole block demonstration sites, particularly in perennial horticulture run over several years, assist practice change through demonstrating techniques and results. For wine, results need to be demonstrated across both the viticultural and oenological aspects, and a dedicated demonstration site allows comparisons between treatments and controls through organoleptic as well as chemical assessment.
Leveraging Existing and Recent Investment
Complementary research projects previously undertaken or currently being undertaken include the following and linkages with each are articulated in the detail of the research project methodology:

- **2016 (ongoing)** - proof of concept, non-destructive and *in situ* bud scanning method - TIA (Dr Jones), funded by Wine Australia, with the following objectives:
  a) Identification of bud fruitfulness by spectral analysis
  b) Demonstration of feasibility of prediction of bud fruitfulness by pre-pruning portable hand-held bud sensing
  c) Avoidance of blanket approach to pruning
  d) Reduction in late season bunch removal for achieving target yields

- **2012-2016** - ‘Factors that underpin the certainty of yield and quality in cool climate viticulture’, TIA (Dr Kerslake), co-funded by Brown Brothers with the following objectives:
  a) To gain maximum value for Brown Brothers and the wider Tasmanian industry from the existing resource of research findings relevant to factors that underpins stable yields and quality for cool climate viticulture.
  b) To investigate the effect of leaf removal on bunch architecture, fruit and wine quality, fruitfulness and carbohydrate accumulation.
  c) To utilise existing climate and yield data and to establish a range of standardised sites in order to build relationships that will enable better fruitfulness predictions. This sub-project will also begin to establish varietal benchmarking sites for climate change adaptation.

- **2013-current** - Consecutive one year projects lead by Bachelor of Agricultural Science Honours students and funded by Wine Australia have built a critical mass of information around nutrient application in vineyards. Valuable data about yield response to fertilising is emerging and will complement the proposed trial.

- **2008-2012** - Improving cool climate sparkling and Pinot Noir - TIA / Australian Wine Research Institute, funded by a Tasmanian-based consortium and AusIndustry.

- **2007-2010** - Understanding the critical stages of initiation and differentiation in cool climate viticulture. This project was funded by Wine Australia to work with Tasmanian vineyards to determine the timing of the critical phases of bunch initiation and differentiation, and to determine the impact of management practices during these times on yield.

- **2015-16** - Wine Tasmania Extension Program, supported by Wine Australia.

Risk Identification & Management

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<td>Project members leaving</td>
<td>Maintaining funding through research and extension grants and industry support. Use of group to have a range of team members capable of carrying out the research.</td>
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<td>Crop failure</td>
<td>Working with professional viticulturists with strong record of pest and disease management.</td>
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Winemaking inconsistency | Retain project members with experience in controlled small-batch winemaking; maintaining strict winemaking protocol.
Seasonal variability | Conducting research across multiple seasons.
Site variability | Conducting research across multiple sites.

Supporting Material & References:
- Wine Tasmania Strategic Plan 2013-2016, updated March 2015
- Tourism Tasmania Food & Beverage Tourism Snapshot, March 2015
- T21 - Tasmanian Visitor Economy Strategy
- AgriVision 2050 Plan

Attachment 1: Project Details & Methodology - Research, Development and Extension

Attachment 2: Budget - Improving Productivity in Tasmanian Vineyards
Theme 1. Modelling the effects of weather on fruitfulness
This model will build on an extensive study run by a TIA / Brown Brothers collaboration, and will be led by Dr Fiona Kerslake. The TIA / Brown Brothers project will contribute a sound base of four years of fruitfulness and weather data. The trial encompassed cane and spur pruning systems, of the same variety and clone. Value adding to this data set, the current proposal will allow for the extension of this trial at the same sites for an additional three seasons, giving a total of seven seasons of data for the ongoing development of a weather and fruitfulness model. This will allow for a more robust model to be developed, as the variability of the data, inherent of a cool climate, necessitates a large data-set to build reliability. The aim of the model is to provide predictions of significant fruitfulness fluctuations driven by weather conditions.

The approach is to use the same sites to develop the model over the seven years and use other sites to progressively validate the model.

