MARGARET RIVER REGIONAL PROFILE

Viticultural Practices

INTRODUCTION ---- 3
- Grower survey ---- 3
- Industry associations ---- 3
- Education ---- 3

Regional statistics ---- 4
Site selection ---- 10
- Land capability ---- 10
- Slope ---- 11
- Aspect/Topography ---- 11
- Elevation ---- 11
- Proximity to bodies of water ---- 12

Vineyard establishment ---- 12
- Planting preparation ---- 13
- Block layout ---- 13
- Row and vine spacing ---- 13
- Row orientation ---- 13
- Planting material ---- 14
- Trellising - posts ---- 14
- Establishment costs ---- 15

Vineyard floor management ---- 16
Irrigation ---- 18
Training systems and canopy management ---- 19
Uneven budburst ---- 21
Pruning practices ---- 21
Pest and disease management ---- 24
Precision viticulture ---- 24
Vineyard recording systems ---- 25

Index of Tables and Figures

Table 1. Bearing hectares for the Margaret River region (2004-2005). Australian Wine and Brandy Corporation, 2006. 4
Table 2. Most common varieties from the Margaret River region. From the MRWIA website, (2007) 6
Table 3. Tonnes harvested from the Margaret River region. From the MRWIA website, (2007). 6
Figure 1. Tonnes crushed of most common varieties in the Margaret River region. From the MRWIA Website, 2007. 7
Figure 2. Tonnes crushed of other red wine grape varieties. Australian Wine and Brandy Corporation "Winefacts Statistics", 2006. 7
Figure 3. Tonnes crushed of other white wine grapes varieties. Australian Wine and Brandy Corporation "Winefacts Statistics", 2006. 8
Figure 4. Proportion of red varieties planted – percentage of total hectares. Created using data from the Australian Wine and Brandy Corporation "Winefacts Statistics", 2006. 8
Figure 5. Proportion of white varieties planted – percentage of total hectares. Created using data from the Australian Wine and Brandy Corporation "Winefacts Statistics", 2006. 9
Table 4. Grape Production in the South West Region 9
Table 5. Land capability for viticulture – hectares. (Department of Agriculture, WA, 2003). . 10
Table 6. Land capability for viticulture – percent of total shire area. (Department of Agriculture, WA, 2003). 10
Table 7. Approvals which may be required when establishing a vineyard. Department of Environmental Protection and the Water and Rivers Commission. (2002). 12
Table 8. Required separation distances for new and/or expanding vineyards to sensitive water resources. Department of Environmental Protection and the Water and Rivers Commission. (2002). 12
Table 9. General views on row orientation. Grower discussion group, 2006. 14

INTRODUCTION

Viticulture practices in the Margaret River region are highly varied, depending on end product specifications, site parameters and company philosophies. As such, it is difficult to summarize regional practices as a whole. Instead, general information as to the types of practices used will be provided.

Grower survey

A survey was sent out to a large number of growers with the aim of collecting information on individual practices and management requirements of different sites. The information received will be used anecdotally in this section of the profile. In addition to the survey, numerous grower discussion groups were held in order to obtain general feedback on issues of particular concern to local growers.

Industry associations

People in the local industry have a number of associations that they can be members of:
Margaret River Wine Industry Association (MRWIA) - http://www.margaretriverwine.org.au
Wine Industry Association of Western Australia (WIAWA) - http://www.winewa.asn.au
Augusta and Margaret River Tourism Association (AMRTA) - http://www.margaretriver.com

Education

Margaret River Senior High School (MRSHS)
MRSHS is a partner in the Margaret River Education Campus, allowing Year 11 and 12 students to take part in viticulture and wine making courses. The Campus offers MRSHS students the unique opportunity to gain vocational qualifications prior to finishing school and continue their education at the Campus.

- For more information, see http://www.mrshs.wa.edu.au

Curtin University of Technology – Muresk Institute
The Centre for Wine Excellence is located at the Margaret River Education Campus. The Campus is a joint initiative of the Margaret River Senior High School, Department of Education and Training, South West Regional College of TAFE, Curtin University of Technology and Edith Cowan University. Within the Campus, Curtin is the lead partner in the Centre for Wine Excellence, which comprises a teaching winery, chemistry laboratories, sensory evaluation and research laboratories, classrooms and resource centre. This pivotal location allows Muresk Institute's viticulture and oenology students to access leading vineyards and wineries to complement their theoretical studies.
Courses offered:
Bachelor of Science (Viticulture and Oenology)
Associate Degree in Viticulture
Master of Science (Viticulture)

- For more information, see http://muresk.curtin.edu.au

South West Regional College of TAFE
Certificate II in Food Processing (Wine & Viticulture)
In conjunction with the Centre for Wine Excellence the world class wine training facility at the Margaret River Education Campus.

- For more information, see http://swrc.tafe.wa.edu.au

Chemcert WA
ChemCert training courses educate vineyard staff and managers on risk management associated with chemical use, duty of care obligations, quality assurance and environmental management. Focus is also given on how to improve integrated pest management programs, in order to reduce overall chemical use where possible.
Courses offered:

1. Using Chemicals Safely - an entry level programme designed for students, apprentices and people who use chemicals under supervision.
2. Risk Management in Pesticide Use - essential chemical use training for owner-managers and workers. ChemCert's core course.
3. Reaccreditation Course - to maintain ChemCert accreditation after 5 years and bring chemical users up to date on best practice in risk management in farm chemical use.
4. Spray Application in Vineyards - a specialist course to broaden chemical management skills of people spraying in vineyards. These courses are ideal for reaccreditation.

- For more information, see http://www.chemcertwa.com.au

Regional statistics

Although the region contributes only 3 per cent of the country's wine grapes, it commands over 20 per cent of today's premium wine market (MRWIA website, 2006).

Table 1. Bearing hectares for the Margaret River region (2004-2005).

Australian Wine and Brandy Corporation, 2006.

