

GIS and Precision Viticulture

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TREASURY
WINE ESTATES



Today's Presentation

1. Introduction to TWE and the Sustainability Team
2. GIS & Precision Viticulture at TWE
3. Examples from around the Business
4. Our Challenges and Strategies
5. ArcGIS Online



TREASURY WINE ESTATES

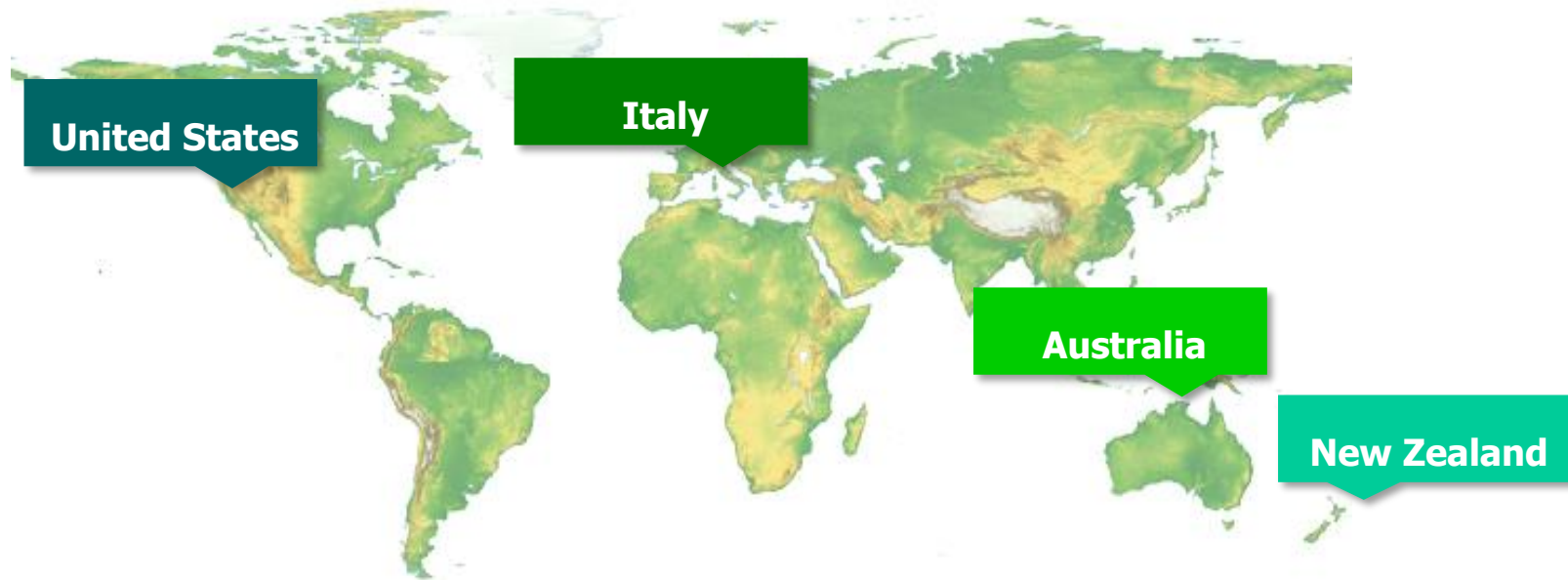


Introduction to the Sustainability Team

Our core functions



Our Global Footprint



United States	Italy	Australia	New Zealand
<ul style="list-style-type: none">▪ 10 Wineries▪ 49 Vineyards▪ 4,002 Planted Hectares	<ul style="list-style-type: none">▪ 1 Winery▪ 2 Vineyards▪ 145 Planted Hectares	<ul style="list-style-type: none">▪ 8 Wineries▪ 78 Vineyards▪ 8,939 Planted Hectares	<ul style="list-style-type: none">▪ 2 Wineries▪ 8 Vineyards▪ 339 Planted Hectares



TWE's Current Capabilities



GIS & Precision Viticulture at TWE

- Plant Cell Density (PCD) Mapping / Zonal Mapping – split picking
- Site Mapping – vineyard blocks, site infrastructure, natural resources, etc.
- Asset Management – people, machinery, equipment, grapes, mobile assets, etc.
- Mobile Mapping – vineyard assets, pest & disease
- Disaster Planning & Management – bushfires, flooding, P&D
- Precision Viticulture – John Deere & TopCon
- Winery – tank optimization, risk management
- Sales, marketing and demographic analysis



