ALPINE VALLEYS
WINE REGION

Australian Government
Grape and Wine Research and Development Corporation

ROOTSTOCK REVIEW FOR THE ALPINE VALLEYS REGION, VICTORIA



FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: RT 05/03-4

Principal Investigator: **FIONA WIGG**

Research Organisation: **VITISENSE**

Date: 28 November 2006

Table of Contents

1.0 Summary **2**
2.0 Background **2**
3.0 Soils, Elevation and Climate **4**
3.1 Introduction 4
3.2 Elevations 4
3.3 Soils 4
3.4 Rainfall 6
3.5 Temperature and Evaporation 6
3.6 Suggested Subregions 6
4.0 Grapevine Rootstocks **8**
4.1 Introduction 8
4.2 Rootstock Characteristics 8
4.3 References 14
5.0 Vineyard Survey **15**
5.1 Introduction 15
5.2 Site Descriptions 15
5.3 Planted Rootstocks 16
5.4 Rootstock Selection 16
5.5 Vine Growth 17
5.6 Water use 20
5.7 Nutrition 20
5.8 Pest and Disease 21
5.9 Pruning and Trellis 21
5.10 Harvest Data 21
5.11 Wine Assessment 24
5.12 Conclusion 26
6.0 Recommendations **28**
7.0 Appendices **30**
Appendix A – Average maturity data for dry or semi-sweet table wines^ 30
Appendix B - Rootstock by variety by area 31
Appendix C - Harvest data 33
Appendix D - Winemaker comments 35
Appendix E – Rootstock Survey 37

1.0 Summary

A review of rootstock use was undertaken in the Alpine Valleys Wine Region, Victoria. The review was prompted by the high percentage of vines on own roots, an increase in topworking and the expectation that an expansion of planted area would occur in future. This was set against the presence of phylloxera, the paucity of rootstock trial data from the region and growing concern about the high costs and poorer quality fruit associated with high vigour vines. The soils, climate and elevation of the region were assessed to determine suitable subregions given the diversity of microclimates within the region. A limited review of recent literature was undertaken to provide background information on rootstock characteristics. Thirteen grapegrowers representing a range of microclimates, varieties and rootstocks were surveyed to obtain subjective experiences of rootstock use. As the majority of fruit grown on surveyed vineyards is purchased by large wineries from outside the region, winemakers from purchasing companies were surveyed for assessments of fruit and wine quality. Recommendations for rootstock use in the three suggested subregions were made. Additional recommendations relating to further work in the region have also been made.

2.0 Background

Alpine Valleys Wine Region is situated in the picturesque Ovens and Kiewa Valleys of north east Victoria. Vines were first planted here in the 1870's. The region experienced a resurgence in plantings in the early 1980's with approximately 540 ha now under vine. There are currently 55 vineyards and 12 wineries in the region with more cellar doors to open in future.

The modern wine industry in the Alpine Valleys region began in 1969 when a vineyard was established by Frank Ferrarro at Merriang near Myrtleford however major expansion did not commence until 1980. It was also at Merriang that the Bailey family planted 10 acres of cabernet sauvignon followed by the Michelini family in 1982 who established a 30 acre vineyard in the Buckland Valley. The planting boom of the mid 1980's saw vineyards planted at Whorouly, Rosewhite, Porepunkah and in the Kiewa River valley.

By the mid 1990's many of these original vineyards had undergone significant expansion and other small vineyards were also established. Vineyard planting slowed significantly in the early 2000's. Varietal change to meet differing market needs is now largely due to topworking existing vines rather than new plantings.

More than 24 winegrape varieties are planted in the Alpine Valleys with the major varieties in order of planted area being merlot, chardonnay, cabernet sauvignon and shiraz. Recently more importance has been placed on aromatic white varietals such as pinot gris and sauvignon blanc. With a wide range of elevations and soil types and virtually unlimited quantities of good quality water this region has the potential to produce a range of winestyles whilst focusing on premium quality.