Red/White/ Multipurpose	Variety	Bearing hectares
Multi-purpose	Muscat Gordo Blanco	5.80
Multi-purpose	Sultana	4.00
Multi-purpose	**Total**	**9.80**
Red	Barbera	2.40
Red	Cabernet Franc	416.58
Red	Cabernet Sauvignon	1,243.00
Red	Grenache	13.70
Red	Malbec	37.50
Red	Mataro	6.20
Red	Merlot	537.80
Red	Muscat a Petits Grains Rouge	1.70
Red	Nebbiolo	2.80
Red	Other Red	44.50
Red	Petit Verdot	37.20
Red	Pinot Noir	26.70
Red	Sangiovese	3.00
Red	Shiraz	848.40
Red	Tempranillo	7.30
Red	Touriga	0.40
Red	Zinfandel	6.10
Red	**Total**	**3,235.28**
White	Chardonnay	738.00
White	Chenin Blanc	73.00
White	Marsanne	7.10
White	Muscadelle	0.10
White	Other White	9.10
White	Riesling	67.00
White	Sauvignon Blanc	454.60
White	Semillon	467.90
White	Traminer	0.60
White	Verdelho	60.10
White	Viognier	30.40
White	**Total**	**1,907.90**
Total		**5,152.98**

Table 2. Most common varieties from the Margaret River region.
From the MRWIA website, (2007)

Most Widely Harvested Varieties	
Cabernet Sauvignon	5,655 (tonne crushed 2006)
Shiraz	4,665 (tonne crushed 2006)
Merlot	2,179 (tonne crushed 2006)
Chardonnay	3,981 (tonne crushed 2006)
Semillon	4,624 (tonne crushed 2006)
Sauvignon Blanc	4,483 (tonne crushed 2006)

Table 3. Tonnes harvested from the Margaret River region.
From the MRWIA website, (2007).

Tonnage Figures		
2006 vintage	28,637 tonne	56% white 44% red
2005	30,630 tonne	49% white 51% red
2004	35,101 tonne	46% white 54% red
2003	26,178 tonne	43% white 57% red
2002	25,751 tonne	41% white 59% red
1999	13,041 tonne	62% white 38% red

(Statistics have been collected from Australian Bureau of Statistics, Association's own records and other wine industry associations.)

Figure 1. Tonnes crushed of most common varieties in the Margaret River region. From the MRWIA Website, 2007.

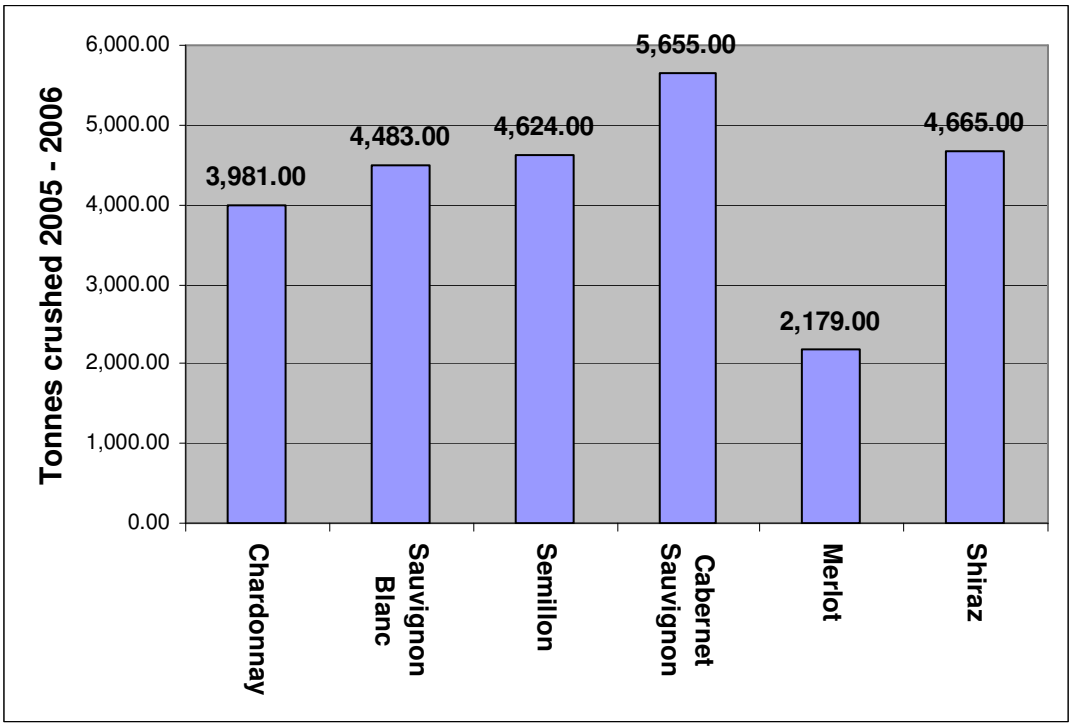


Figure 2. Tonnes crushed of other red wine grape varieties. Australian Wine and Brandy Corporation "Winefacts Statistics", 2006.

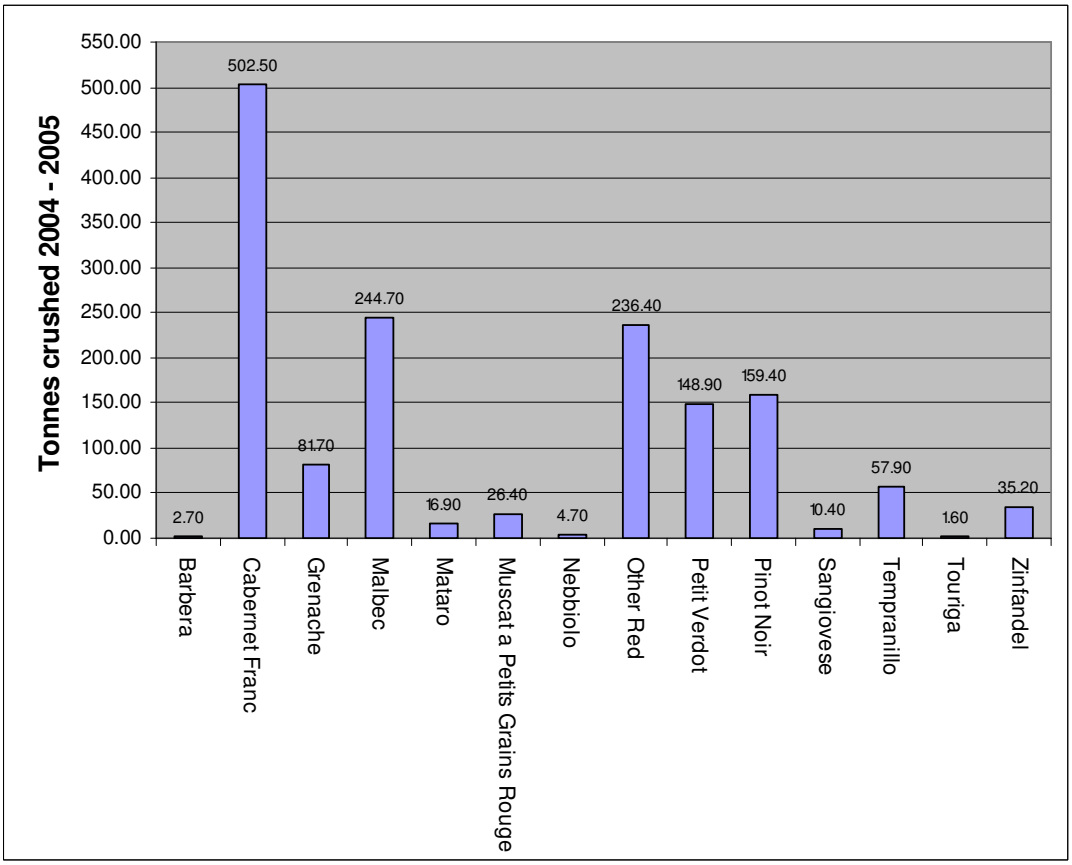


Figure 3. Tonnes crushed of other white wine grapes varieties.