In the Vineyard



Vineyard Fruit

Wine



Low Vigour



Medium Vigour



Vineyard variability
drives wine quality

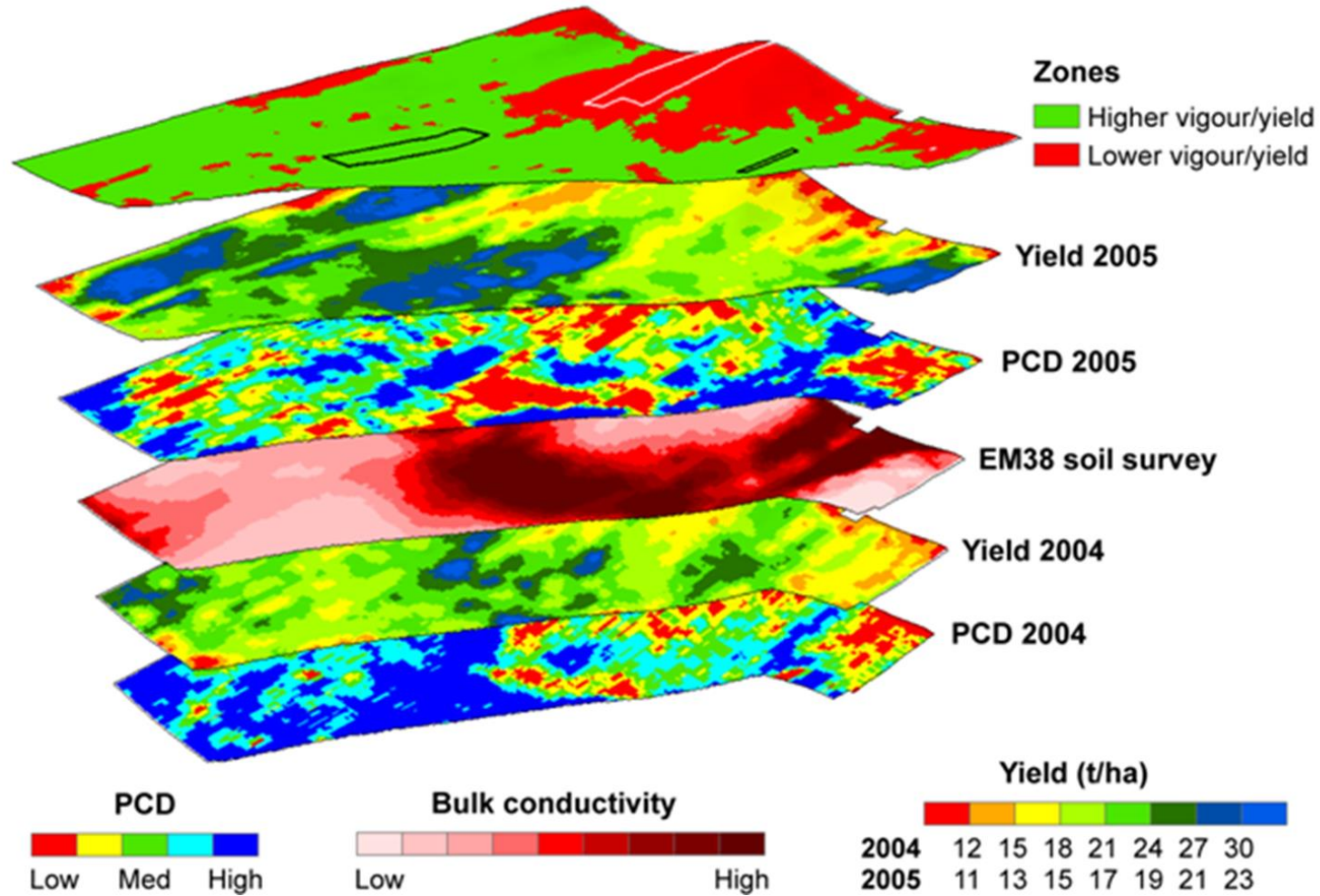


High Vigour

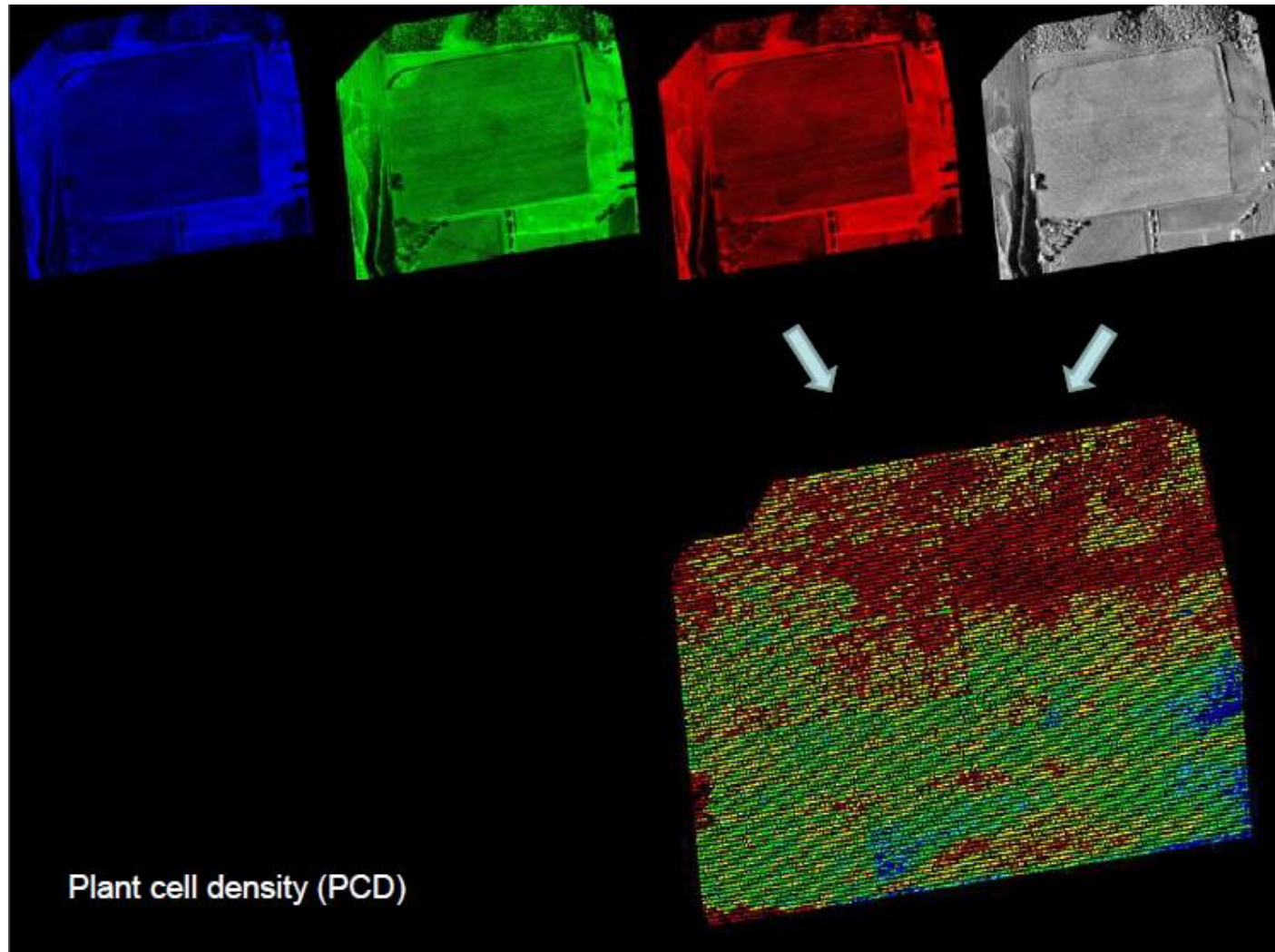


Precision Viticulture
exploits vineyard
variability

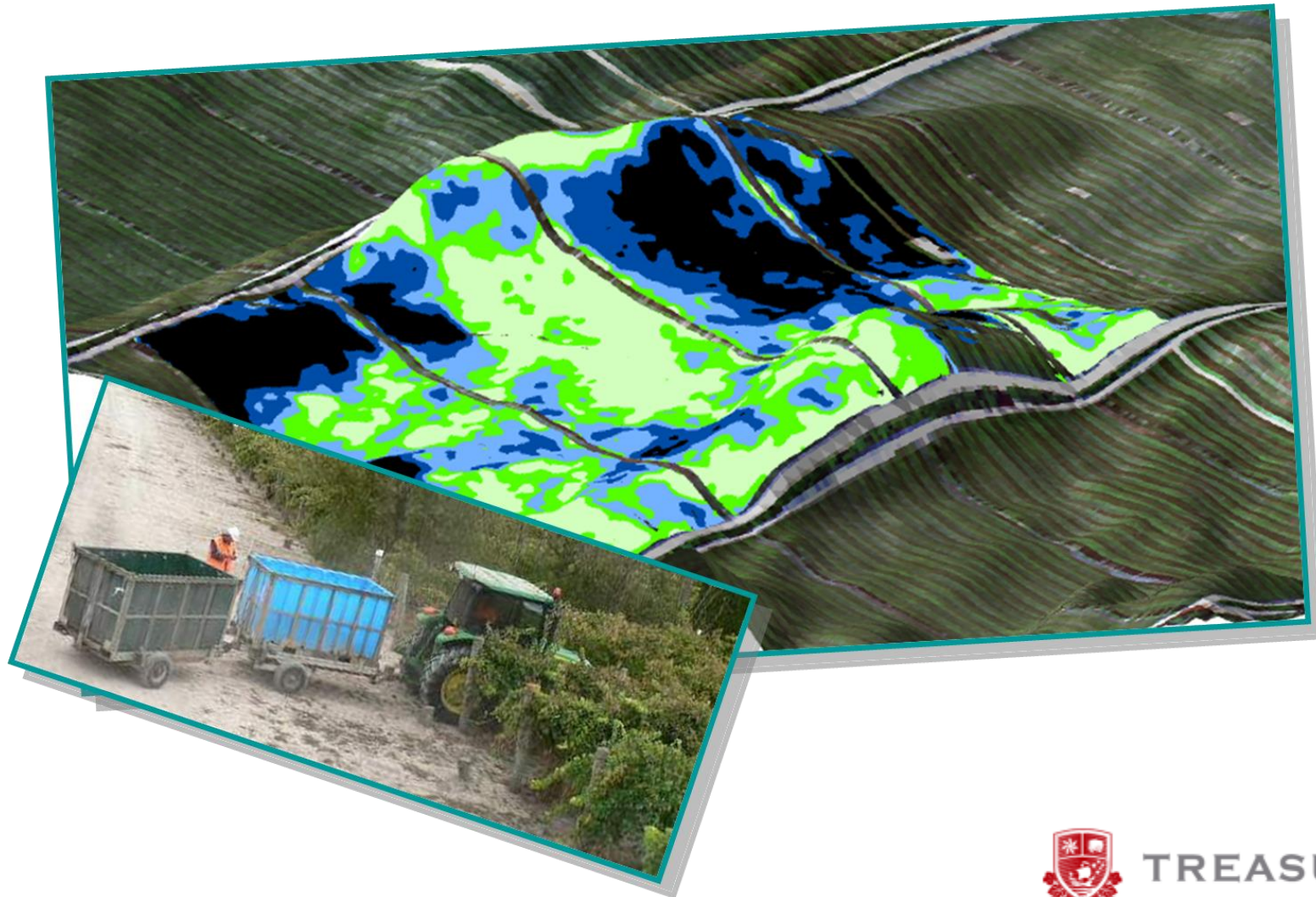
Building our knowledge



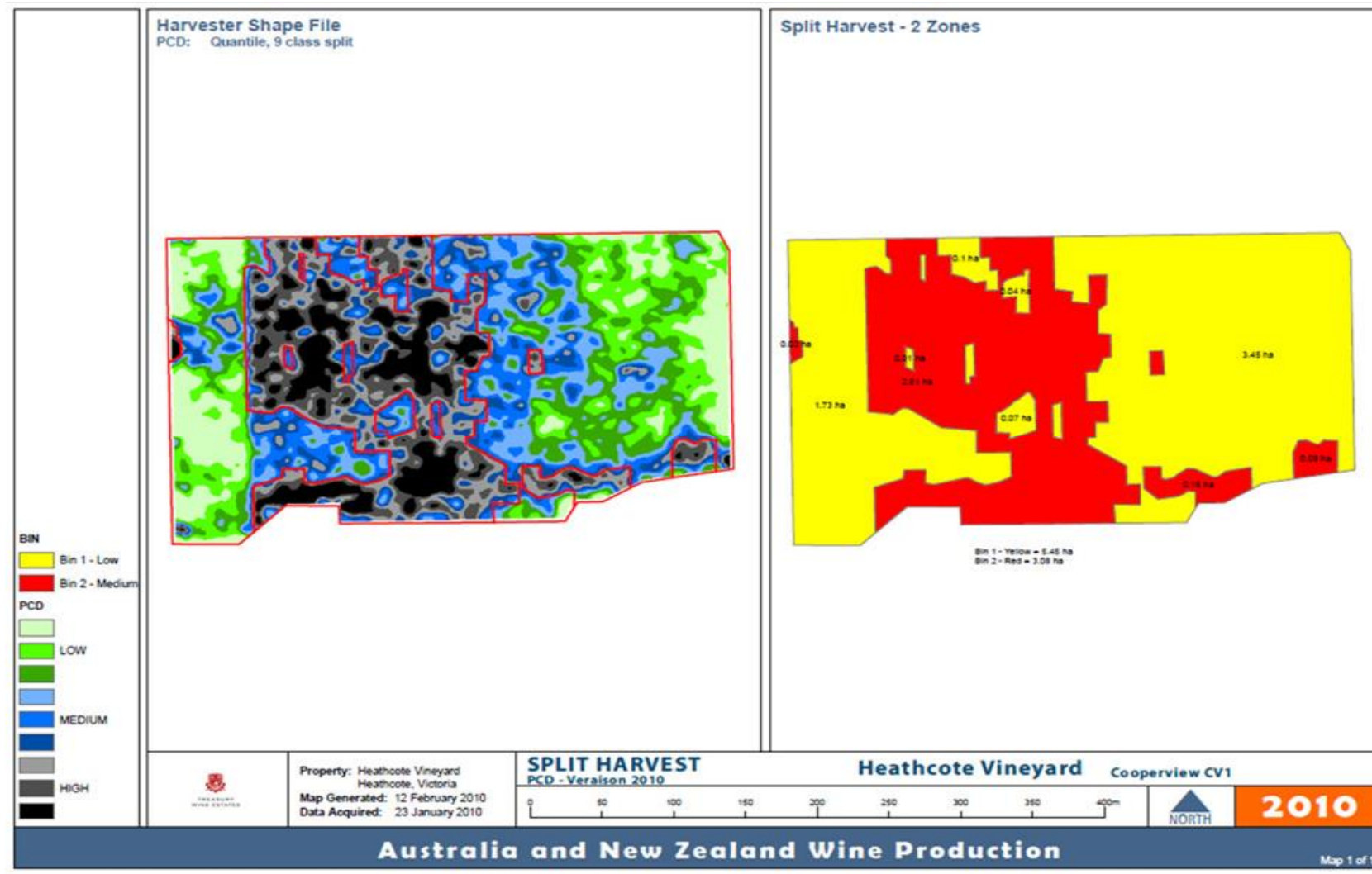
Imagery

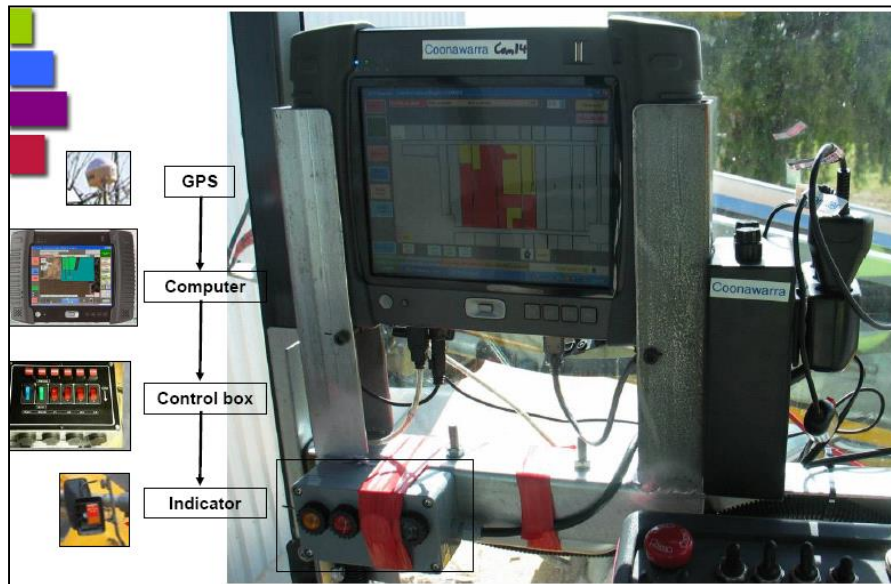
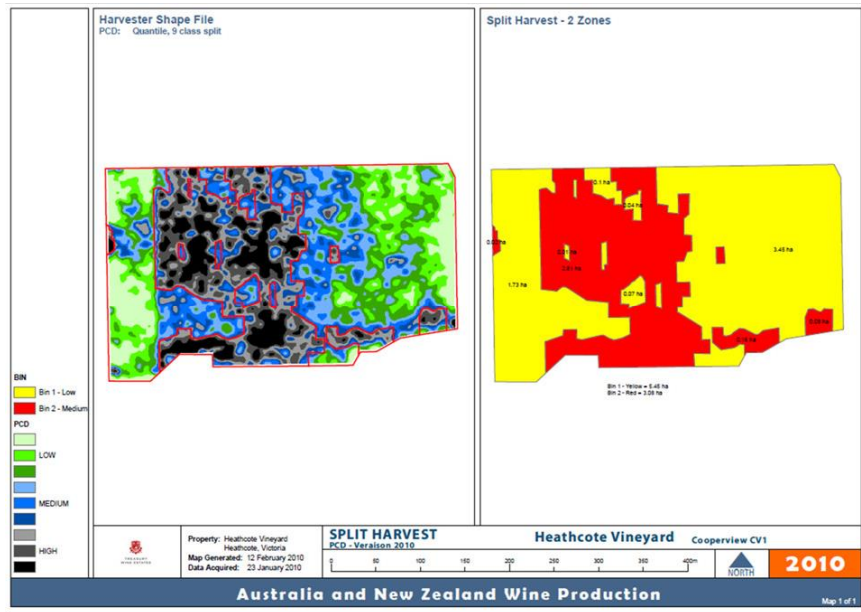