The Alpine Valley Vignerons Association (AVVA) commissioned a study in 2005 to collect planting details from vineyards in the region. The resulting document, Alpine Valleys Vineyard Directory (Vintage 2006), captured information from nearly all vineyards in the region. Of these, twenty vineyards comprising more than 50% of the area under vine gave detailed responses regarding clonal and rootstock choices. A key finding from these detailed responses was that nearly 30%, or 80ha, of the area under vine is planted on own roots. This agrees with data collected from a smaller sample group for Research to Practice Hands On workshops held in 2004 and 2005. It suggests that the true figure of vineyard area planted on own roots is probably much higher. This finding is of concern as the region lies within the North East Phylloxera area. Phylloxera was found in the Buffalo River area in 1998 and upper Ovens Valley in 2002. At least four vineyards in the region are currently known to have been infested.

Given the presence of phylloxera rootstocks are a necessity when planting in this region. Early rootstock choices were largely driven by the degree of resistance to phylloxera. Later choices, during the peak of planting Australia wide, were driven by rootstock availability and limited information about performance in cool climate areas. The only rootstock trial undertaken in the Alpine Valleys region is located at Porepunkah investigating pinot noir grafted to four rootstocks. Published data is available for two years of trial work.

Rootstocks can potentially have a significant impact on vine performance. Apart from phylloxera and nematode resistance, other attributes conferred by rootstocks include variations in fruit set, nutrient uptake and shoot vigour all of which affect final yield and wine quality. Vines on rootstocks in many Alpine Valley vineyards show high capacity and vigorous growth. This has multiple impacts including high disease pressure, increased capital and operating costs for canopy management, and poorer outcomes for fruit yield and quality. Rootstocks which are matched to variety and terroir to produce balanced vines would assist in reducing inputs resulting in economic and environmental benefits. The potential for improved fruit quality would also be enhanced.

AVVA believes it's long term future lies with wine tourism and foresees an expansion in plantings in addition to replanting of vineyards currently on own roots. Additionally, many vineyard managers are topworking vines to replace varieties no longer in demand without assessing the suitability of existing rootstocks. With a focus on premium quality, AVVA would like to ensure that the best available rootstocks are used in future. More detailed knowledge is required about the performance of previously recommended rootstocks to enable recommendations to become tailored to particular terroir. Additionally new or untried rootstocks may also be suitable for this region and should be investigated.

3.0 Soils, Elevation and Climate

3.1 Introduction

The Alpine Valleys region consists of a catchment area of two major river basins, namely the Ovens and Kiewa, which are part of the larger Murray River catchment area. Included in the region are the tributaries of the Ovens and Kiewa Rivers which includes the Buffalo River, Buckland River, Happy Valley Creek and Yackandandah Creek (see Figure 1).

3.2 Elevations

Three distinct growing areas identified by elevation have been previously suggested as potential subregions. The first is the north and northwest sections comprising the Whorouly-Everton Plains and Kancoona Plains. These areas are relatively flat with the lowest elevation at Tarrawingee (180m) increasing to 200m at the base of the mountainous areas. This area is at the edge of the area influenced by mountain winds and cooler temperatures.

The second subregion is suggested for elevations between 200m and 400m which extend up the river valleys and adjoining hillsides. This is where the majority of planted area occurs and includes areas of Myrtleford, Merriang, Porepunkah, Coral Bank and Buffalo River.

Finally, the higher elevations above 400m and up to 800m which occur at the extreme ends of the valleys, on the high plateaus and in the ridgelines between river valleys is suggested as the third subregion. This includes the area of Yackandandah and areas between Bright, Harrietville and Mt Beauty and Rosewhite (see Figure 2).

3.3 Soils

The soils of the region reflect the geology and topography of the area. The two major river basins have been carved from middle and upper Ordovician sedimentary rock. The Ovens River cuts exclusively into sedimentary rock whilst the Kiewa River and it's tributaries cut into sedimentary rock in the northern part and into metamorphosed Ordovician rock in the southern part of the valley. The Buffalo and Buckland Rivers also cut into the granite of the Mt Buffalo Monolith. Soils in these valleys may have coarser textures due to the granite influence.