Australian Wine and Brandy Corporation "Winefacts Statistics", 2006.

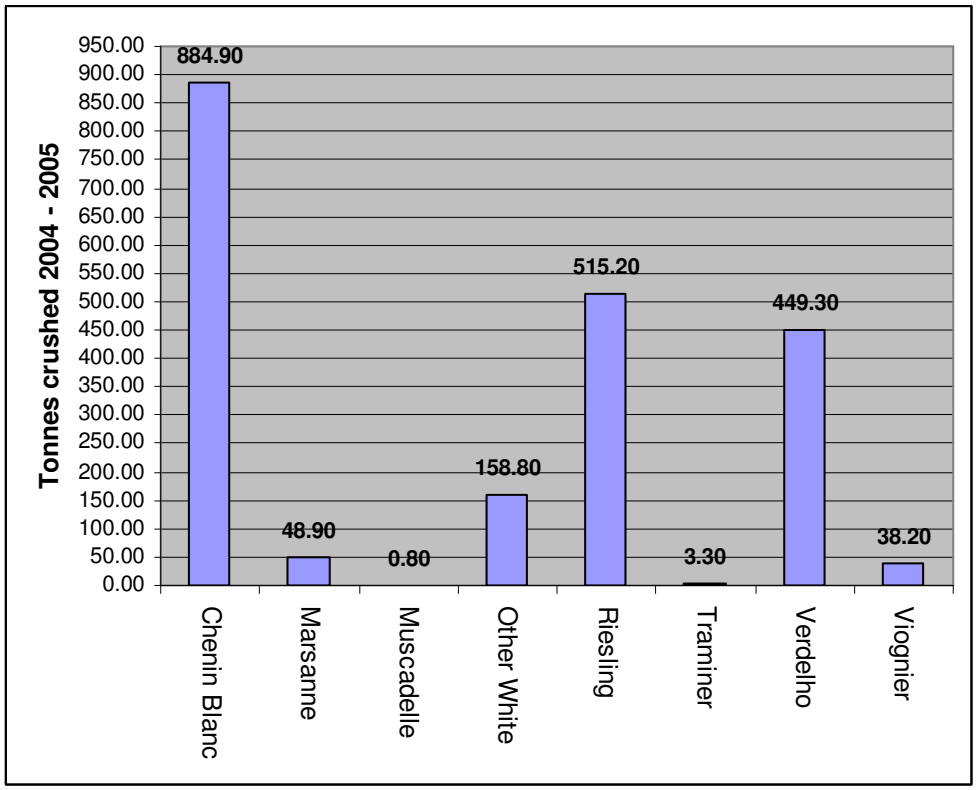


Figure 4. Proportion of red varieties planted – percentage of total hectares. Created using data from the Australian Wine and Brandy Corporation "Winefacts Statistics", 2006.

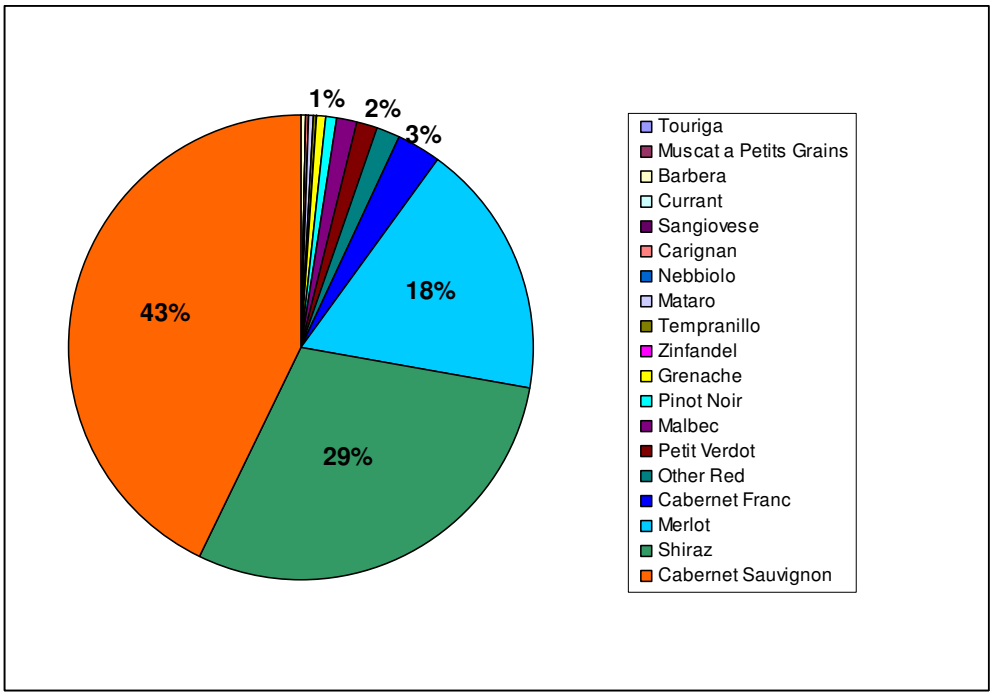
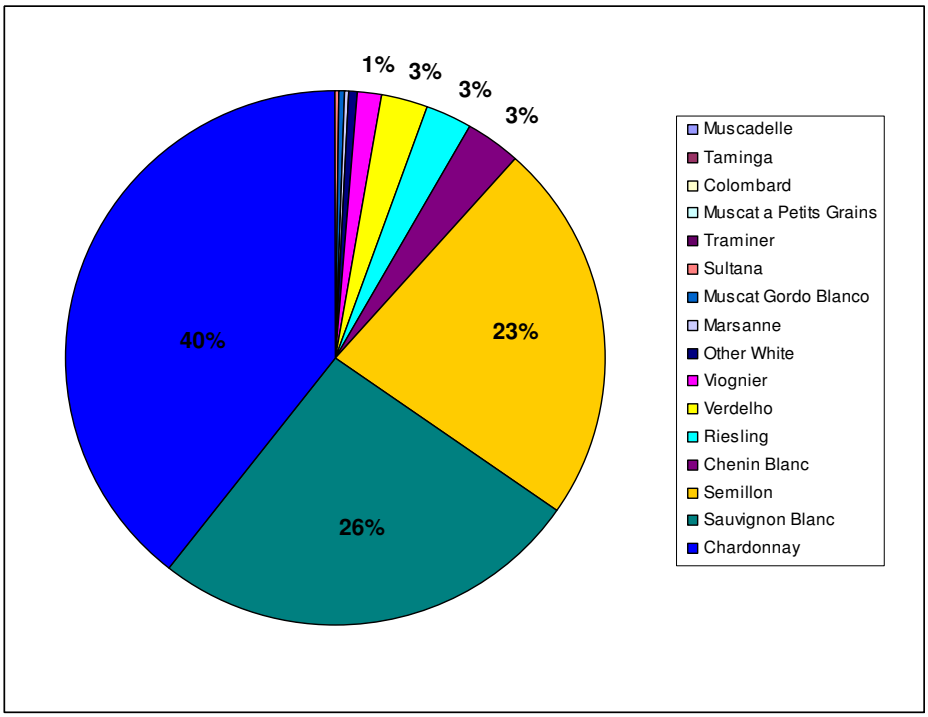