Optimal quality outcomes

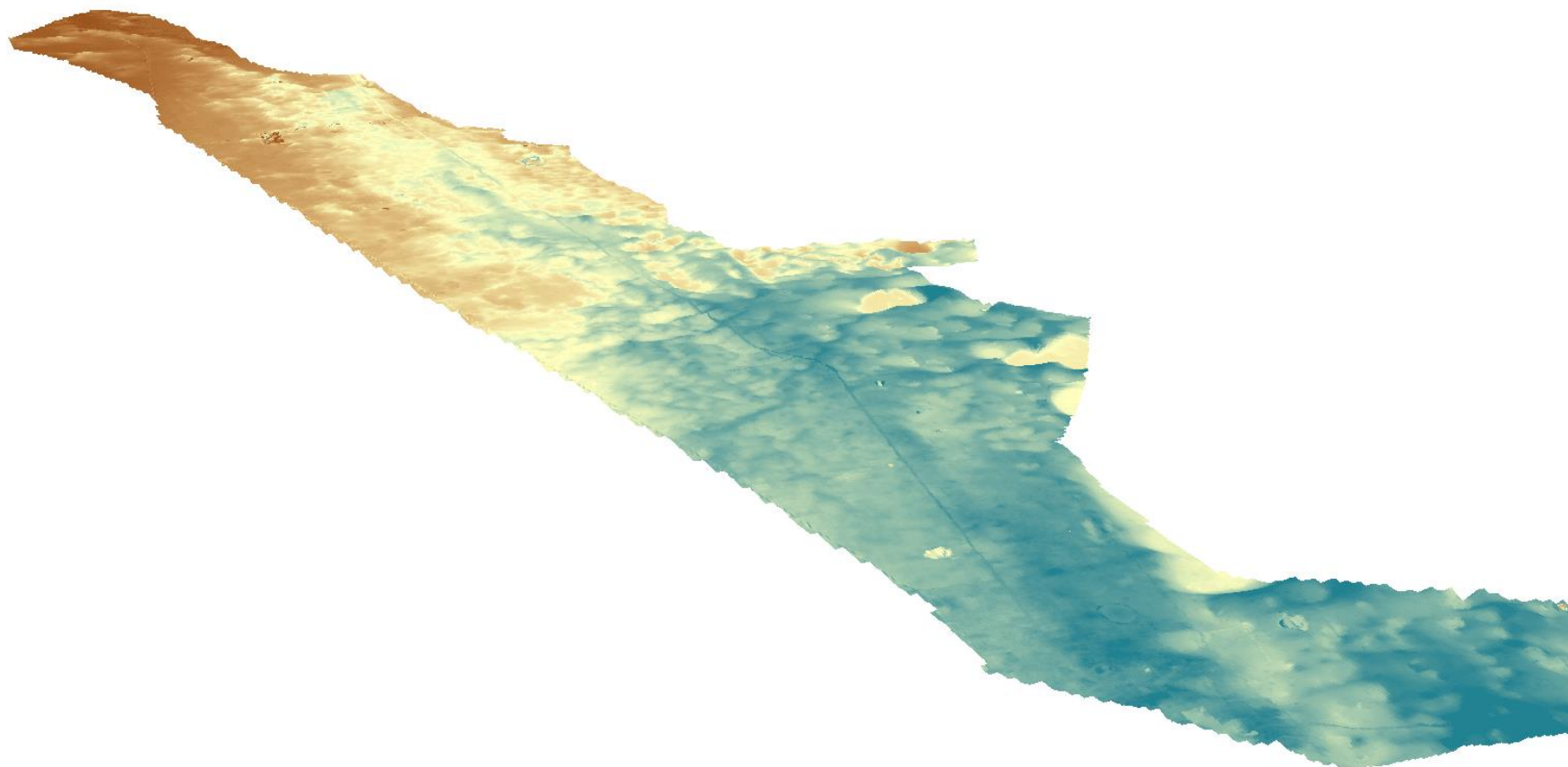


PCD & Zonal Mapping

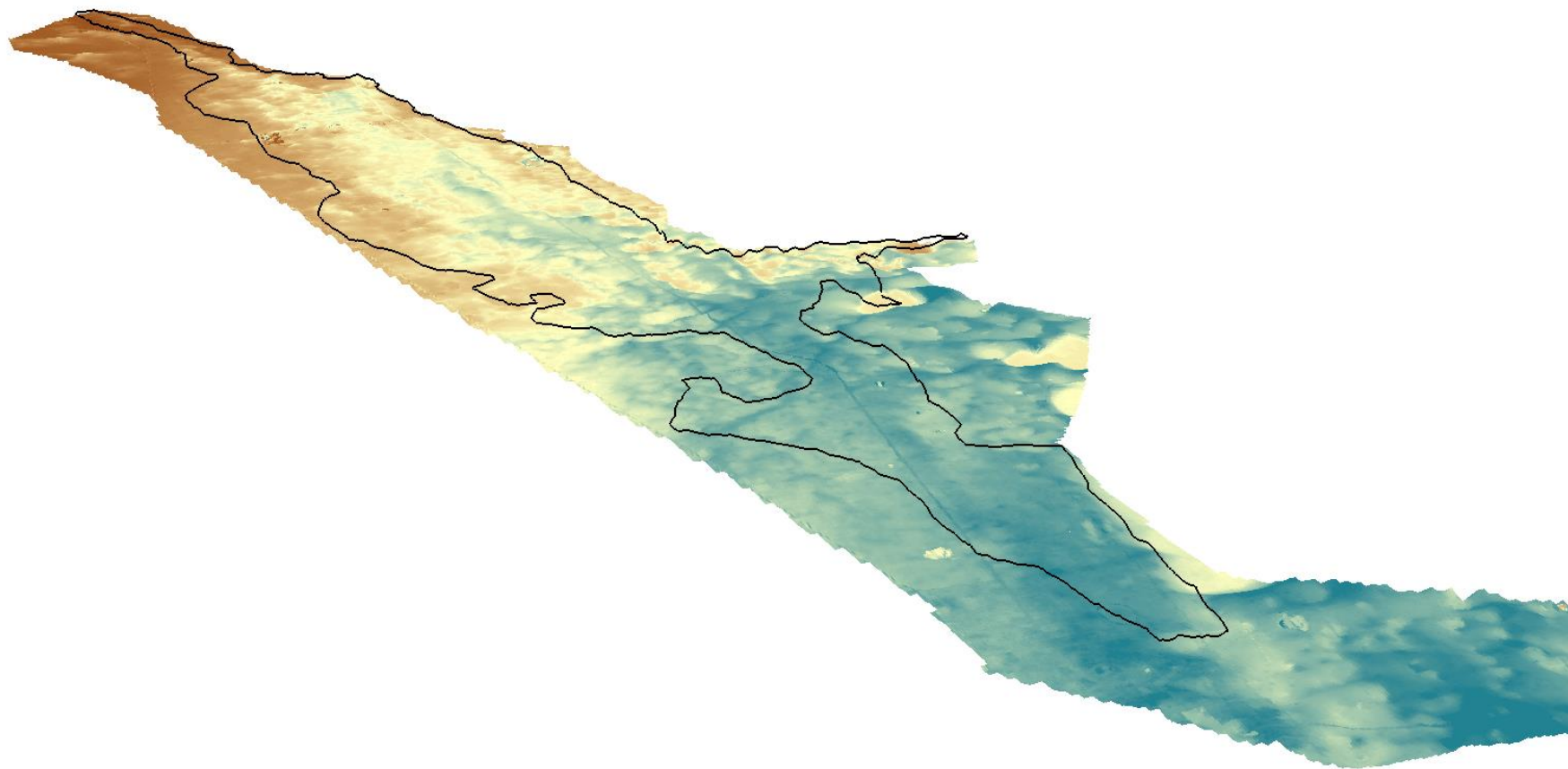




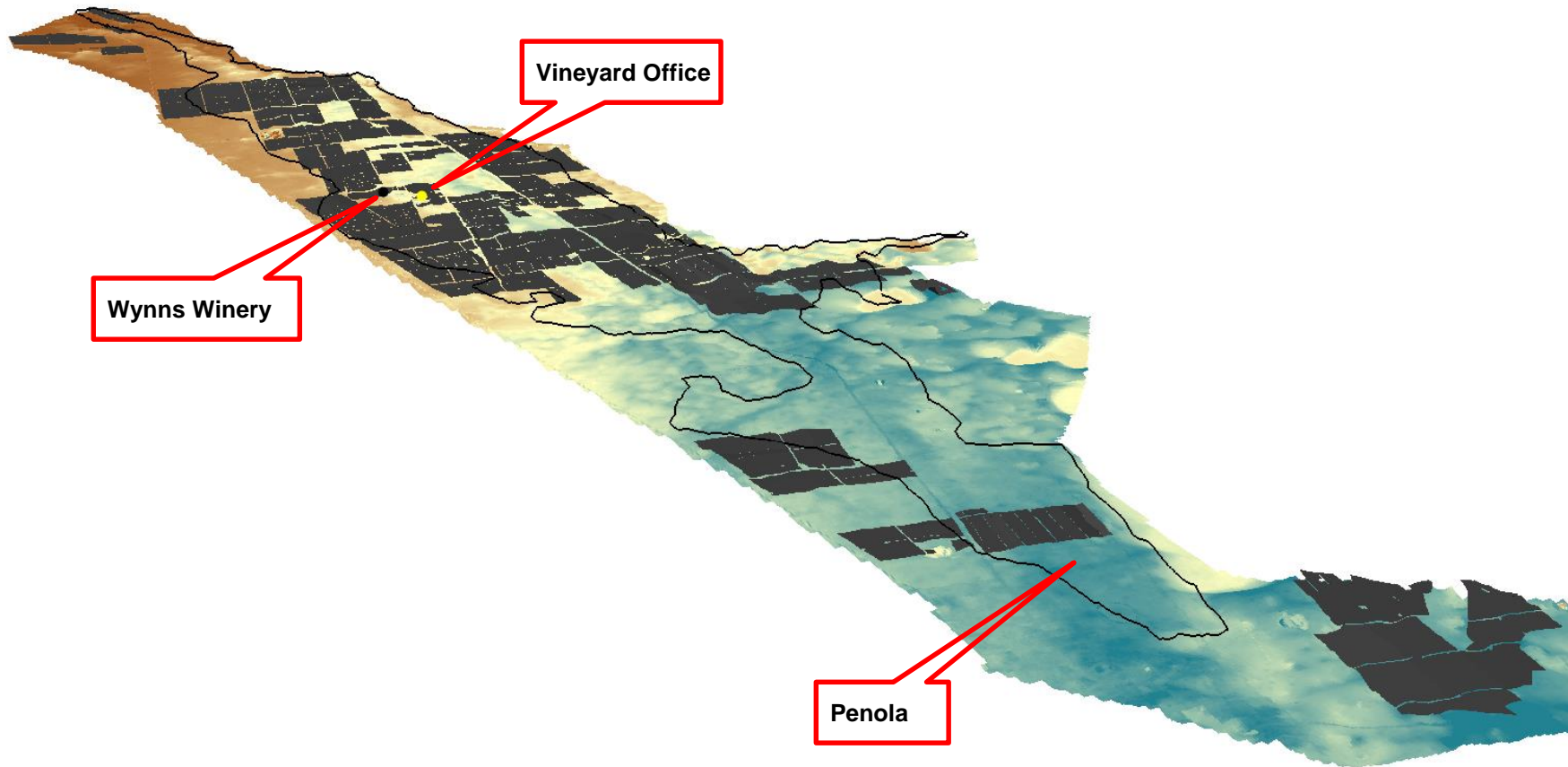
Coonawarra Digital Elevation Model



Coonawarra Digital Elevation Model



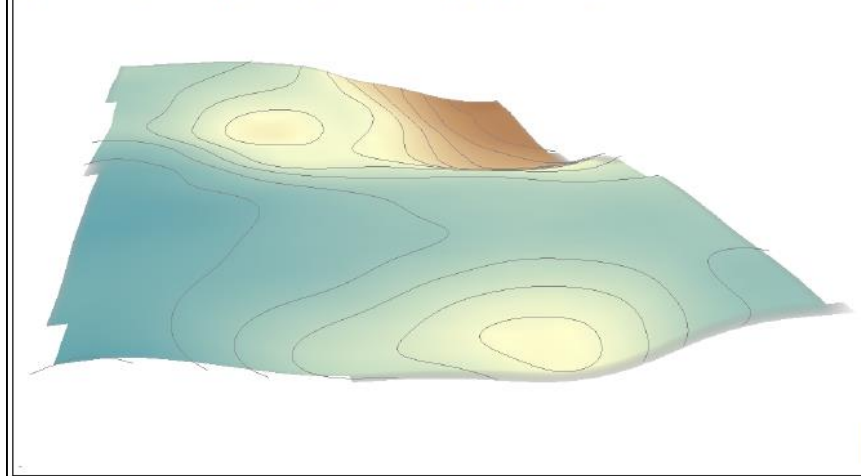
Coonawarra Digital Elevation Model



Coonawarra Digital Elevation Model



Block Name	Max Elevation	Min Elevation	Mean Elevation	Block Size (ha)	Variety	Vertical Exaggeration
V&A7	60.56	57.83	59.51	5.894	Cabernet Sauvignon	x 20



Wynns Estate
Coonawarra

WYARRA
COONAWARRA DISTRICT

Vineyard Elevation Model
Block: V&A 7 (CAS)

Legend

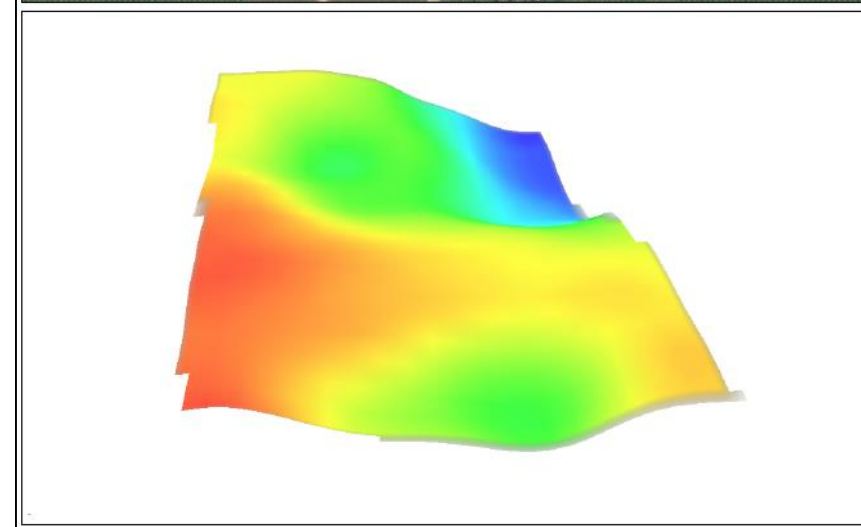
- Elevation Contours - 25m
- Block Boundary
- Terre Rose Boundary (Holiday 1982)

Scale at A3 1:2,000

0 25 50 Metres

GDAL/RA - MGA Zone 54
Data Sources: TWE, DTPI, DEWNR, SERIC
Map generated April 2014 by
David Garner, Wynns Coonawarra Estate

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Wynns Estate
Coonawarra

WYARRA
COONAWARRA DISTRICT

Vineyard Temperature Model
Block: V&A 7 (CAS)

Legend

- Elevation Contours - 25m
- Block Boundary
- Terre Rose Boundary (Holiday 1982)
- Temperature (°C)

Scale at A3 1:2,000

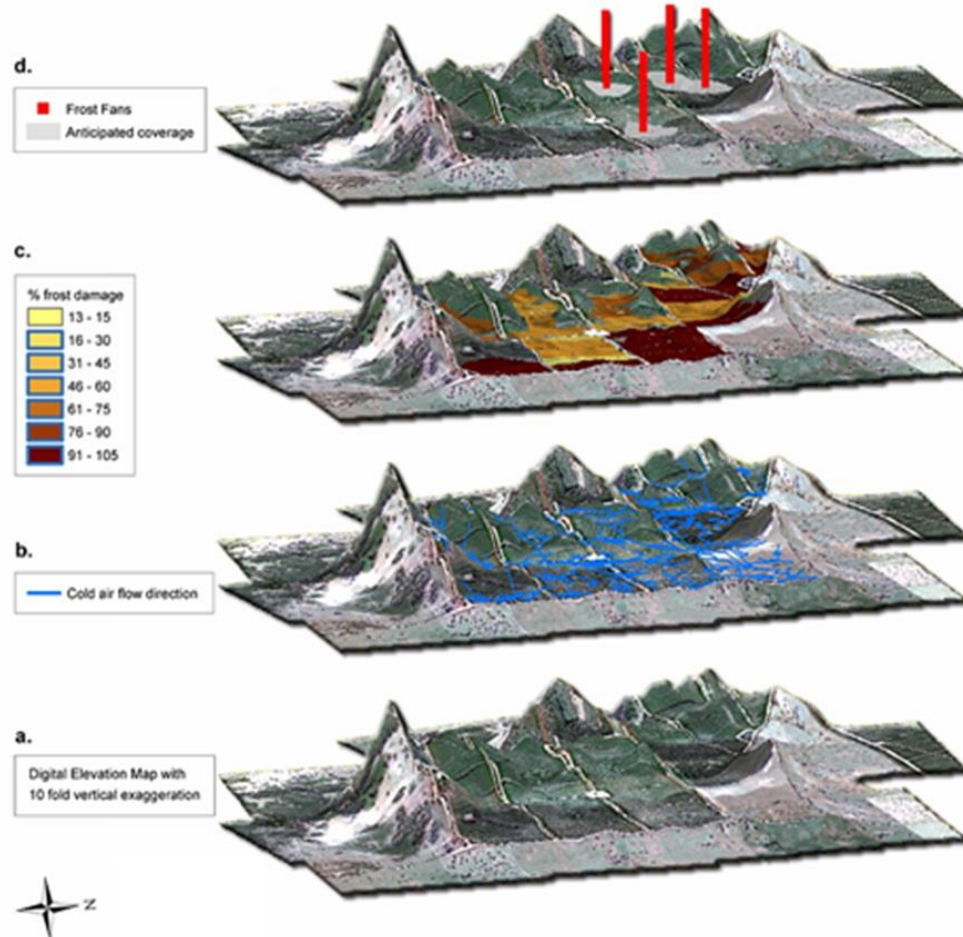
0 25 50 Metres

GDAL/RA - MGA Zone 54
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Making decisions