The rivers have narrow deep valleys at the upper parts of their catchment where the action of the major streams is eroding rather than depositing. At the northern reaches of the valleys where the valleys widen, smaller particle deposition has occurred resulting in heavier soil textures than soils upstream. Five distinct river terraces can be distinguished and are identified as terrace i, ii, iii, and iv, with v and vi being the terraces highest in the landscape.

Soil Group Characteristics (extract from Application for the determination of Alpine Valleys Wine Region as an Australian Geographical Indication).

Group 1. Undifferentiated sandy loam soils
Soils formed on present flood plains. Elevation ranges from 300m upstream in the four river valleys to 180m downstream. These soils have no profile development and are the most fertile soils. Vines growing on these recent alluvial soils will produce high yields of fruit of less value to winemakers than fruit produced on higher terrace soils.

Group 2 Terrace i - Greyish brown gradational soils
Young, highly fertile soil with little profile development. Elevation 180-200m. Control of vine vigour will present problems with yields similar to Group 1 soils.

Group 3 Terrace ii - Greyish brown to brown gradational soils
Vigour control is still a high priority. Carefully chosen sites where soil textures become lighter than fine sandy loam at a depth of 75cm will assist in vigour control as some moisture stress can be imposed.

Group 4 Terrace iii - Duplex soils
Soils upstream from Rocky Point Bridge (RPB) are lighter with soil textures not exceeding clay loams in the B horizon. Soils downstream from RPB have heavier soil features and medium clay B horizons are common. Good canopy management is still required to obtain high quality fruit. Elevations range from 180m to 240m.

Group 5 Terrace iv - Duplex reddish brown to red brown soils
Soil features change abruptly from fine sandy clay loam to reddish or red brown medium clays with stable structure. Elevations range from 240 to 250m. Vigour control is still required as these soils are fairly fertile.

Group 6 Terrace v and Terrace vi - Very old dark red duplex soils
These soils form a ring around Mt Buffalo and are on ancient river terraces (v mb) or overlain by colluvial material (vi mb). Elevation is 300m for terrace v in the Buffalo, Buckland and Ovens River valleys. Terrace vi is situated at 300-320m. Even on these soils vigour control must be practiced.

Group 7 True hill soils – Gradational to duplex soils.
Colour ranges from yellowish brown to reddish brown. Hill soils have less depth in the profile and hill gravel with medium clays is often encountered before one metre. Vine vigour is more easily managed because of lower soil fertility and plant moisture stress. Elevations are mainly 300-550m above RPB, 240-300m downstream of RPB and 300-600m in the Kiewa River valley.

3.4 Rainfall

Rainfall ranges from 750-850mm in the Whorouly South area below Rocky Point Bridge. Above Rocky Point Bridge rainfall varies from 750mm at Merriang , 950mm at Buffalo Creek through to 1050mm at Ovens. Higher up the valleys and along the valley slopes the lowest rainfall of 900mm occurs at Rosewhite whilst growers above Ovens and in the Kiewa Valley report rainfalls of 1100-1200mm (see Figure 3).

Rainfall is winter dominant where June is the wettest month and February the driest. The increase in rainfall along the valleys can be attributed to increasing elevation, narrowing of the valleys and the north-easterly moving cyclonic system of moist cool air hitting the hills and mountains.

3.5 Temperature and Evaporation

In general average temperatures follow the same inverse pattern as rainfall where average monthly temperatures decrease with elevation. Due to aspect, slope and elevation considerable variation may be found along the valleys. Actual evaporation figures for the area are not available. However calculated evaporation figures show that in most years some irrigation will be required to avoid acute water stress.