Figure 5. Proportion of white varieties planted – percentage of total hectares. Created using data from the Australian Wine and Brandy Corporation "Winefacts Statistics", 2006.



The Margaret River wine region is made up predominately of boutique size wine producers, although winery operations range from the smallest crushing 3.5 tonne per year to the largest around 7000 tonne. The current number of wineries/grape growers is 183 (2006).

Margaret River makes the largest contribution to the economy through grape production in WA (Table 4.) In 2006, the value of grape production was $32,808,116 greater in Margaret River compared to its nearest competitor, Geographe.

Table 4. Grape Production in the South West Region

Region	Tonnage (Crushed)			Estimated Value ($)		
	2003	**2005**	**2006**	2003	2005	2006
Blackwood Valley	2,083	1,930	1,617	2,389,653	2,301,336	1,625,873
Geographe	3,405	5,761	4,645	4,005,596	6,095,772	5,035,162
Manjimup	1,029	1,418	542	1,343,671	1,938,670	738,737
Margaret River	22,172	30,631	25,015	35,146,106	44,046,249	37,843,278
Pemberton	4,511	4,364	3,631	6,705,524	6,129,619	4,396,583

Source: Wine Grape Utilisation Survey, 2001-2006 (Extract from SWDC website).

Notes: Data from 2004 unavailable as the survey was not conducted for that year.

Site selection

Initial site selection and vineyard design is essential in determining the potential wine quality and quantity for a given vineyard. Although many factors can be manipulated via vineyard management techniques, it is critical that environmental, climate and soil parameters be considered prior to establishing a new vineyard. This section will only include information not covered in the *Regional Climate* and *Regional Soil Types* chapters of this profile.

Land capability

The shire document "Augusta-Margaret River Regional Profile" is a background into the location, demographics, economy and environment of the Shire of Augusta-Margaret River and was prepared by the Resource Futures Program, CSIRO Sustainable Ecosystems (2005). Under Section 4.4, *Viticulture in Augusta-Margaret River*, it states:
"The land most suited to viticulture is located around the Margaret River Township, with smaller sections of best quality land located between the Bussell Highway and Caves Road. The coastal area is not suited to grape production (due to sandy soils). The area surrounding and inland from, Margaret River is also very suitable for viticulture. Of the 99,100 hectares of private land in the Shire, 40,300 hectares have a very high or high capability for grape vines, representing 41% of private land. Moderate capability for grape vines is found on 31,000 hectares of private land, representing 31% of private land (Department of Agriculture, WA, 2003). The total area of private land in the Augusta-Margaret River Shire with a land capability of moderate to very high is 72% compared to 62% in the Busselton Shire, and 58% in the Capel Shire.

Table 5. Land capability for viticulture – hectares. (Department of Agriculture, WA, 2003).

Shire	Total area	Reserve area	Area of private land	Area of cropping capability 1&2 (on private land)	Area of cropping capability 3 (on private land)
Aug/M-River	224,400	125,400	99,100	40,300	31,000
Busselton	145,400	52,100	93,300	30,500	27,500
Capel	55,700	12,900	42,800	8,600	16,300
Total	425,500	190,300	235,200	79,400	74,800

Table 6. Land capability for viticulture – percent of total shire area. (Department of Agriculture, WA, 2003).

Shire	Total area	Reserve area	Area of private land	Area of cropping capability 1&2	Area of cropping capability 3
Augusta, M-River	100%	56%	44%	18%	14%
Busselton	100%	36%	64%	21%	19%
Capel	100%	23%	77%	15%	29%
Total	100%	23%	77%	19%	18%

Land capability classes: 1 = very high, 2 = high, 3 = moderate, 4 = low, 5 = very low. For more detailed descriptions of capability classes, see the WA Department of Agriculture's *AGMaps Land Profiler – Shires of Capel, Busselton & Augusta-Margaret River,* CD ROM (2003).

Slope

The slope is the inclination or declination that a parcel of land varies from the horizontal, usually expressed as a percentage. For example, a 5-metre fall over a 100-metre horizontal distance would be a 5% slope. Slope can be accurately measured with an inexpensive, handheld inclinometer. Planting on slopes is utilized in wine regions at latitudes of 47^0 or higher, in order to increase the amount of incident radiation. In Australia, however, slopes can be used to advantage in cool climates where frosts prevail. Sloping land allows cold air to drain down into flatter land areas and valleys, and differences of up to 10^0C have been recorded between high and low points (Spurling and Jennings, 1956). In addition, heat loading and light interception are optimized in vineyards planted on north-facing slopes (Southern Hemisphere). Land slope also is important for surface and, to some extent, internal soil water drainage. As discussed later, surface and internal soil drainage are extremely important, and a slope is conducive to these movements. In "Reference Soils of South-Western Australia", W.M. McArthur (1991) defines slope categories as:
Level <1%
Very gently inclined 1-3%
Gently inclined 3-10%
Moderately inclined 10-32%
Jackson and Schuster (Cool Climates, 1997) recommend that in areas with high rainfall and erosion-prone soils, slopes exceeding 7-10^0 should be terraced.