Frost fan placement - PV application



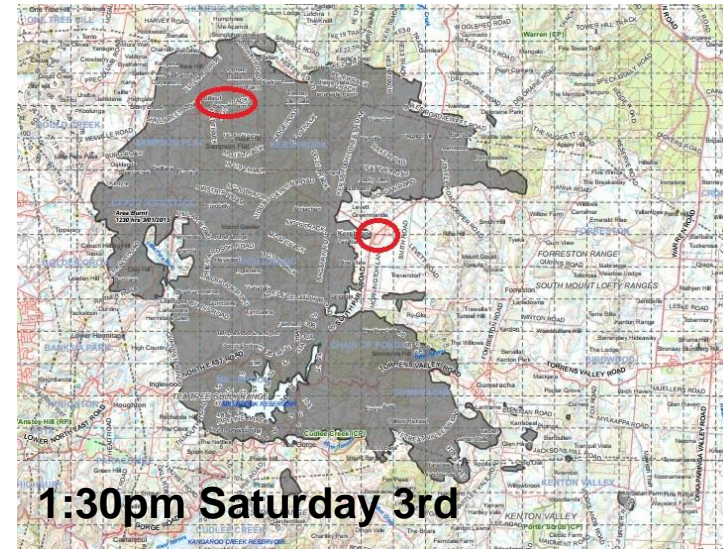
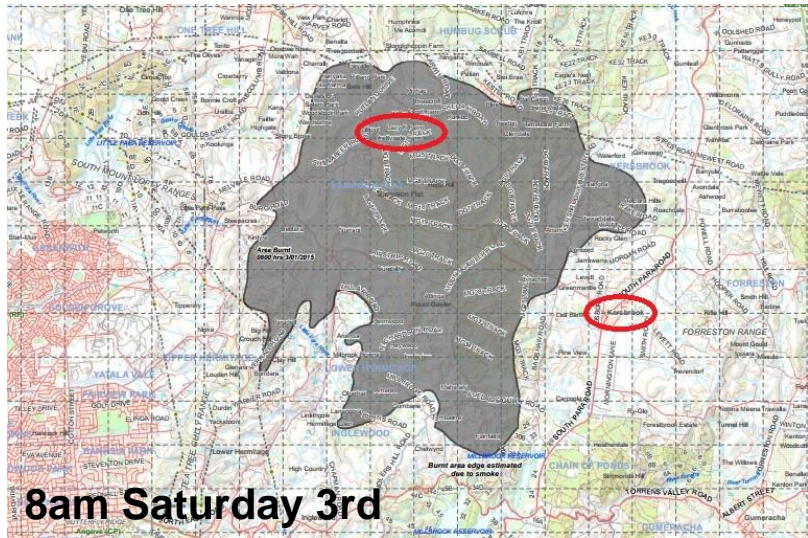
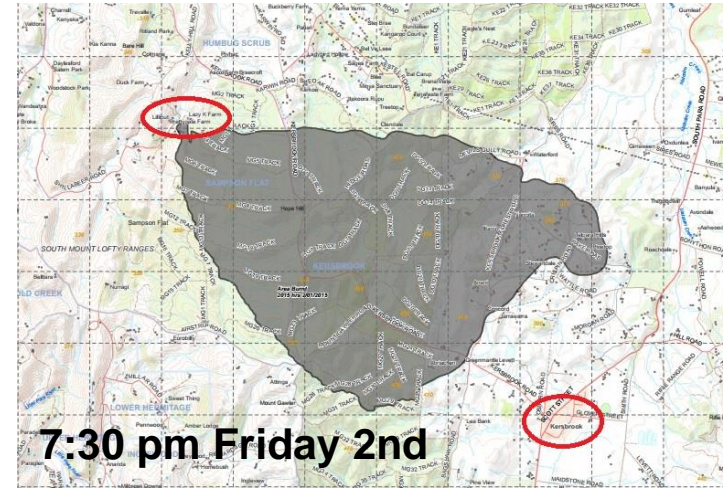
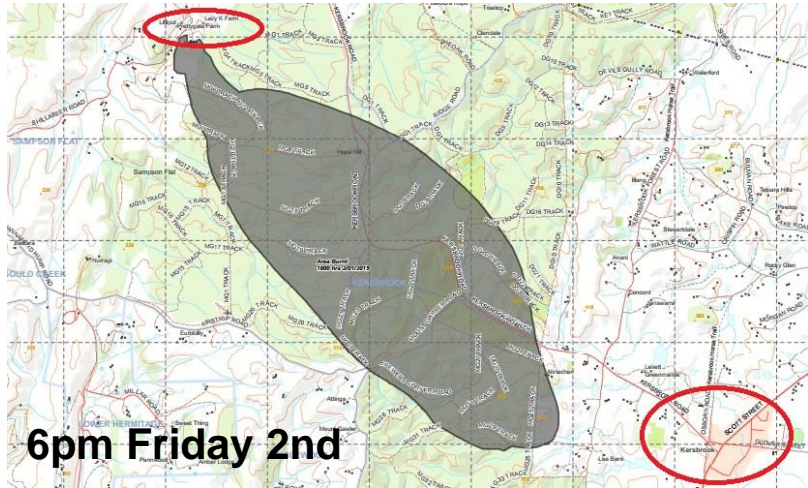
Disaster Management



Bushfire Disaster Management



Adelaide Hills Bushfires – January 2015

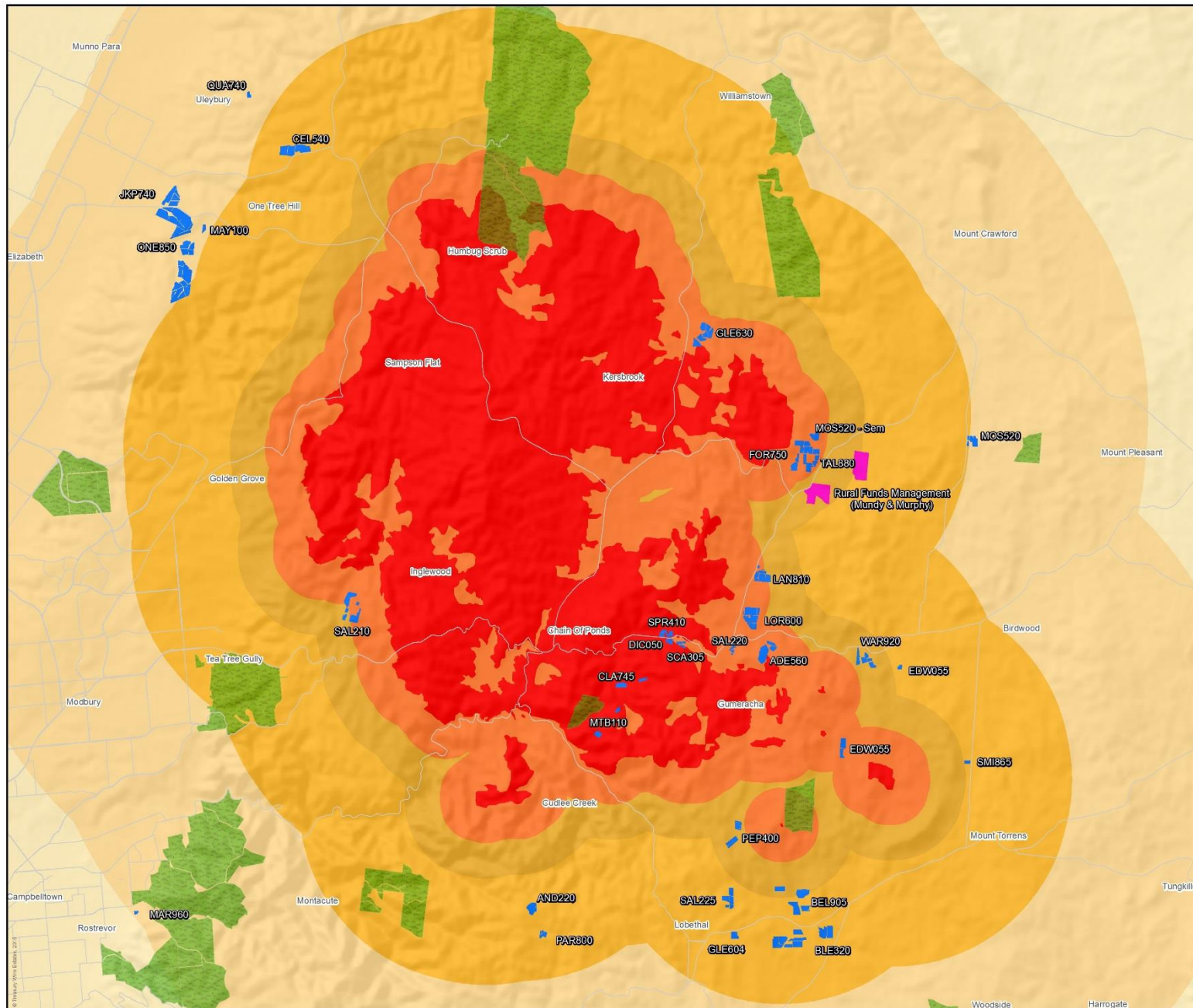


Erratic wind conditions throughout event



Jan-15	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			Temp °C	RH %	9:00 AM					3:00 PM				
		Min °C	Max °C				Dir	Spd km/h	Time local			Cld 8 th	Dir km/h	Spd km/h	MSLP hPa	Temp °C	RH %	Cld 8 th	Dir km/h	Spd km/h	MSLP hPa
1	Th	15.1	37	0		12.3	WNW	31	14:58	23.9	43		SW	11	1012.1	34.2	20		NNW	9	1009.3
2	Fr	23.2	44.1	0		13.1	NW	41	11:19	34.9	12		N	17	1009.4	42.8	10		NW	20	1006.7
3	Sa	24.4	38.2	0		8.9	SW	56	14:44	29.2	33		SSW	15	1005.8	35.4	17		S	28	1007.3
4	Su	17.7	30.5	0		13.6	S	33	0:51	21.6	51		SSE	13	1016.4	28.9	33		SE	13	1014.8
5	Mo	18.2	34.9	0	43.4	13	ESE	50	22:57	24.1	45		Calm		1016.7	32.4	28		SE	13	1014.7
6	Tu	23.7	39.4	0	10.2	13.4	ESE	48	23:33	30.2	31		ENE	11	1015.4	38	25		WSW	19	1013.1
7	We	27	42.2	0	10.8	8	W	46	17:55	35.1	29		N	17	1011.8	39.4	23		WNW	17	1008.7
8	Th	21.8	27.2	7.4	7.6	1.3	SSW	52	7:12	22.3	94		S	9	1010.5	25.6	64		N	15	1008.6





TREASURY WINE ESTATES

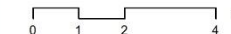
Adelaide Hills Bushfires
January 2015

Company & Grower Vineyards

Legend

- Roads
- Company Vineyards
- Grower Blocks
- Burn Boundary - 8 January 2015
- Burn Boundary Buffers (km)**
- 1
- 2
- 5
- 10
- 20
- National Parks

Scale at A3 1:100,000



GDA 94 - MGA Zone 54
Data Sources: TWE, DPTI, DEWNR
Map generated January 2015 by
Dave Gerner, TWE (Magill)

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TREASURY WINE ESTATES

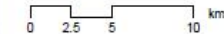
Pinery Bushfires
November 2015

Company & Grower Vineyards

Legend

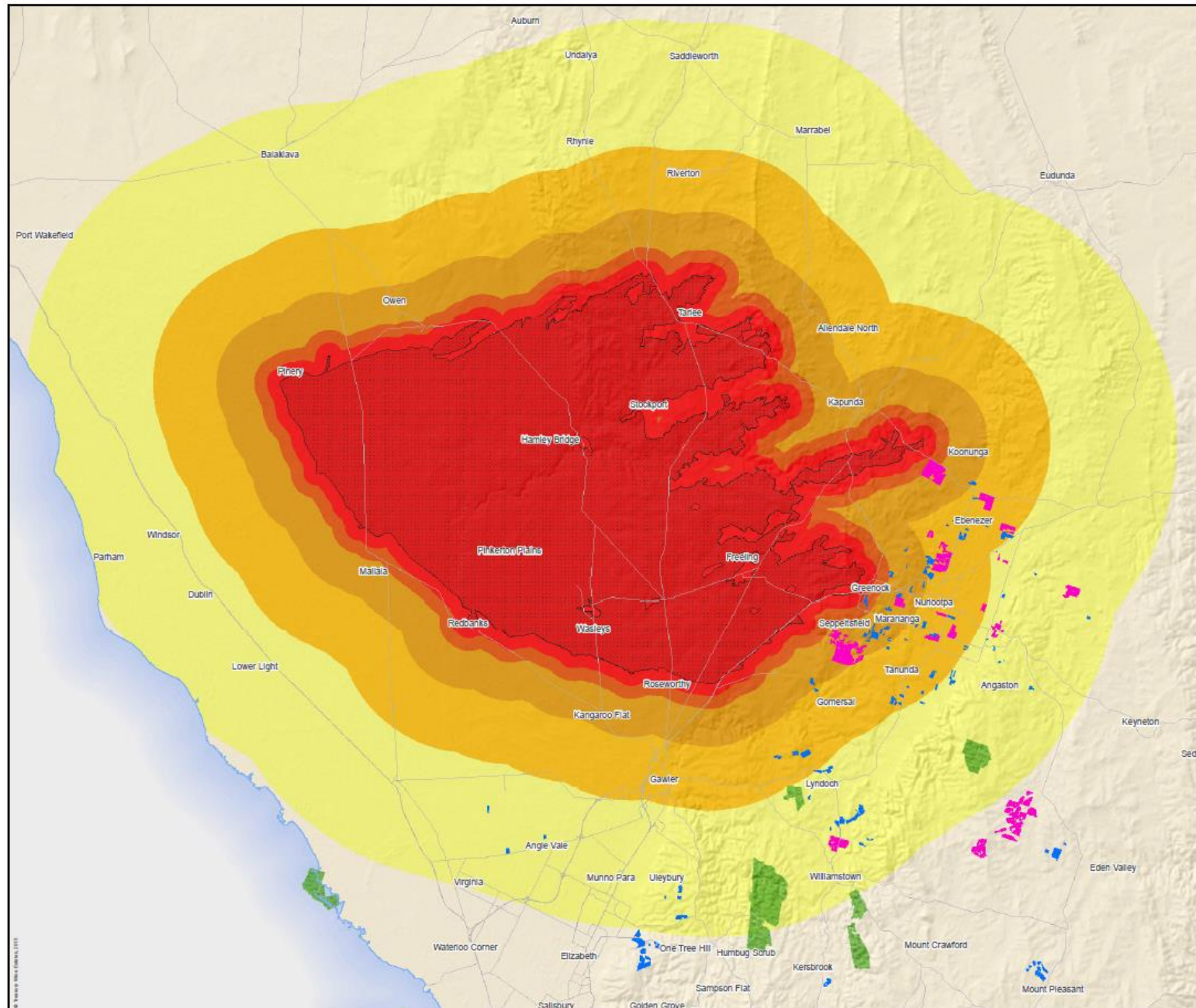
- Roads
- Pinery Bushfire - Fire Scar
- Fire Scar Buffers (km)
 - 1
 - 2
 - 5
 - 10
 - 20
- Company Vineyards
- Grower Blocks
- National Parks