Average maturity data has been calculated for three areas within the Alpine Valleys region (see Appendix A). These are Lower Ovens (LO) for the area from Markwood to Gapsted including Whorouly South; Ovens and Buffalo (OB) for the areas from Gapsted to Ovens (including Myrtleford) and Gapsted to Lake Buffalo including Buffalo Creek. The Upper Ovens and Buckland area includes Porepunkah and the Buckland Valley. Unadjusted data is also given for Mt. Beauty and extrapolated along the Kiewa valley. This data will be used to compare predicted maturity dates with actual maturity dates.

3.6 Suggested Subregions

For the purpose of matching rootstock to terroir in this survey, the characteristics of the site must be considered. Firstly, consideration was given to the soil depth and texture which influences root development and the vine's capacity to access water and nutrients. Secondly annual rainfall and it's seasonal pattern, evapotranspiration rates from the vine canopy and readily available soil moisture will determine the requirement for drought tolerance from a rootstock. And finally daily temperature and elevation must be considered due to their impact on the length of the growing season.

These criteria for grouping vineyards into subregions for the purpose of recommending rootstocks differ from those suggested by the authors of the Application for the determination of Alpine Valleys Wine Region as an Australian Geographical Indication. Using site characteristics, the following subregions are suggested:

1. Low Terrace

This subregion encompasses elevations between 180m and 260m and soils from groups 1 to 5. Differences in soils are distinguished as heavier downstream of the RPB and lighter soil upstream. These soils are deep and fertile producing vigorous vine growth with large canopies early in the growing season. The soils have high readily available water (RAW) values but this subregion receives lower rainfall than the upper reaches of the valleys. Annual rainfall varies from 750mm to 850mm. High evapotranspiration rates combined with large canopies due to vigorous spring growth may result in vines requiring supplementary irrigation from nearbu creeks and rivers during the ripening period. This subregion includes sections of Whorouly and Merriang and stretches along the Ovens River to Porepunkah. It also includes the lower reaches of the Buffalo Creek and Buffalo River.

2. Hills

The Hills subregion is distinguished by True Hill soils which differ from the terrace soils in their lower fertility and RAW values. Access to water for these vineyards is usually via surface collection rather than river or creek entitlement and is therefore subject to seasonal variation. Vines grown on these soils show lower vigour than in other subregions and can be water stressed due to the gravel reaches which lie less than one metre below the surface. The True Hill soils are found above the Ovens, Kiewa and Buffalo River valleys. Elevations range from 280m at Whorouly to 550m in the Kiewa Valley. Rainfall varies widely from 750mm at Whorouly to 1100mm below Porepunkah.

3. High Terrace

This region includes the upper reaches of Buffalo Creek, Buffalo River and the Ovens, Buckland and Kiewa Valleys. Elevations range from 300-550m and annual rainfall is generally 1100mm to 1200mm. Soils are from Group 6 comprising terrace v and terrace vi soils. Due to the higher elevations and high rainfall the growing season is restricted with later ripening varieties less able to reliably achieve optimum ripeness and flavour development. Soils are deep, moderately fertile and have high RAW values however the large canopies resulting from high spring rainfall ensure high evaporative losses later in the season. Irrigation water is generally available by water right from nearby creeks and rivers and supplementary irrigation may be required during the ripening period. Disease pressure is also high.

These subregions will be used for the purpose of grouping surveyed vineyards and analyzing data.

4.0 Grapevine Rootstocks

4.1 Introduction

Phylloxera has been present in north east Victoria since 1895. Attempts to eradicate phylloxera from the region have been unsuccessful resulting in widespread use of grapevines grafted to phylloxera resistant rootstocks. The most commonly used rootstocks are hybrids bred principally from three *Vitis* species of American origin; *Vitis rupestris*, *Vitis berlandieri* and *Vitis riparia*.

Vitis rupestris originates from the stony soils of south-western Texas and is commonly found growing on the banks of mountain streams. It needs a deep soil and penetrable subsoil which is not prone to waterlogging as it's roots are sensitive to root rotting fungi. In shallow dry soil it will suffer from drought sooner than Riparia however shows drought tolerance where it's roots are able to penetrate deep to utilize subsoil moisture. The vegetative cycle is long and Rupestris can tolerate excessive heat and cold. It is highly resistant to phylloxera although rootlets can show galls. The leaves support the leaf galling form of phylloxera.