Year 1 (2016-17):
- Vineyards invited to participate in the three-year research project will be provided with instructions and support on setting up and conducting industry trials, as well as the collection and recording of data.
- Comprehensive data gathering using weather stations.
- Measurement of bud fruitfulness, yield, individual yield components and fruit quality using existing experimental vines; Sparkling Pinot noir (MV6), Sparkling Chardonnay (I10V1), Table Pinot noir (MV6) and Table Sauvignon Blanc (F14V9).

Year 2 (2018):
- Comprehensive data gathering using weather stations.
- Measurement of bud fruitfulness, yield, individual yield components and fruit quality using existing experimental vines; Sparkling Pinot noir (MV6), Sparkling Chardonnay (I10V1), Table Pinot noir (MV6) and Table Sauvignon Blanc (F14V9).
- Develop fruitfulness prediction model (Version 1 of the model does not yet exist, as some trial blocks had to be moved after Year 1, so only Years 2 & 3 are complete and Year 4 is currently being harvested). The final report to Brown Brothers (Years 1-3) is currently being completed and Year 4 will be included and updated in the next 6 months. Feedback has been received from respected researcher Dr Mike Trought, warning against developing the model with too little data in cool climates due to the high variability of the seasonal weather conditions. Dr Ross Corkrey, Senior TIA Biometrician, has the expertise to develop the model.

Year 3 (2019):
- Final data gathering using weather stations.
- Measurement of bud fruitfulness, yield, individual yield components and fruit quality using existing experimental vines; Sparkling Pinot noir (MV6), Sparkling Chardonnay (I10V1), Table Pinot noir (MV6) and Table Sauvignon Blanc (F14V9).
- Further develop and test model in conjunction with local industry.

Theme 2. Nutrient and irrigation management for fruitfulness
This theme seeks to maximise the potential yield for a given level of fruitfulness. Once the association between weather and fruitfulness is determined, management can be altered accordingly. Initiated and differentiated buds can revert to vegetative if nutrient and water resources are not adequately available to prevent reversion and bud necrosis. Dr Jones will lead
the trials relating to management for bud fruitfulness through winter and early spring. Modelling will be carried out by microscopic examination of buds followed by Raman imaging by collaborating with Dr Thomas Rodemann the Central Science Laboratory at UTAS.

Year 1 (2016-2017 vintage):
- Vineyards invited to participate in the three-year research project will be provided with instructions and support on setting up and conducting industry trials, as well as the collection and recording of data.
- Replicated trials will also occur in the north and south on single clones.
- Pinot Noir and Chardonnay vines will receive nutrient and irrigation treatments over three vintages. Nutrient treatments will include a 50, 100 and 150% of grower’s practise nutrient regime. Irrigation treatments of high (4L/hr) and low (2L/hr) will be overlaid onto the nutrient regime in a fully replicated factorial design to investigate the influence of irrigation on nutrient uptake. Treatments will be applied by the grower via modified dripper rates through their existing fertigation system. Fertigation treatments will commence pre-harvest in the 2017 vintage as earlier studies have shown the efficacy of earlier application.
- Ten buds per vine will be collected from both varieties over a range of dates in winter 2016.
- Buds will then be dissected using a stereo microscope to determine the number of inflorescences and the inflorescence size category (this measurement is directly aligned with the Wine Australia project).
- Return crop (2017) will be monitored, and thorough yield analysis performed. Fruitset, bunch number, bunch size, bunch compactness, degree of rachis branching, berry size and seed number will all be monitored.
- Statistical analysis of the influence of nutrition and water on crop factors described above will be completed using a univariate general linear model approach in SPSS with irrigation, fertigation and time considered as fixed factors.

Year 2 (2017-2018 vintage):
- Nutrient and water status experiments will be repeated - with statistical analysis as described above.
- More buds will be sampled and yield analyses repeated - with statistical analysis as described above.

Year 3 (2018-2019 vintage):
- Nutrient and water status experiments will be repeated - with statistical analysis.
- More buds will be sampled and yield analyses repeated - with statistical analysis.
- Data from all three vintages will be combined for thorough statistical analysis.
- Recommendations will be developed relating to vine nutrient and water status through winter and early spring.

Theme 3: Best practice pruning
Dr Kerslake will lead the pruning trials. Cane and spur pruning will be applied both by hand and using mechanical pruners in a whole-block approach. Field trials will be replicated in both the north and south of the state - with a minimum of four replicates of each treatment at each site. Canopy, yield and fruit quality will be assessed. Standardised micro-vinification will be carried out to produce base Pinot Noir and Chardonnay wines which will be tested for wine quality attributes.