Aspect/Topography

The aspect of a slope refers to the prevailing compass direction which the slope faces. Aspect will affect the angle that sunlight hits the vineyard and thus its total heat balance. Vineyards should be exposed to direct sunlight for at least a portion of the day; with north, east, and west-facing exposures being optimal (Gladstones, 1992). The early morning exposure advances the start of temperature and light dependent photosynthesis and results in more rapid drying of foliage and fruit, potentially reducing disease problems. Aspect also influences exposure to cool winds, which may potentially lower the heat budget of a site, even in sunny weather (Coombe and Dry, 1988).
Rainfall is also affected by aspect, with higher amounts received on windward side of hills.

Elevation

The elevation of a site influences wind exposure and temperature. Temperature can decrease by 0.5-0.6^0C with each 100m increase, and vineyards with an elevation difference of more than 200m can experience delays in ripening of 2-3 weeks compared to those on lower ground (Coombe & Dry, 1988).

Precision viticulture technologies have allowed changes in relief over a given area to be mapped, establishing block boundaries to minimize vine variation. Contour variations can be categorised as follows (W.M. McArthur, 1991):

Very low	9-30m
Low	30-90m
High	90-300m

On some sites *microrelief* can be caused by the swelling of soils with high clay contents, causing alternate mounding and depressions of 2-4m diameter.

Proximity to bodies of water

Vineyard sites located in coastal areas generally experience a moderated diurnal temperature range (Gladstones, 1992). Water has a much greater specific heat than land, enabling it to store more heat per unit mass and buffer against temperature extremes. Many vineyards in the Margaret River region are located within a few kilometres of the coastline and receive the benefit of increased relative humidity and reduced afternoon temperatures as differential heating and cooling patterns between land and water cause local convention cycles.

Vineyard establishment

Before planting can begin, certain development approvals must be sought from appropriate agencies. Vineyard sites in the Margaret River Region will be located in either the Shire of Busselton or the Shire of Margaret River.

Table 7. Approvals which may be required when establishing a vineyard. Department of Environmental Protection and the Water and Rivers Commission. (2002).

Approval required	Comments	Agency
Development	Must be consistent with town planning scheme and local by-laws.	Local Shire
Environmental	An environmental impact assessment may be required under Part IV of the Environmental Protection Act.	Department of Environmental Protection
Development near prescribed water resources, such as public drinking water sources or waterways management areas	A permit is required for Priority 2 & 3 Underground Water Pollution Control Areas. Vineyards are unacceptable in Priority 1 source protection areas, wellhead protection zones, reservoir protection zones, and within buffers to designated waterways and wetlands.	Waters and Rivers Commission
Licence to draw water from water resources	Required to draw water from a proclaimed Goundwater Area or if drawing from a confined aquifer.	Waters and Rivers Commission
	Required to draw water from a proclaimed Surface Water Catchment.	Waters and Rivers Commission
Land clearing (for clearing >1 hectare of land)	Commissioner of Soil Conservation has responsibility to issue approvals to clear land.	Department of Agriculture
Aboriginal heritage	Aboriginal sites must be protected	Department of Aboriginal Affairs

Table 8. Required separation distances for new and/or expanding vineyards to sensitive water resources. Department of Environmental Protection and the Water and Rivers Commission. (2002).

Water resource	Minimum separation distance	Comments
Bores, wells, soaks, and dams used for private water supply	100 m	Under the *Metropolitan Water Supply, Sewerage and Drainage Act, 1909*.

Well used for public water supply	300 m	Under the *Metropolitan Water Supply, Sewerage and Drainage Act, 1909*.
Wetlands and estuaries	200 m	In order to reduce nutrient inputs and sediment transfer.
Banks of permanent streams/rivers	100 m	In order to reduce nutrient inputs and control turbidity from potential sources.
Banks of natural watercourses that flow intermittently	50 m	In order to reduce nutrient inputs from potential sources.
Ground water table (historical maximum level water table to ground surface)	1.5 m	In order to reduce nutrient inputs from potential sources.

Planting preparation

Preparation for planting is largely dependent on soil type. Recommendations for soil amendments are given for each soil type in the *Regional Soil Types* chapter of this profile.

Block layout

Block layout in the region commonly involves an initial assessment of soil type boundaries. This can be achieved conventionally by digging soil pits and determining available land area for planting and which varieties are most suitable to the soil types present. As discussed later, precision viticulture technologies are increasingly utilised for this process.

Row and vine spacing

Although there is a large degree of variation in this parameter across the region, results from the grower survey revealed that the most common row by vine spacing in the region is 3m rows x 2m vine spacing, followed closely by 3m rows x 1.8m vine spacing.

Row orientation

Row orientation is considered to be quite an arbitrary issue in the Margaret River region, with most growers having a subjective view of the benefits of their chosen layout. No regional data was available as to the proportion of hectares planted with north-south vs. east-west row orientation. However, results of the grower survey revealed that north-south orientation was more common. A discussion group with 25 local growers provided the feedback in Table 9. This information expresses the opinions of those who attended the discussion and does not seek to represent the region's views as a whole.

Table 9. General views on row orientation. Grower discussion group, 2006.

Row orientation	Pros	Cons
North-south	More even ripening	West side of row is exposed during hottest part of the day
	Full illumination of both sides of the canopy for equal times of the day	Heat damage and sunburn on west side of canopy on very hot days
	Considered better for red varieties in eliminating unripe characters	Not recommended for planting on north-facing slopes due to erosion
East-west	Complexity of fruit flavours	Good protection from direct sun for aromatic, or herbaceous white varieties
	Receives more red:far red light - significant impact on ripening processes	Doesn't exploit sunshine as effectively
	May discourage overly vigorous growth	Not considered as beneficial for ripening of red Bordeaux-type varieties

Planting material

The majority of plantings in the Margaret River region are own-rooted cuttings. Clonal selections have historically been limited and early growers planted whatever was available at the time. As a result, many vineyards lack records of which clones are actually planted in their vineyards. The Western Australian Vine Improvement Association (WAVIA) was established to provide 'A' Class propagation material of a known origin and disease status to the local viticulture industry. In conjunction with the Department of Agriculture, WAVIA provide planting material through maintaining the *Foundation Collection of Varieties and Clones for the State*, located at the Manjimup Horticultural Research Institute (MHRI). All material in the Foundation Collection has been tested for presence of grapevine virus and only material with a virus acceptable status is distributed to industry. Over the past three years WAVIA has successfully imported 51 varieties and clones of grapevine material of improved health status. Some of this material is new to Western Australia whilst other material has been imported to provide material of improved health status and/or enhance wine quality through clonal diversity.
The Register of grapevine varieties and clones held by the WA Department of Agriculture can be found on the following website: www.agric.wa.gov.au.