Vitis berlandieri is native to the limestone hills of south west Texas and is suited to hot climates. It has a high root density and will not tolerate waterlogged conditions. The growing cycle is one of the longest of all Vitis species. It is highly resistant to phylloxera but supports some leaf galls.

Vitis riparia is spread over a large geographical area extending from central Canada south to Texas and west to the Rocky Mountains. It's natural habitat is along river banks in cool, deep, moist and fertile soils. The root system is shallow and well branched with high resistance to phylloxera although Riparia's leaves often carry galls. Riparia grows poorly under dry conditions and in less fertile soils. Cuttings root easily and graft well and it has a relatively short growing cycle.

Cross breeding of these rootstocks was undertaken to combine desirable characteristics whilst minimizing the undesirable traits. Commonly used hybrids which are highly resistant to phylloxera will be discussed in further detail.

4.2 Rootstock Characteristics

V. riparia

Riparia gloire

This rootstock has not been widely evaluated under Australian conditions although it is one of four rootstocks in the sole rootstock trial located in the Alpine Valley region. It is a low vigour rootstock which roots and grafts easily and shows good compatibility with *V. vinifera*. It is best suited to deep, fertile soils well supplied with water and does not tolerate drought. Performance in Victorian trials has been variable (Whiting 2003) where in a high rainfall site (Whitlands) it yielded well but showed low vigour and low yields

under more limiting conditions (Porepunkah). It requires further evaluation in a broader range of sites.

V. riparia x *V. rupestris*

Schwarzmann

This rootstock is not grown in France but small plantings can be found in northern Italy, Bosnia and the Czech Republic. It is extensively planted in Australia and is the most commonly used rootstock in the Alpine Valleys region. Attributes include moderate vigour, high yield and improved fruitset (Cirami 1999). It is easy to propagate and has high resistance to nematodes.

Victorian trial data (Whiting 2003) shows Schwarzmann to have moderate vigour however under dry conditions both vigour and yield decline. Berry number per bunch is high although berry weight tends to be lower than other rootstocks. Maturity appears to be advanced compared with other rootstocks at similar cropping levels. Under dry conditions it has low sugar levels even at low yields. Juice pH is higher than other rootstocks at similar sugar levels and this appears to correlate with higher juice potassium. Petioles taken at flowering also showed elevated potassium levels. This rootstock is not particularly sensitive to nitrogen and is therefore suitable for fertile soils (Dry 2006).

Schwarzmann should not be used where summer drought is common or where water stress is applied to manipulate grape quality. It appears best suited to deep, moist soils due to it's high water requirement.

101-14

Plantings of this rootstock are found in South Africa and France where it is recommended for clayey soils and humid terrains.

101-14 has a shallow, highly branched root system and requires deep, moist soils. It has moderate vigour, and varieties in trials show improved fruit set, advanced maturity and higher colour than varieties on other medium to high yielding rootstocks (Cirami 1999). Cuttings root and graft easily. It is more vigorous than *Riparia gloire* with a shorter vegetative cycle than 3309 Couderc (Pongracz 1983). Similarly to Schwarzmann it is not sensitive to nitrogen and can be used in fertile soils (Dry 2006).

Attributes in Victorian trials (Whiting 2003) include moderate vigour and moderate yields with satisfactory grape composition and generally high sugar levels at harvest. Higher pH levels in the juice were also found. Poor growth and yield was related to poorly structured sodic soils. 101-14 did not tolerate spring waterlogging at one trial site on a clay loam soil in contrast to Cirami (1999) who states it is resistant to spring waterlogging.

Dry (2006) reported little difference in vine performance between this rootstock and Schwarzmann but noted that 101-14 would be preferred due to lower potassium levels at flowering and veraison.