Scale at A3 1:280,000



GDA 94 - MGA Zone 54
Data Sources: TWE, DPTI, DEWNR
Map generated November 2015 by
Dave Gerner, TWE (Magill)

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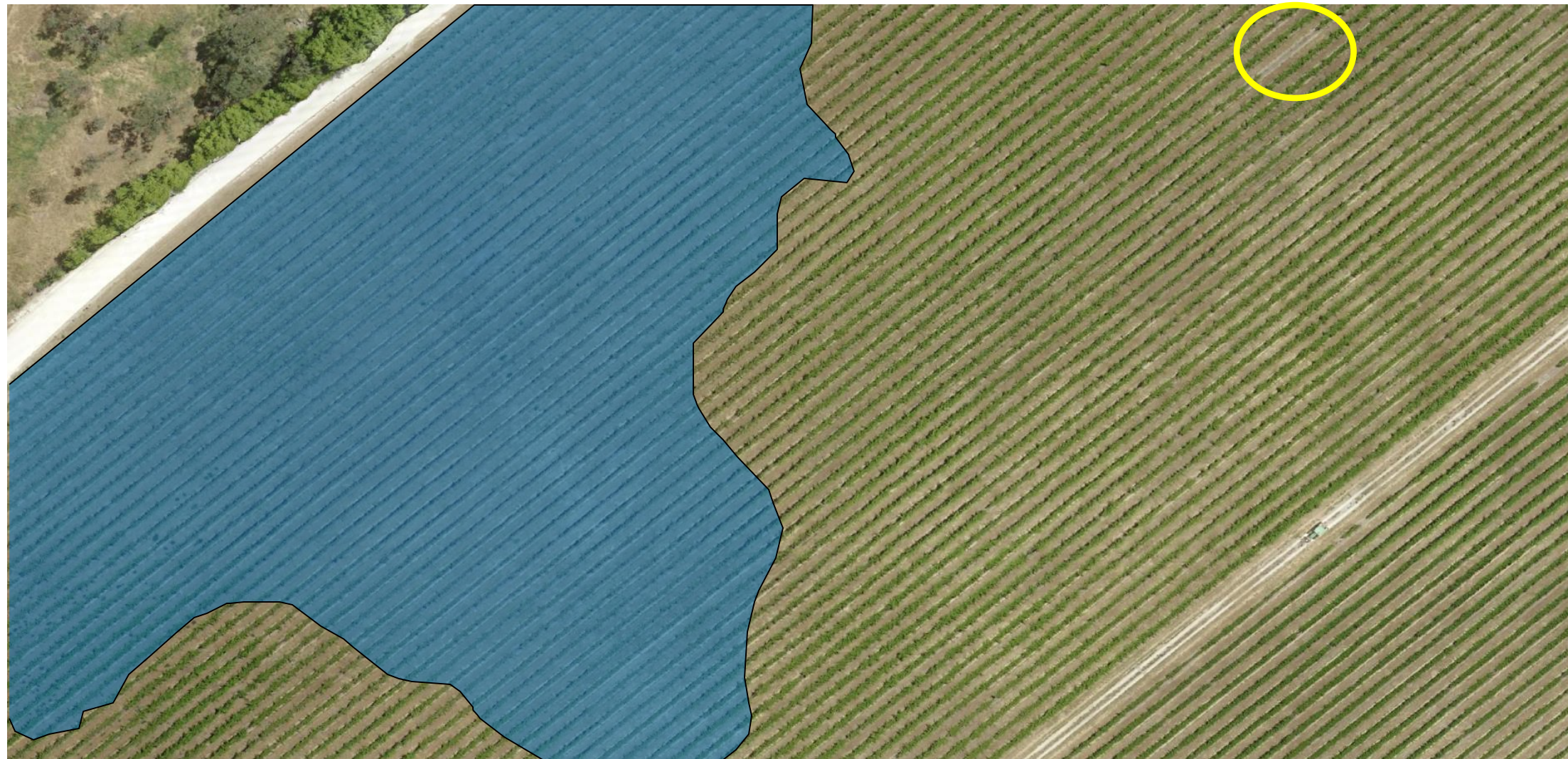


Frost Management

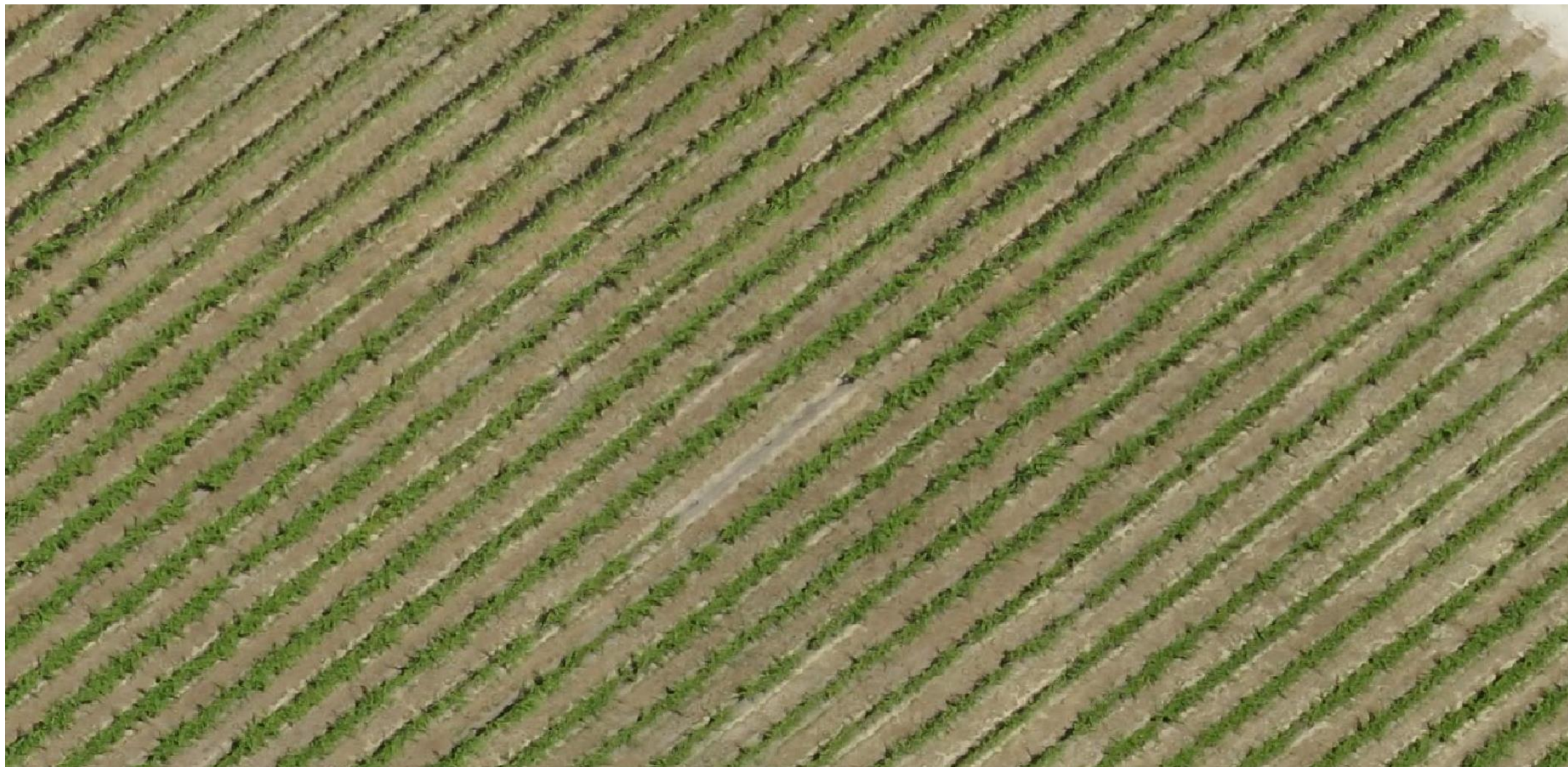


TREASURY WINE ESTATES

Frost Management



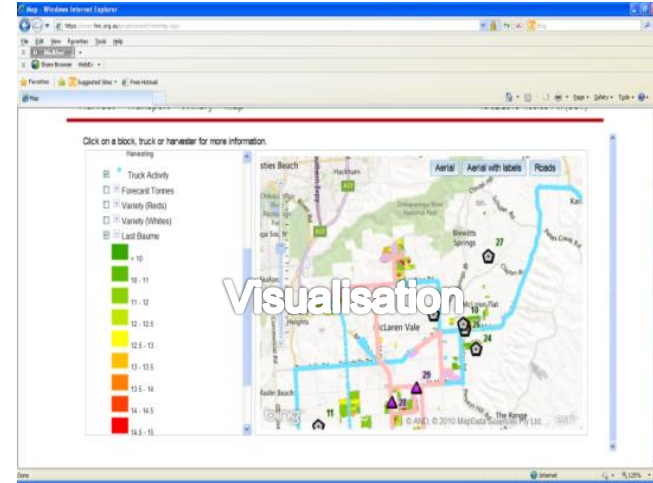
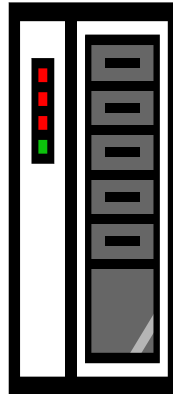
Frost Management



In the Winery



Visualising harvest in real time



3 Dashboards

Account	Booking Number	Block Name	Variety	Field Grade	Harvester ID	Area Harvested	Est. Completion Time
MAG570	3998	HUNT %	CHR	C	26 %	1.32	01:50
MAG570	3999	SCHAE %	CHR	C	28 %	1.06	03:11
VF400	4175	JARRE %	CHR	C	28 %	2.55	21:27
VF400	4176	JARRE %	CHR	C	28 %	2.55	21:27
FOMOW	4722				20 %		02:38
FOMOW	4061				20 %		02:20
FOMOW	4062				20 %		02:27
FOMOW	4723	BOSHO %	SH	B	20 %	1.45	00:42



TREASURY WINE ESTATES

Winery Baume dashboard:

Harvest Transport Winery Map Weather

25/02/2013 10:32:29 AM (CST)

Click on a block, truck or harvester for more information.