Trellising - posts

The majority of vineyards use CCA-treated pine posts of differing dimensions for strainers and intermediate posts. It is also common to see the combined use of pine and steel posts. Large numbers of damaged posts (especially after machine harvesting) have been observed in vineyards where all intermediate posts are of steel construction. Vineyards with intermittent timber posts between steels appear to ensure reduced risk of damage and number of replacements required.
The use of steel railway sleepers as strainer posts can also be observed throughout the region, and anecdotal feedback favours their solidarity and longevity.

A number of organic vineyards throughout the region are trialling the use of Australian native timber in trellis construction. Unfortunately, white ant infestation has been observed in a number of the eucalypt species used in these trials.

Establishment costs

The following information was taken from AHA Viticulture's Benchmarking Report (2004).

Typical values that are currently quoted in the industry appear to be in the range of $40000 to $60000 per hectare of vines, not including the price of the land. The cost to bring a vineyard into production can vary considerably from as low as $10,667/ha to as high as $81,769/ha. Costs vary depending on location, size, site characteristics and site infrastructure. Costs are also higher where vineyard developments are completed in phased stages as opposed to a single development. The following examples demonstrate the impact that site conditions can have on the cost of establishment:

Examples:

Vineyard I: A large 73 ha vineyard, with gently sloping terrain, large blocks of uniform, quality soils, irrigation water from an existing dam, power on site, vines on own roots, existing sheds and office, minimum landscaping, all mechanisation by contractor.

Establishment cost was $33,820/ha.

Vineyard II: A medium sized 30 ha vineyard, undulating terrain, a variety of soil types, short rows, expensive dam, landscaped property, power off-site, no existing buildings, pressure from feral animals, full range of equipment and machinery.

Development cost was $50,180/ha

Vineyard III: Small 2.2ha vineyard, numerous short rows, landscaped, expensive dam.

Development cost was $64,740/ha.

The major factors that influence the costs of establishing a new vineyard are:

- **Vineyard size:** Large vineyards will have a lower per hectare cost of shared facilities than small properties.
- **Rate of development of the vineyard:** Vineyards that are brought into production in two years are generally cheaper to establish than those that take an extra year or more to produce a first commercial crop or those that are built in stages, phased in over time.
- **Plant density:** Many establishment costs (and operating costs) are directly related to the number of vines per hectare, including plant material, trellis costs, irrigation in-field, vine training and pruning, and pest and disease control.
- **Water supply:** Provision of an adequate assured supply of irrigation water can cost up to $27,934 (2002) per hectare. Gully-wall dams are generally the most expensive sources, although bores contaminated with iron bacteria can require extensive settling and filtration works which dramatically increase the direct cost of underground water. The lowest cost reflects properties that had an existing water source prior to the commencement of the vineyard.

- **Plant material:** Grafted rootlings cost $5,359/ha (@$3.75ea) for a vineyard planted with a spacing of 2m by 3.5m, compared with $2,858/ha (@$2.00 ea - $1.50 graft + $0.50 budwood) for field grafted vines, $2,001/ha (@$1.40 ea) for rootlings and $715/ha (@50c ea) for callused cuttings.
- **Power supply:** The cost of bringing power to irrigation pump-houses, sheds and buildings is a function of distance from the existing grid. Very large vineyards that require 3-phase power for pumping have found it economical to generate their own power.
- **Trellising:** Most vineyards are established as simple vertical systems with one fruiting wire and one pair of foliage wires. Conversion to more complex systems takes place in later years.
- **Irrigation:** All vineyards in the survey were trickle irrigated. Some properties installed powerful irrigation controllers and variable-speed pumps which increased the cost per hectare. A property with a wide and diverse range of soils will require a more complex layout of irrigation blocks for optimum performance. The slope of the property and the head required to be overcome by the pump can also have a significant impact on capital costs.
- **Sheds & buildings:** Some farming properties have existing buildings that serve adequately as machinery sheds, chemical stores, crib rooms or offices. The trend to sub-divide large farms means that many new WA vineyards require a range of new facilities. Buildings can add around $4000 per hectare to the cost of the vineyard.
- **Equipment & machinery:** Vineyards that make extensive use of contract operators will have low machinery set-up costs. Operating costs are usually lower when using contractors on smaller properties, however, remote sites can make significant savings due to equipment location costs if they use their own machinery.

Vineyard floor management



As stated previously, vineyard management techniques throughout the region are diverse and it is difficult to obtain comprehensive data. However, the grower survey identified the most common vineyard floor treatments as:

- Weed-free undervine strip with an average width of 50-100mm.

- Mulch applied in the undervine strip to improve organic matter content in the active root zone.
- Most common cover crop species in mid-row: oats, perennial/annual ryegrasses and legumes. Numerous growers use mixed-species cover cropping to achieve optimal ground cover, nutrient feedback, and regeneration of sward.



Slashing:
Because of the prevalence of tall growing species as cover crops, slashing is a common practice throughout the region. During seasons of higher than average rainfall slashing passes may be required. Many growers see the benefit in side-throwing slashed material to the undervine area, as it provides a type of weed matting as well as increasing organic matter in the rootzone.

Mulching of prunings:
A mulching pass is commonly carried out prior to spring in order to facilitate more rapid breakdown of cane material removed at pruning.

Weed management:
Cultivation is not a widely used practice for weed control due to potential losses in soil structure. It is sometimes used to control perennial weeds in the season prior to planting, and tyned instruments are preferred.
Undervine mulches used to suppress weed growth are commonly applied at rates up to 10 tonnes per hectare annually.
The use of herbicides is the most common method for weed control in the Margaret River region. Herbicides are applied to new developments, the undervine area strip, and in firebreak zones. Paraquat/diquat and glyphosate formulations are the most commonly used products and ‘spikes’ are often used to increase their effectiveness.
A growing practice is the use of grazing animals in vineyards to control weed growth during the dormant period. Sheep can be observed throughout vineyards in the region during the winter, especially on properties in close proximity to farm land. Various accounts have been given as to the use of cows, with some growers finding the method successful and others reporting damage to vines and irrigation lines.