Year 1 (2016-2017):
- Vineyards invited to participate in the three-year research project and will be provided with instructions on conducting trials (by April 30 2016).
- Replicated trials will occur in Pinot Noir and Chardonnay, on single clones.
- Set up northern and southern trials comparing hand and mechanical, cane and spur pruning treatments.
- Measurements will include canopy measurements, fruitfulness, yield and yield component analysis, fruit quality and resulting wine quality.

Year 2 (2018):
- Apply pruning treatments.
- Measurements will include canopy measurements, fruitfulness, yield and yield component analysis, fruit quality and resulting wine quality.

Year 3 (2019):
- Apply pruning treatments.
- Measurements will include canopy measurements, fruitfulness, yield and yield component analysis, fruit quality and resulting wine quality.
- Development of recommendations.

Theme 4: Industry awareness, development and extension plan for practice change

Year 1 (2016-17 vintage):
- Plan and establish industry trials related to research trials in Themes 1 and 3 - as demonstration trials for the wider industry.
- Publish a series of articles in the Wine Tasmania newsletter, Harvest, highlighting factors involved in grapevine productivity, including genetics, temperature, rainfall, soil moisture, nutrition, soil chemistry and biology and vine physiology.
- Discuss the relationship between yield and quality at the annual Wine Tasmania Field Day held in September/October.
- Provide introductory details of the vineyard management support tool at the Wine Tasmania Field Day.
- Conduct demonstration trials of Pinot Noir wines made with different degrees of fruit thinning (funded through the Australian Grape and Wine Authority’s Regional Program).

Year 2 (2017-18 vintage):
- Publish a series of articles in the Wine Tasmania newsletter, Harvest, highlighting factors involved in grapevine productivity, including genetics, temperature, rainfall, soil moisture, nutrition, soil chemistry and biology and vine physiology.
- Present results of demonstration trials of Pinot Noir wines made with different degrees of fruit thinning.
- Discuss the relationship between yield and quality at the annual Wine Tasmania Field Day held in September/October.
- Provide practical demonstrations of the vineyard management support tool at the Wine Tasmania Field Day.
- Include workshops and field days around the industry trials established in Year 1.

Year 3 (2018-19 vintage):
- Publish case studies of producers who have changed their yield management practices based on demonstration trials and extension work.
• Include case studies and demonstrations of the vineyard management support tool at workshops, including a dedicated field day.
• Encourage adoption by other wine producers, based on case studies and results.
• Integrate results of demonstration trial and case studies into Tasmanian Sustainable Winegrowing program.
• Publish details of the research, development and extension model used for potential applicability to other industry sectors.
## Attachment 2: Budget - Improving Productivity in Tasmanian Vineyards

<table>
<thead>
<tr>
<th></th>
<th>AgriGrowth</th>
<th>TIA in-kind</th>
<th>Collaborators *</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2016/17</strong></td>
<td></td>
<td></td>
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<tr>
<td>Salary</td>
<td>105,674</td>
<td>33,155</td>
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<td>138,829</td>
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<td>Operating</td>
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<td>0</td>
<td>28,000</td>
<td>37,325</td>
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<tr>
<td>Travel</td>
<td>9,835</td>
<td>0</td>
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<td>9,835</td>
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<tr>
<td><strong>2017/18</strong></td>
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</tr>
<tr>
<td>Salary</td>
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<tr>
<td>Travel</td>
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<td>6,360</td>
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<tr>
<td><strong>2018/19</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Salary</td>
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<td>35,907</td>
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<tr>
<td>Travel</td>
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<td>0</td>
<td>0</td>
<td>6,487</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>381,260</td>
<td>103,814</td>
<td>84,000</td>
<td>569,074</td>
</tr>
</tbody>
</table>

* TIA contribution is a conservative estimate and likely to be higher, due to use of TIA’s in-house statistician to assist with fruitfulness modelling.

** Conservative estimate of in-kind costs based on input and allocation of resources and personnel by Wine Tasmania and individual Tasmanian wine businesses participating in the research project. Direct contribution of participating vineyard owners to be further defined.