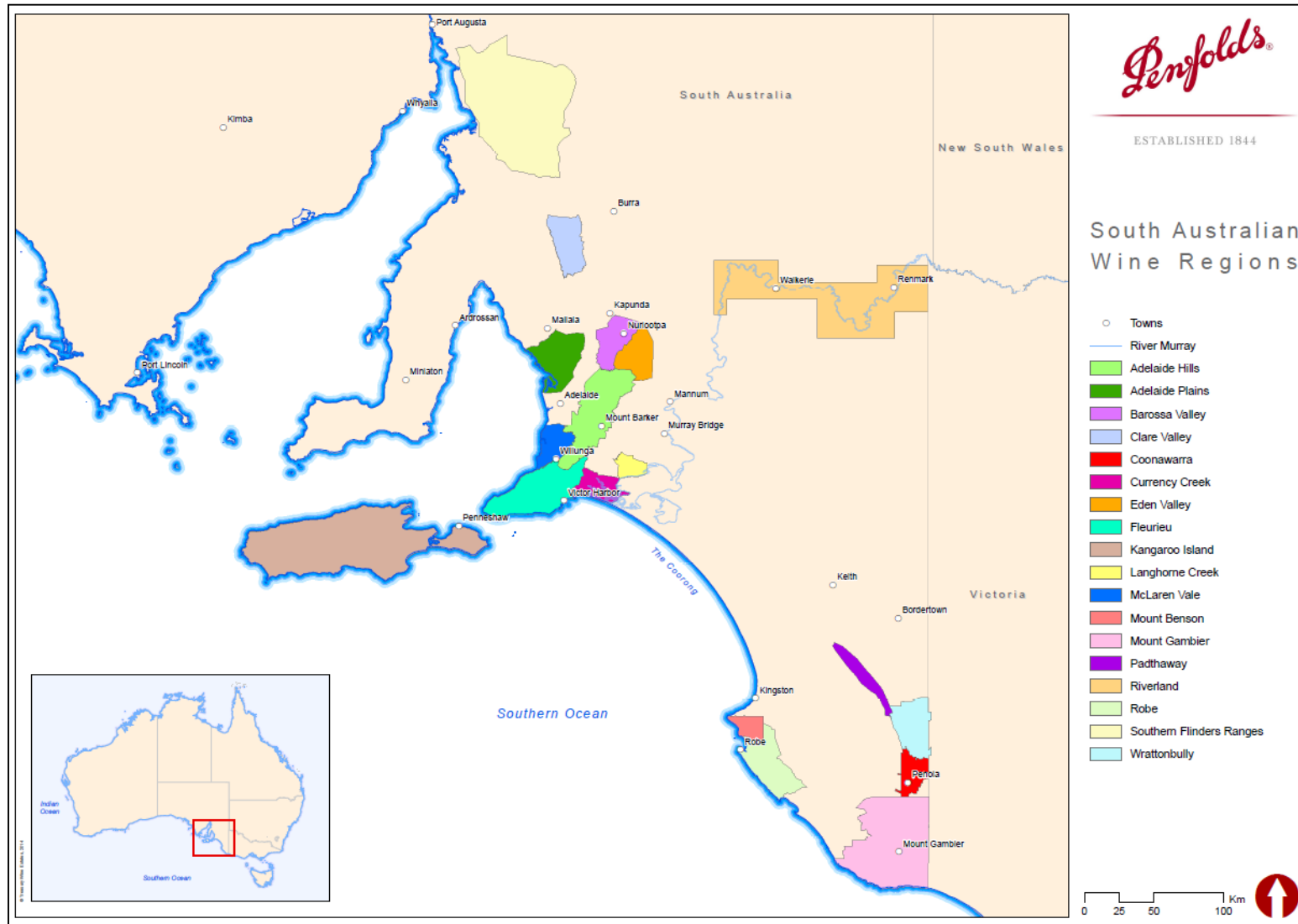


TREASURY WINE ESTATES

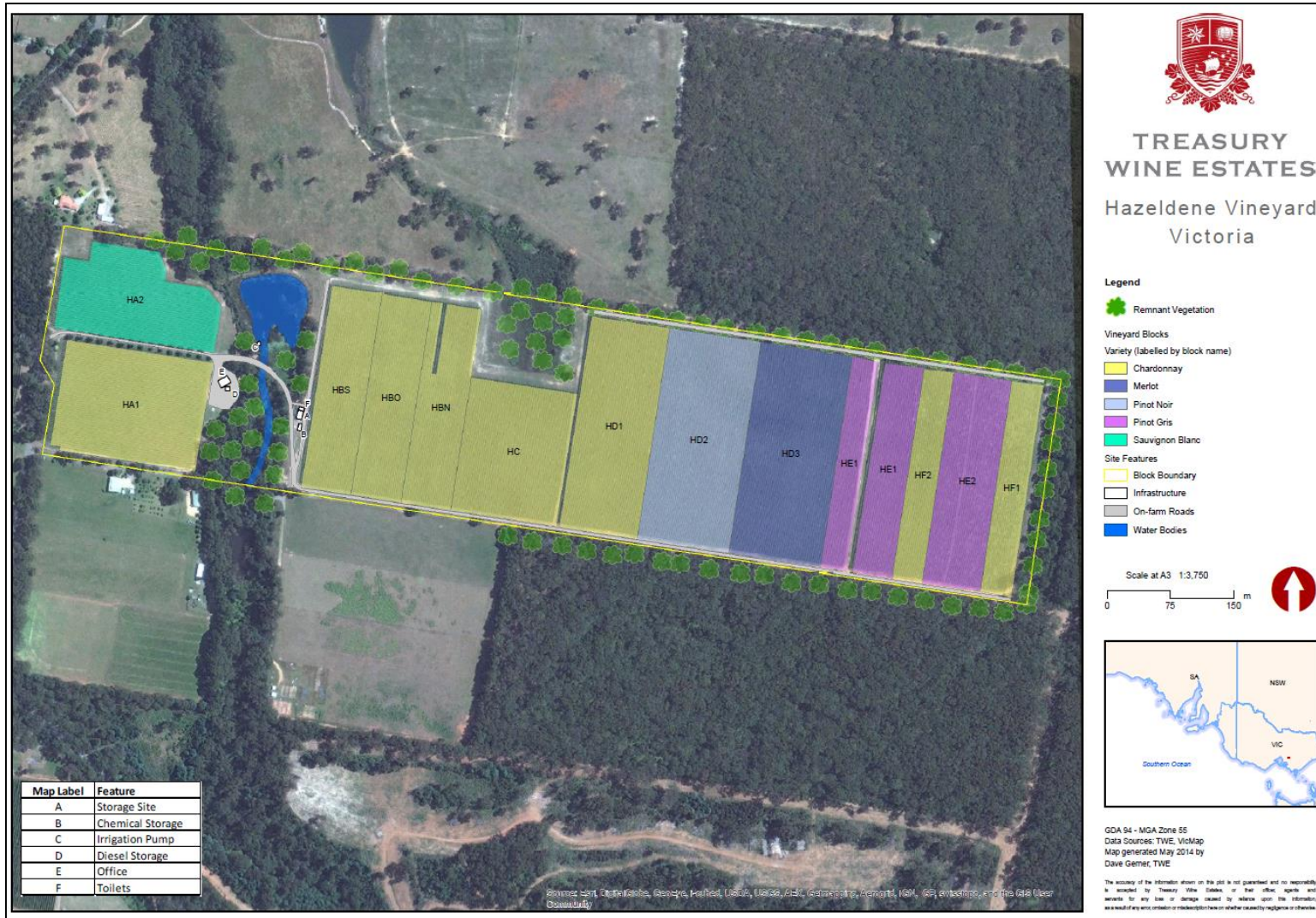
In the Cellar Door



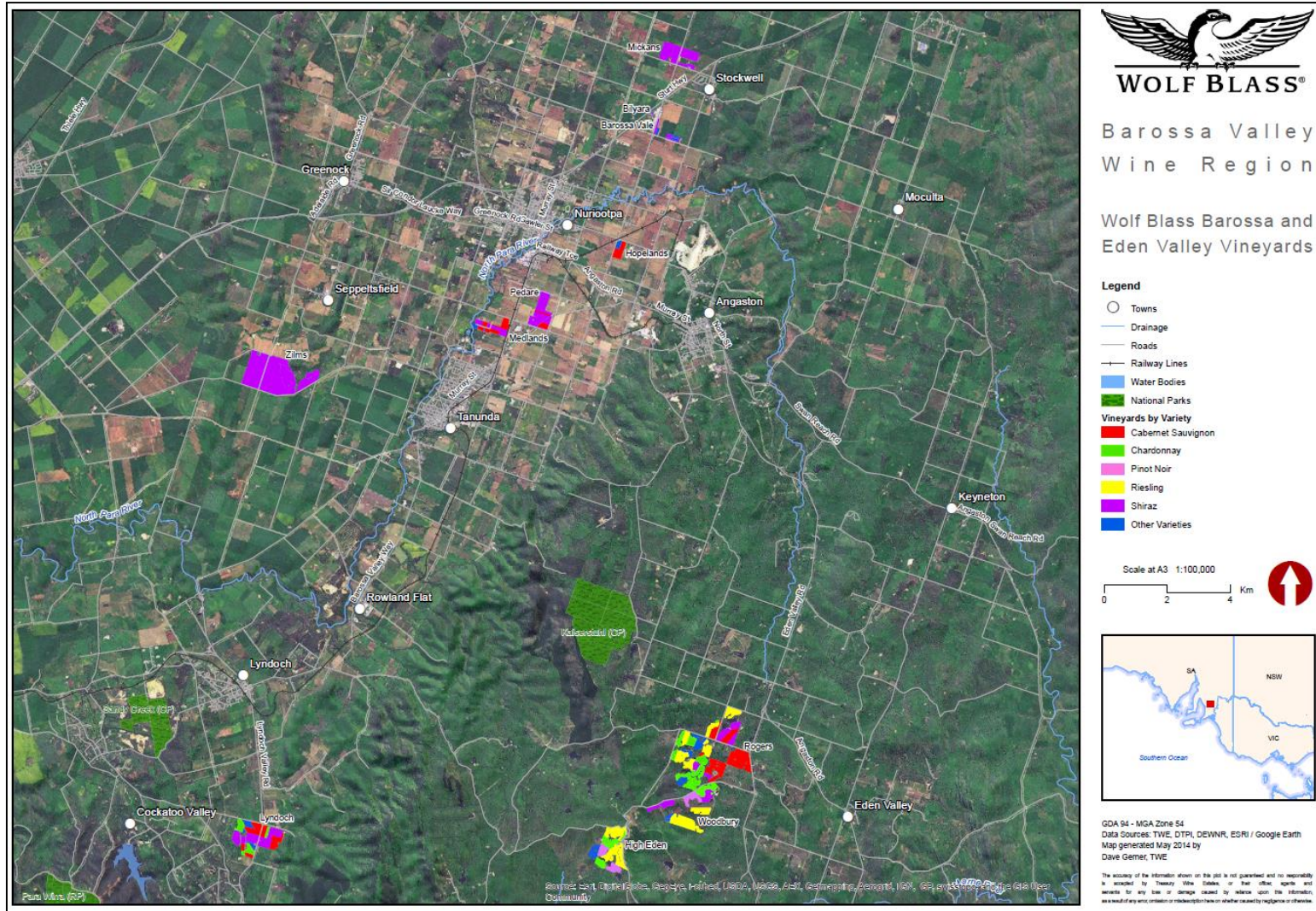
Region Mapping



Vineyard Planning – Hazeldene & Deer Farm (Victoria)



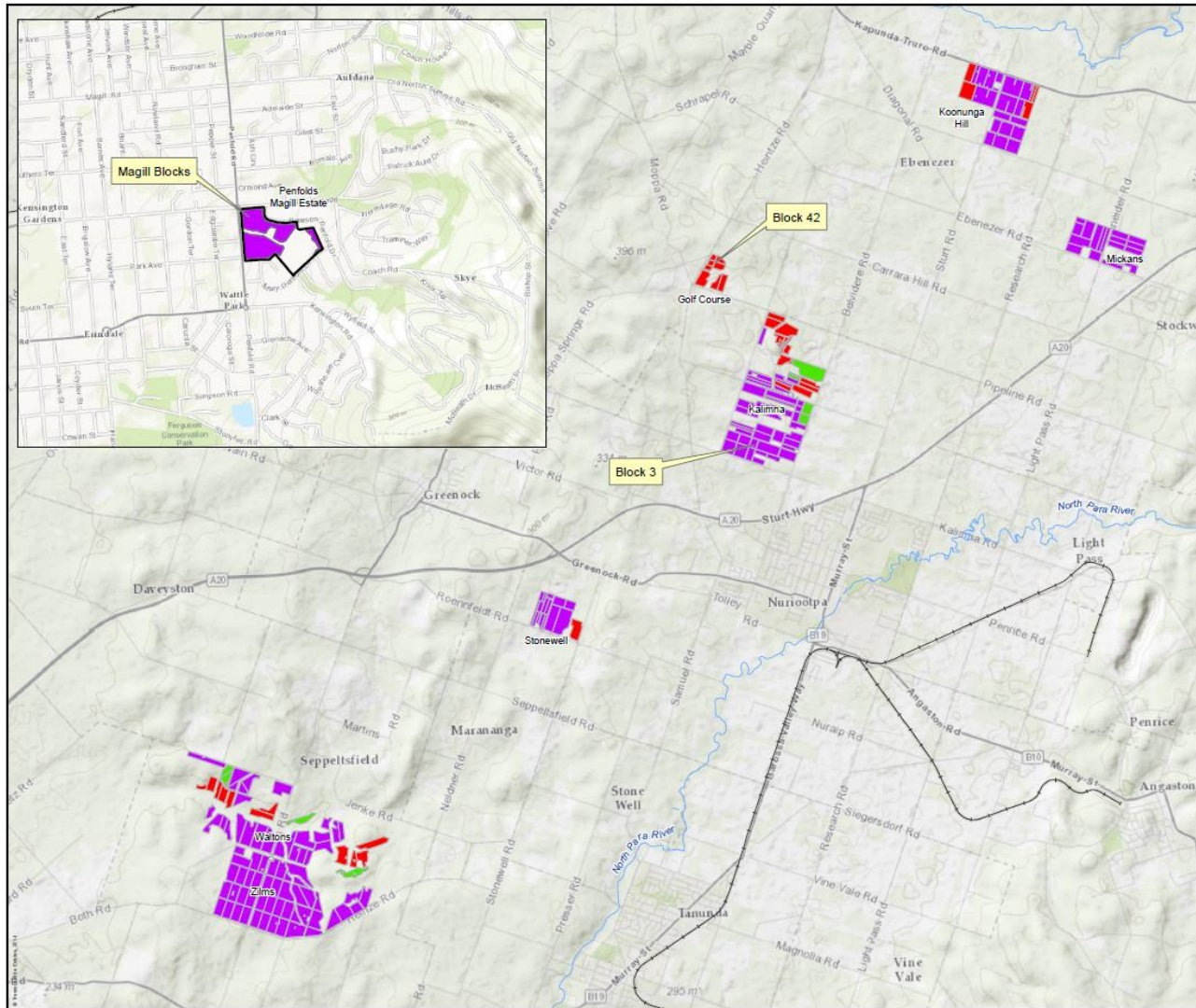
Vineyard Mapping



Sales, Marketing & Other Business Units



Sales & Marketing – Product Understanding



ESTABLISHED 1844

Penfolds Barossa & Magill Estate Vineyards

Legend

- Drainage
- Roads
- Railway Lines
- Penfolds Magill Estate
- Penfolds Barossa Vineyards by Variety**
- Cabernet Sauvignon
- Shiraz
- Other Varieties