Irrigation

The most common water sources for vineyards in the region are soaks, and surface or spring-fed dams.

The most common watering method in Margaret River vineyards is drip irrigation. Water output per vine and emitter spacing are selected on the basis of vine spacing and soil type. The prevalence of plantings on sandy soils (mungite, abba, busselton, yellow and bleached) presents an irrigation challenge to many growers, who often require dripper spacing as close as 30-50cm. Because of the low water holding capacity of these soils, irrigation demands can be high during hot, dry periods. The average annual water requirement for winegrapes is 1.8 mega litres per hectare, with sands sometimes requiring more than 2 mega litres per hectare (Lantzke, 2004).



Results from the grower survey revealed a wide range of irrigation scheduling techniques, with a surprising number of growers relying only on subjective visual assessment of soil moisture and vine condition. Survey findings identified the most common soil moisture sensors used in the region were gypsum blocks, followed by tensiometers, then capacitance probes. A smaller proportion of growers use weather and evaporation data to schedule watering.



Although many growers identified that their chosen watering protocol was regulated deficit irrigation (RDI), they also noted that this strategy is difficult to achieve due to the prevalence of spring rain. RDI was also noted to be a challenge to those producing on sandy soils. Regardless, many growers still aim to use the soil moisture tension parameters outlined in RDI programs.

Other growers describe their irrigation strategy as more conventional, with watering based on refill points established by trial and error, as well as good record-keeping on evapotranspiration and soil moisture.

Many of the older vineyards in the Margaret River remain un-irrigated, a factor considered by some as a major contributor to wine quality. Another new trend is occurring as some irrigated vineyards that were planted in the 1980's are now turning the water off, with the aim of pursuing ultra-premium status. Still another group of growers are using irrigation during the establishment phase but have every intention of shutting off the pumps permanently after establishment is complete.

Training systems and canopy management

The grower survey identified the most common training systems in order as:

1. Vertical shoot positioned (VSP) – all shoots tucked
2. Scott Henry
3. Lazy VSP – a proportion of shoots tucked
4. Smart Dyson
5. Lyre
6. Australian sprawl - no shoots tucked
7. Other





VSP was by far the predominant system employed throughout the region. Reasons given for this in the discussion group were:

- Cheaper trellising costs
- Ease of management
- Good machinery access between rows

- Fewer foliage wire lifts
- Single fruit zone
- Adaptable to many varieties
- Suitable for low to moderate vigour vines

On north-south rows, the lazy VSP system commonly involves tucking all shoots on the west side and allowing a proportion of shoots on the east side to remain loose.

Obviously, the number of canopy management passes required in a given vineyard and season will depend on training system, vine vigour, specified wine style, and required level of fruit exposure, target yield, and disease pressure.

Photographs of “Lazy VSP” in Shiraz and Cabernet Sauvignon blocks, respectively:





Regional canopy management practices generally involve:

- 1-2 passes for disbudding/trunk sucker removal early season.
- Shoot thinning to alter crop load after early yield assessments and on those varieties where optimal fruit exposure is desired. Also carried out in vigorous blocks to open the canopy and reduce disease pressure.
- Shoot positioning is sometimes carried out in conjunction with wire lifting passes.
- 1-3 wire lifts, depending on training system.
- 1-4 trimming/hedging passes, depending on vine vigour and seasonal growth. Shoots are usually trimmed to 300-600mm above the top wire.
- Crop thinning is carried out to reduce yields and reduce “clumping” of bunches in the fruit zone, which can exacerbate fungal infections.
- Leaf plucking:
    - Leaf plucking is widely carried out on red varieties with the aim of reducing unripe characters achieving desired flavour profiles. On north-south oriented rows, the east side is commonly plucked and the west side is left natural to provide protection from sunburn. A light leave pluck is sometimes done on the west side of very dense canopies with multiple leaf layers.
    - The decision to leaf pluck Chardonnay is highly dependant on the desired wine style and is usually specified by the winemaker.
    - Semillon and Sauvignon Blanc may occasionally require a light leaf pluck to increase aeration in the fruit zone, or where the prescribed wine style tends towards a riper, more fruit driven flavour profile. Where disease pressure is not as much a concern, these varieties are usually managed with the aim of maintaining shading of fruit so that herbaceous, grassy flavours can be retained.

- Mechanical leaf plucking is increasingly being used throughout the region, except where a high level of selectivity is required.

Uneven budburst

The coastal nature of the region means that many vineyards experience poor and uneven budburst, especially in early varieties such as Chardonnay. This is caused by the moderating effect of the ocean, resulting in mild winters and insufficient vine dormancy. There are a number of techniques applied in the region to overcome this problem.

1. Prune later – delaying pruning can have a corresponding delay in budburst of early varieties. This avoids periods of high temperature fluctuation.
2. Cracking canes – bending canes during the wrapping stage creates a wounding response near the node that helps facilitate budburst.
3. Arching canes – Creating an arch in the cane helps assuage apical dominance, promoting more even budburst and shoot growth along the cane.
4. Shorten canes – same result as point 3.
5. Dormex – a “rest breaking agent” with the active ingredient being hydrogen cyanamide. This is usually sprayed at 2.5-5% to runoff with a recycling unit 7-21 days before projected budburst. Dormex is widely used on Chardonnay and situations where vineyards are being converted from cane to spur pruning.

Pruning practices

There are numerous strategies used to determine bud/node numbers retained at pruning in the Margaret River region.

Some growers use a guideline based on spur spacing and buds retained per hectare. For example, a spacing of a 2-bud spur every 100mm (to a maximum of 150mm) along the cordon would equate to an average of 56600 buds per hectare. This can be divided by the number of vines per hectare to calculate the number of spurs retained per vine. The majority of vineyards in the region have 1667 vines per hectare which equates to 17 (2-bud) spurs per vine.

Another commonly applied principle is ‘pruning to vine vigour’, which requires training the pruning crew to make a visual assessment of vine capacity in terms of cane number, cane thickness, and trunk diameter in determining the number of buds to leave. Feedback from growers is that this technique works best with experienced pruners who have some history of the vineyard. A simple approach to cane pruning in the region requires pruners to simply “fill the wire”, leaving a small gap between vines to avoid crowding the canopy during the growing season. However some training is required on selecting the best canes with optimal internode lengths. The effectiveness of using of *balanced pruning* protocols is a somewhat contentious issue. Feedback from the grower discussion group revealed that some growers had little faith in using yield to pruning weight ratios and other widely adopted balance parameters because of the large difference in cane production between varieties. Other growers reported success with using more complex bud number calculators in order to achieve target yields. These involve the use of spreadsheets containing formulas based on historical and seasonal vine data.