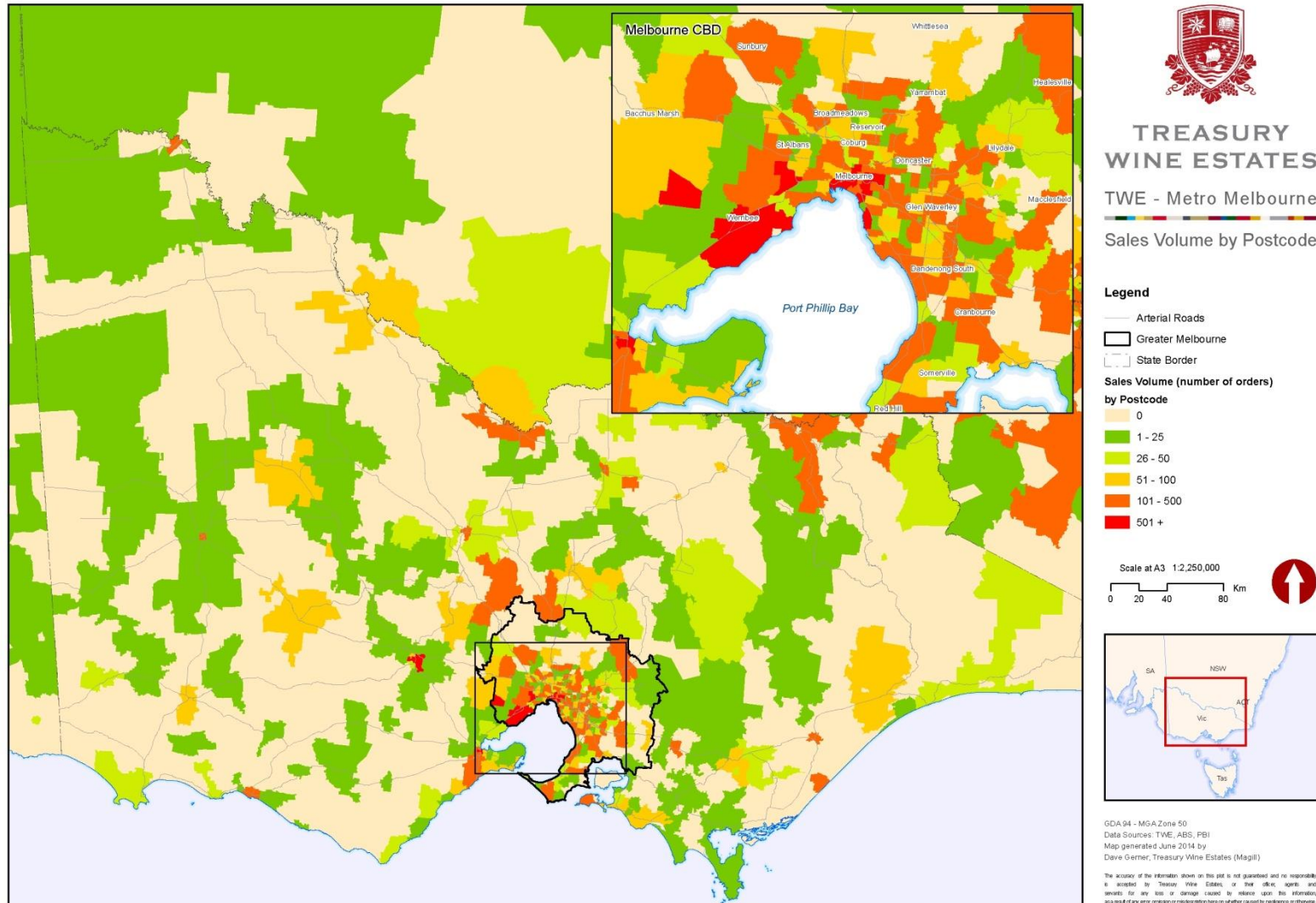
GOA 94 - MGA Zone 54
 Data Sources: TWE, DTPI, DEWNR, ESRI Basemaps
 Map generated June 2014 by
 Dave Gerner, TWE

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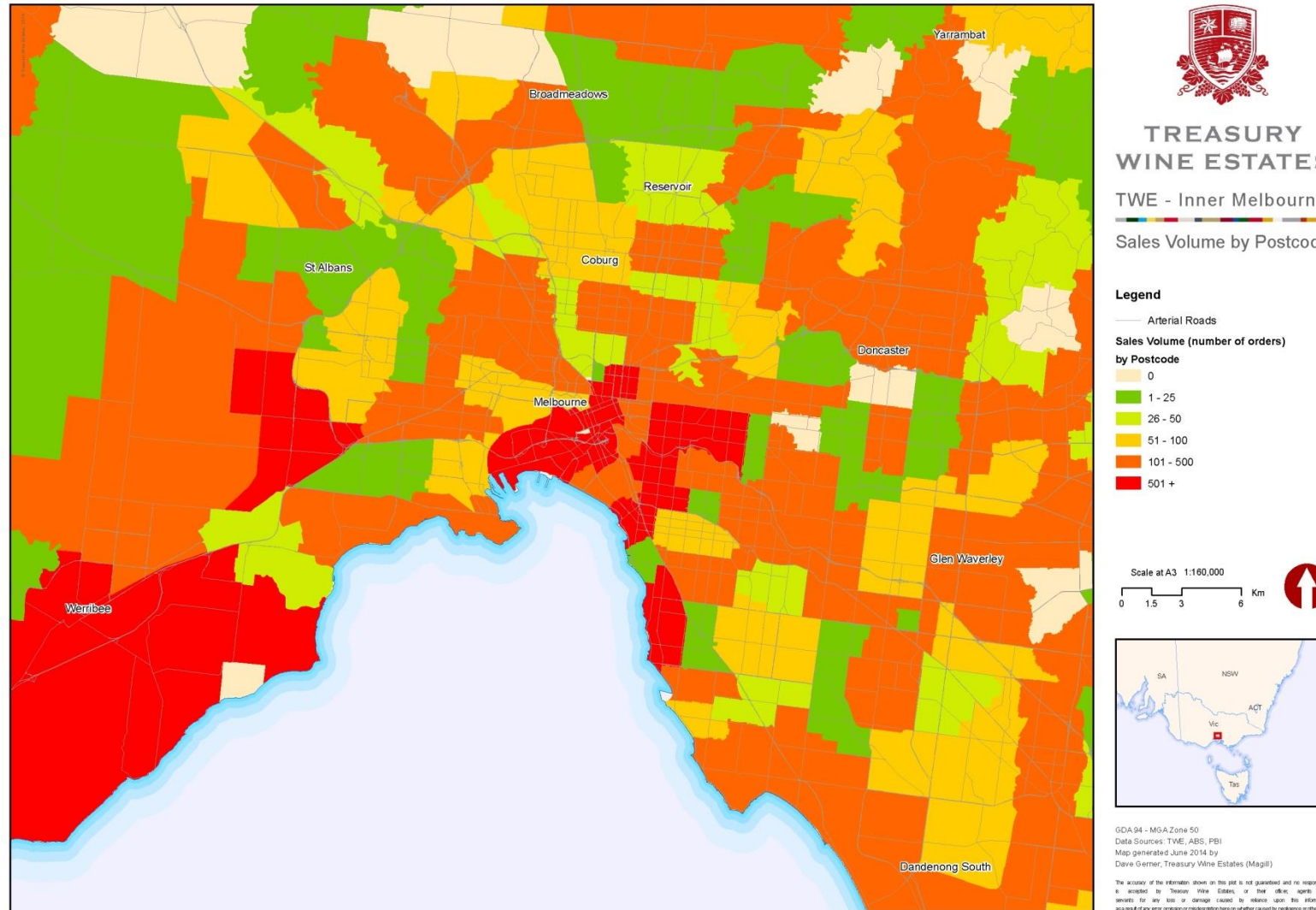


TREASURY WINE ESTATES

Sales & Marketing – Sales Volume by Postcode



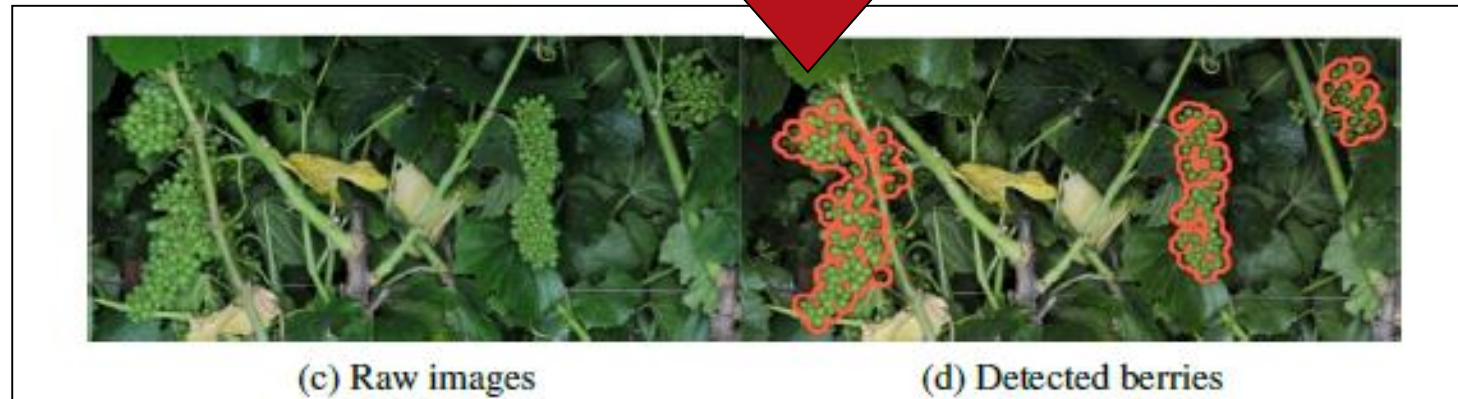
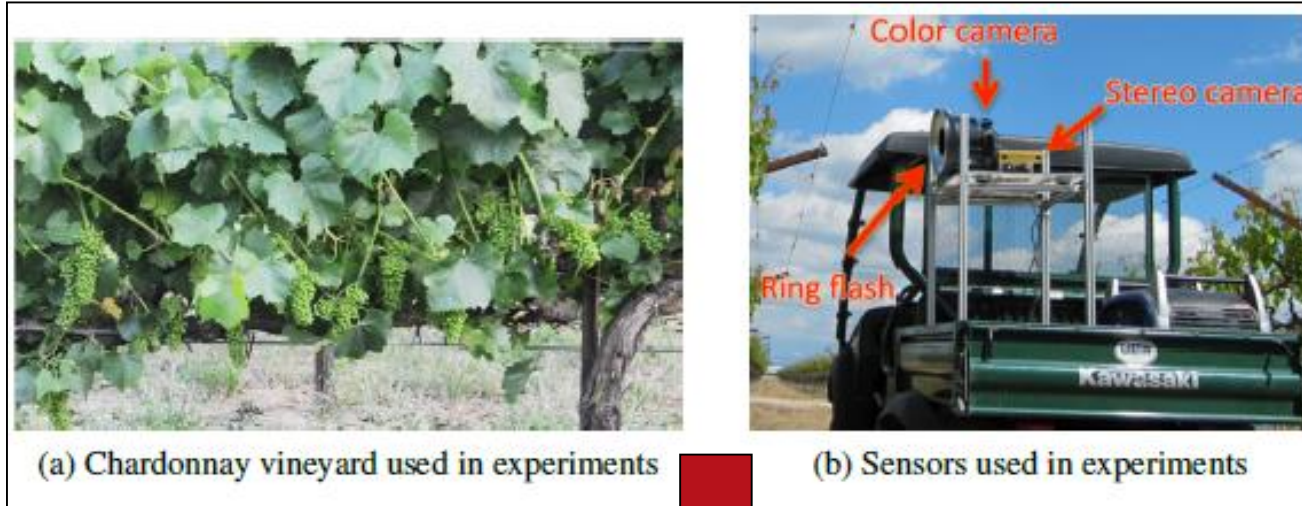
Sales & Marketing – Sales Volume by Postcode



Precision Viticulture



Image analysis for *accurate* yield estimation



Auto-steering of tractors on the horizon for Viticulture



- Controller
- GPS
- Auto-steer

Future tractor operations to be controlled from the office



Remotely Piloted Aircraft (RPAs)



Challenges & Strategies

The image is a collage of four photographs related to wine storage. The top row consists of four panels showing wine bottles in wooden racks, with a semi-transparent red overlay across the middle. The bottom row shows wine barrels on the left and more wine bottles in wooden racks on the right.