Many growers with older vineyards have established set bud numbers per vine based on trial and error in achieving vine balance and target yields.

General spur pruning practices:

- A pre-pruner (also called a barrel pruner) is commonly used to hedge the vines prior to hand pruning. This leaves shorter, easier to manage canes and greatly reduces the amount of cane material that needs to be pulled out of the trellis wires.
- A pruning crew will then hand prune the vine back to 2-3 bud spurs, ignoring the base bud.
- A general rule used throughout the region is to space spurs at least a hand-width apart to set up optimal shoot positioning.





General cane pruning practices:

- Cane pruning in the region is achieved via three passes:
    1. Cutting existing cordons and selecting new canes to wrap down.
    2. Pulling cane material and old cordons out from the trellis wire.
    3. Wrapping new canes around wire and securing ends.
- “Cracking” of canes during the wrapping stage is commonly carried out to improve bud burst.
- The use of replacement spurs in the crown area is widespread. However some growers prefer not to retain them as they believe it causes crowding in the crown area of the vine.
- Dormex is also widely used in cane pruned vineyard to improve uniformity of budburst. This will be discussed in more detail later.



The choice of cane pruning vs. spur pruning for different varieties is quite subjective. Each grower can provide anecdotal evidence as to why their method is preferred. That aside, the most common practice for red varieties is spur pruning. A higher proportion of Chardonnay in the region is cane pruned (especially for thee ‘gingin’ clone due to its light bunch weight), followed by Sauvignon Blanc.

Bud dissection is increasingly being used as a pre-season estimate of yield potential. In the case that bud fruitfulness is low, growers use various options to increase the amount of fruitful buds retained at pruning:

1. Increase cane length.
2. Increase cane number.
3. Increase number of buds on spurs (as basal buds are often the least fruitful) – this can be done at each spur position of alternating with 2-bud spurs.
4. Utilise “finger and thumb” pruning.
5. Add “kicker canes” to spur pruned vines – involves wrapping 2 canes to wires above the permanent cordon.

The use of pruning equipment other than conventional loppers and secateurs is increasing throughout the region. Pneumatic and hydraulic machinery, as well as electric secateurs are being used to reduce costs and pruning fatigue. These types of equipment are especially efficient when re-working vineyards.

Pest and disease management

The most common issues in the region are:

- Botrytis and other bunch rots, often resulting in acetic acid bacteria infection
- Powdery mildew
- Downy mildew
- Weevils
- Mealy bug
- Black beetle
- Snails – small pointed, garden, and Italian white
- Grasshoppers
- Various mites – erinose, bud, two-spotted, and rust
- Birds – starlings, twenty-eights
- Animals – rabbits and kangaroos

Results from the grower survey and discussion groups reveal that the most common pest and disease control methods are conventional spray programs, followed by organic practices. A proportionately small number of growers adhere to biodynamic farming principles. There is currently no formal integrated pest management (IPM) program in the region, rather, the majority of growers have the attitude of trying to reduce chemical use where possible and employ other techniques to reduce pest and disease pressure.






Precision viticulture

The term ‘Precision Viticulture’ encompasses the use of a range of tools and technologies that allow grapegrowers and winemakers to make more informed, targeted management decisions in the vineyard. One of the major issues grapegrowers in the Margaret River region have to deal with is that of vineyard variation. The high degree of variation in soil type and depth presents numerous challenges, especially with irrigation, canopy management and nutrition. Management practices and new technologies are focused on creating a more uniform vineyard. Grapegrowers within the Margaret River region have started to embrace Precision Viticulture in order to be able to ‘see’ the extent of that variation and to do something about it.

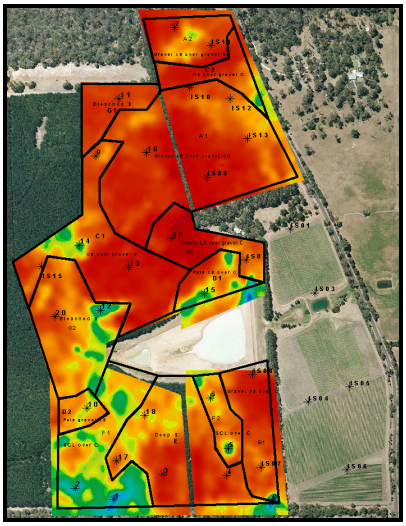
To date, the focus within the region has been to use remotely-sensed imagery, with or without yield maps, as a basis for selective harvesting (the split picking of fruit according to

different yield and/or quality criteria). In this way, viticulturists and winemakers are using the spatial information as a means of ensuring that parcels of fruit delivered to the winery are as uniform as possible and meet the specifications for their intended end-use product (Proffitt and Pearse, 2004). Other examples of the use of imagery to target the application of inputs in an effort to be more efficient in the use of vineyard resources are also beginning to emerge (Proffitt and Malcolm, 2005).

More recently, grapegrowers within the region have started to use high resolution soil maps to better define the spatial variation in soil characteristics prior to the establishment of new vineyards. This usually entails the followings steps:

1. A reconnaissance survey is carried out using one or more sensors (eg. Electromagnetic Induction, Gamma-ray Spectrometry and Ground Penetrating Radar) to determine preliminary soil boundaries.
2. A real-time kinematic DGPS is used in order to provide accurate elevation information as well as position through longitude and latitude coordinates.
3. Excavation of soil pits and description of profiles. Samples are collected and analysed for physical and chemical properties.
4. Soil types are then defined and classified as to their suitability for wine grapes.
5. Soil types, boundaries and elevation are mapped using software.

This information is assisting grapegrowers to match grape varieties with desirable soil properties and to design irrigation systems that deliver certain outputs according to those soil properties.



Vineyard recording systems

The collection of vineyard data has increased throughout the region due to the prevalence of growers using Quality Assurance (QA) management systems such as HACCP and SQF. However, many of those who don't implement QA systems still collect vineyard data in order to make more informed management decisions.

Feedback from the grower discussion groups identified the following information as being the most commonly recorded:

- Spray diaries
- Nutrition programs

- Irrigation schedules
- Vine performance data, such as buds retained, shoot number, bunch counts, bunch weights, and yield per vine. This data is either collected randomly or from established data panels/monitor vines
- Pest and disease monitoring results
- Chemical inventories
- Fruit maturity parameters

These records assist in making seasonal decisions as well as providing an historical data set from which trends can be identified and utilised.

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