Our Challenges:

- Data-rich company: how to turn data into information
- How to deliver information to relevant stakeholders
- Geographically disparate (global)
- Single Point of Truth
- IT limitations – support, training, infrastructure
- People





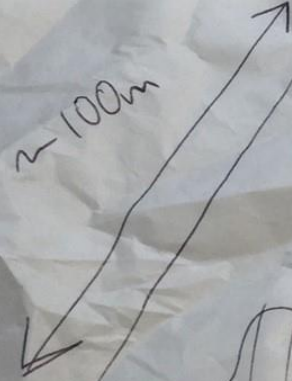




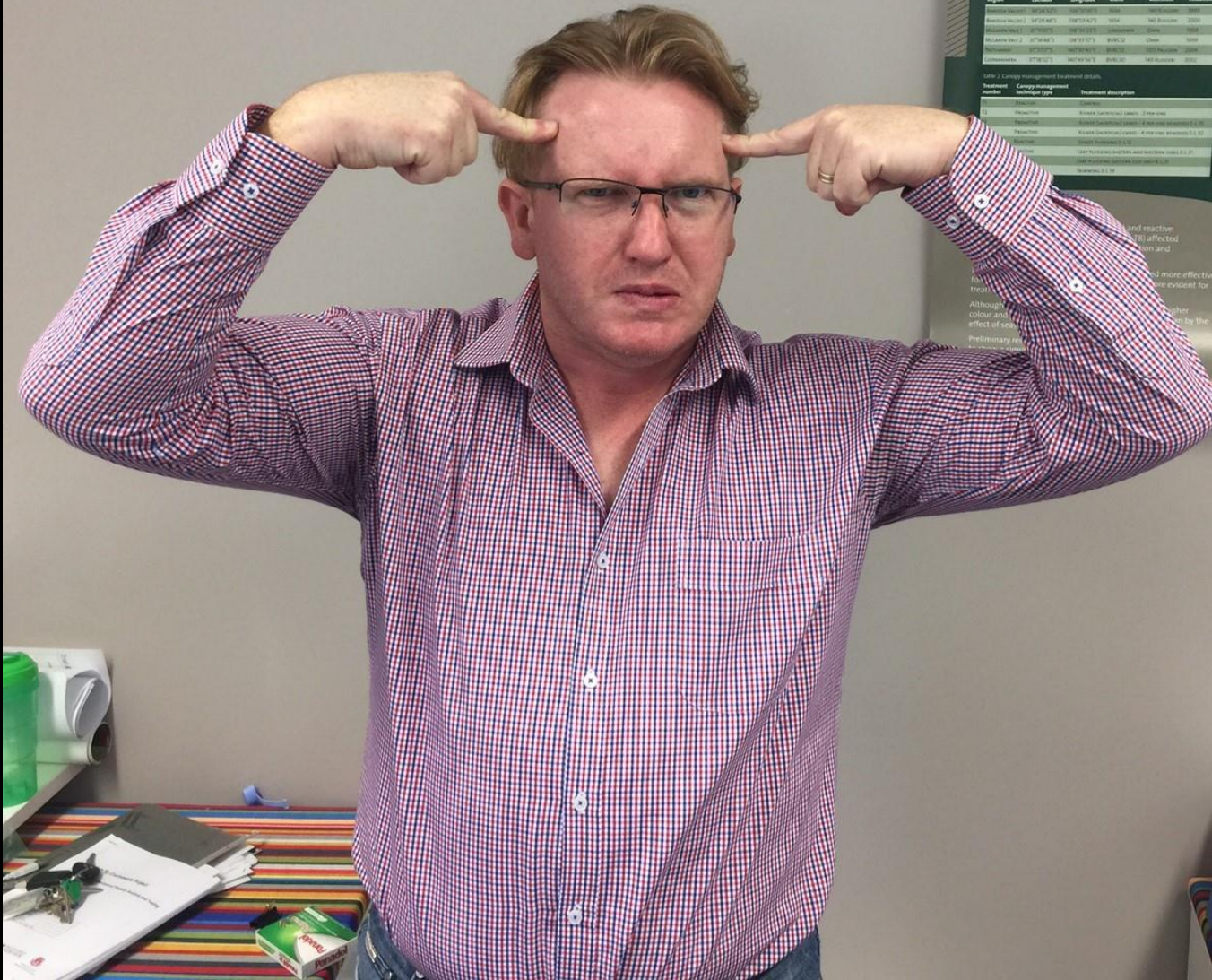




N?



\$M fruit
= most
manage
well



Methods and Experimental design

Trial sites were located in the Barossa Valley, McLaren Vale, Pathways and Coonawarra wine regions of South Australia (Table 1). At each site, a randomized replicated experiment comprised eight different canopy management techniques (Table 2). These eight treatment combinations were applied to six replicate plots consisting of six rows of fifteen vines per replicate. The effects of canopy management were assessed by measuring yield and yield components, colour and tannin. Canopy temperature per treatment was monitored hourly using tiny tag temperature data loggers placed at cordon height.

Table 1. Canopy management trial site details.

Region	Latitude	Longitude	Climate	Soil/soil type	Year established
Barossa Valley 1	34°34'45"S	138°32'42"E	Temperate	Black	1998
Barossa Valley 2	34°33'42"S	138°32'42"E	Temperate	Black	1998
Barossa Valley 3	34°32'42"S	138°32'42"E	Temperate	Black	1998
McLaren Vale 1	34°36'45"S	138°33'07"E	Temperate	Clay	1998
McLaren Vale 2	34°36'45"S	138°33'07"E	Temperate	Clay	1998
Pathways	34°33'42"S	138°32'42"E	Temperate	Black	1998
Coonawarra	34°33'42"S	138°32'42"E	Temperate	Black	1998

Table 2. Canopy management treatment details.

Treatment number	Canopy management technique type	Treatment description
1	Pruned	Standard (barossa) canopy, 2.5 m vines
2	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m
3	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m
4	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m, 1.5 m
5	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m, 1.5 m, 1.5 m
6	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m
7	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m
8	Pruned	Standard (barossa) canopy, 4 m vines, removed 2.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m, 1.5 m

and reactive (RA) affected yield and tannin. The more effective treatments were more evident for colour and tannin. Although colour and effect of canopy management was not by the preliminary results. A lack of some treatments, or that impacted yield and tannin parameters. Over time, the canopy management techniques and findings are a management

How does this affect a business?

GIS Data Management



Our Challenges:

- Data-rich company: how to turn data into information
- How to deliver information to relevant stakeholders
- Geographically disparate (global)
- Single Point of Truth
- IT limitations – support, training, infrastructure
- People



ArcGIS Online at TWE

- Provides a central data repository
- Accessible to the entire business
- Leverages existing technology
- Range of applications and solutions
- Mobile enabled
- Integrates with other IT / GIS platforms
- Easy to use / easy to train = self-sufficiency



ArcGIS Online at TWE

How we use it:

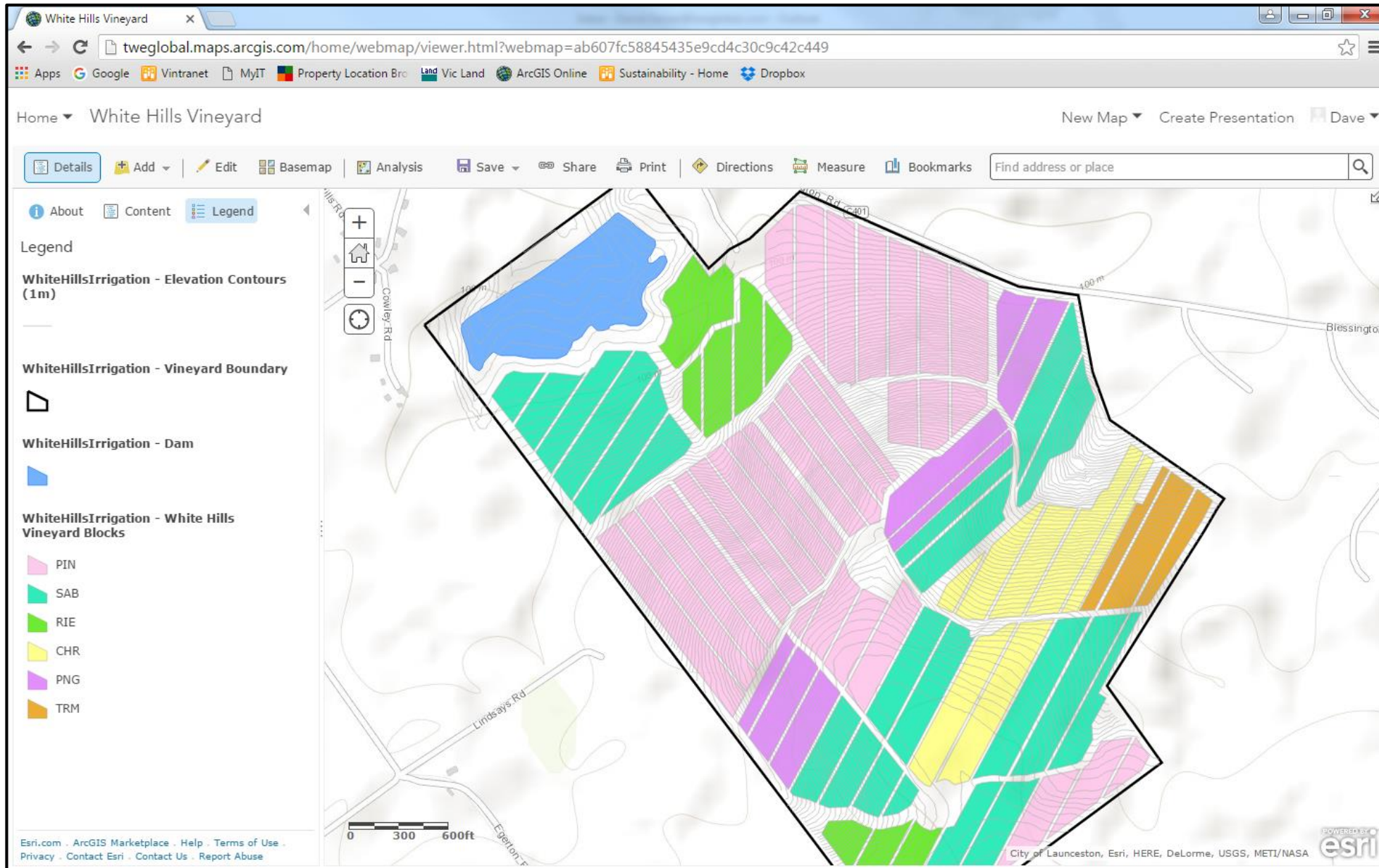
- Block boundary mapping
- Pest & Disease mapping
- Operational deployment – mulching, weed management, fertilizer application, etc.
- Asset management
- Irrigation asset mapping and maintenance
- Phenology mapping



ArcGIS Online – Vineyard Mapping



ArcGIS Online – Vineyard Mapping



ArcGIS Online – Vigour Assessment

The screenshot displays the ArcGIS Online web interface for a map titled "Robe PCD 2016". The browser address bar shows the URL: `tweglobal.maps.arcgis.com/home/webmap/viewer.html?webmap=a1580e04fa6142c5b70f705f88a8b691`. The interface includes a top navigation bar with options like "Home", "New Map", "Create Presentation", and "Dave". Below this is a toolbar with icons for "Details", "Add", "Edit", "Basemap", "Analysis", "Save", "Share", "Print", "Directions", "Measure", and "Bookmarks". A search bar on the right contains the text "Find address or place".

On the left side, there is a "Contents" panel with the following items:

- Blocks
- Dawsons 3 PCD
- Topographic

The main map area shows a topographic overlay (color-coded by elevation) over a cadastral map. The map features several land parcels labeled DCS6, DCH5, DCS4, DCS2, and DCS1. A specific parcel, DSH3, is highlighted with a blue and green topographic overlay. A scale bar at the bottom left indicates 0, 150, and 300 feet. The bottom right corner contains the Esri logo and the text "POWERED BY esri" and "Esri, HERE, DeLorme, USGS".

ArcGIS Online – Irrigation Asset Mapping

The screenshot displays the ArcGIS Online web interface for a project titled "Barossa Irrigation Data Capture". The browser address bar shows the URL: `tweglobal.maps.arcgis.com/home/webmap/viewer.html?webmap=b638d3e8fc004726b1a552d9961ce468`. The interface includes a top navigation bar with options like "New Map" and "Create Presentation", and a search bar. The main map area shows a topographic map with a blue-shaded polygon representing an irrigation system. Numerous small circular icons are scattered across this polygon, representing individual irrigation assets. A popup window titled "Irrigation Points" is open over one of these assets, showing a form with the following fields:

- TYPE:** A dropdown menu with a list of asset types: Flush Tap, Shift End, Irrigation Cable Point, Valve, Air Release Valve, Soil Moisture Probe - Diviner, Soil Moisture Probe - C Probe, Main Line Flush Tap, Well, Irrigation Line, Isolation Tap, Mainline Box, Irrigation Pressure Regulator, Water Meter - Main, Water Meter - Dam, Mainline Isolation Point, Electrical Box, and Solenoid.
- DATE:** A text input field.
- COMMENTS:** A text input field.
- Attachments:** A section with a "None" option and a "Choose File" button.
- Edited by:** TWEAdmin

The left sidebar contains an "Add Features" panel with a list of "Irrigation Points". The bottom of the interface features a scale bar (0 to 0.3 miles) and the Esri logo.

ArcGIS Online – Pest & Disease Assessment



ArcGIS Online – Pest & Disease Assessment



A screenshot of the ArcGIS Online web interface for a pest and disease assessment map. The browser address bar shows the URL: `tweglobal.maps.arcgis.com/home/webmap/viewer.html?webmap=ff98ce9342a245a1b8b0c04a658be7db`. The page title is 'MCV Powdery'. The interface includes a search bar, navigation tools, and a 'Change Style' panel on the left. The 'SEVERITY' legend is visible, showing a table of labels and counts. The map shows an aerial view of a vineyard with colored dots representing different severity levels. A legend pop-up is visible in the bottom right of the map area.

LABEL	COUNT
0 (0%)	551
1 (1 - 3%)	212
2 (4 - 25%)	119
3 (26 - 50%)	77
4 (51% +)	72
Other	0



An aerial photograph of a vineyard with rows of grapevines. A person in a red shirt is walking through the rows on the left side. A dark red horizontal band is overlaid across the middle of the image, containing the text "Thank you & Questions" in white.

Thank you & Questions