3309 Couderc
This rootstock was widely used in the early 1900's in north east Victoria to replant phylloxera ravaged vineyards. 3309 was used extensively in Burgundy, on the granitic soils of the Rhone valley, in Champagne and in Alsace however it's popularity is waning. It is still commonly used in New York State (USA) but no longer so in Australia.

Cuttings from this rootstock strike roots easily and are readily grafted. It has low to moderate vigour, advances fruit maturity and suits varieties with poor fruit set (Cirami 1999). Young vines grafted to this rootstock may have a high nutrient requirement. Whiting (2003) found 3309 recorded consistently lower juice pH and took up greater amounts of chloride. The rootstock had moderate vigour and yield but did not significantly advance maturity or increase berry number per bunch.

3309C is suited to deep, well drained soils with high water holding capacity. It is not recommended for poorly drained soils due to *Phytopthera* sensitivity or where drought tolerance is required.

V. berlandieri x *V. riparia*

5BB Kober / 5A Teleki
This rootstock is used extensively in the northern grapegrowing regions of Europe due to it's shorter vegetative cycle. Vines originally supplied to Australia as Teleki 5A from the University of California have now been shown to have an identical genetic fingerprint to Kober 5BB. Although there appears to be some clonal differences in Victorian trials (Whiting 2003) 5BB Kober is now commonly used as the identifying name for both clones.

5BB Kober has a shallow root system which tolerates lime in the soil but not salt. It is not recommended for sites prone to waterlogging and is sensitive to *Phytopthera* root rot. It shows moderate to high resistance to nematodes. Cirami (1999) described 5BB Kober as having a short vegetative cycle with moderate to high growth and yield in irrigated areas. This agrees with Whiting (2003) who found it produced moderate to high yields and even performed well on shallow, dry, duplex soils. High yields may be due to moderate to high berry weights with correspondingly high sugar levels. Petiole potassium levels were consistently less than Schwarzmann in Victorian trials.

Dry (2006) found this rootstock to be sensitive to nitrogen addition and recommended it be used in low nitrogen soils with low water holding capacity. Early season vigour can be experienced in spring on soils with high water holding capacity. It appears best suited to cooler climates and moist, fine textured soils with low-moderate fertility.

SO4

Cuttings from SO4 strike roots easily and graft well although bench grafting results are often disappointing. It is used extensively in Germany, France and other European countries. SO4 was imported into Australia from the University of California in 1966 but later identified as Teleki 5C. True SO4 material has only been available in Australia since the early 1980's.

SO4 has a shallow growing root system which tolerates lime and grows well in acid soils (Cirami 1999). It is not recommended for dry conditions and performs best in light, well drained soils of low fertility. Whiting (2003) however describes it as vigorous, even under dry conditions, with high yields, moderate to high berry weight and consistently low juice pH. This agrees with French experience where SO4 shows excessive vigour which causes poor fruit set, delays maturity and favours late season *Botrytis* growth. Cirami (1999) also comments that SO4 assimilates magnesium poorly and when grafted to merlot or cabernet sauvignon can induce inflorescence necrosis. It is also susceptible to tyloses but has good resistance to a range of nematodes.

Whiting (2003) suggests it would be excessively vigorous in deep, fertile, humid soils.

5C Teleki

This rootstock is not widely planted in Europe but is gaining popularity in Australia since inadvertently being introduced as SO4. It's attributes according to Cirami (1999) include moderate vigour (less than Kober 5BB and SO4), advanced maturity and improved fruit set. It is suited to well drained fertile soils, particularly clay and clay loam soils.

Whiting (2003) reports 5C Teleki has moderate vigour with moderate to high yields and larger berry weights than other stocks. It did not consistently advance maturity across Victorian trial sites. According to Dry (2006) this rootstock is less sensitive to nitrogen than 5BB Kober and better suited to fertile soils.

Teleki 5C has good nematode resistance and is performing well in regions with sandy soils and high nematode pressure. It does not tolerate waterlogged soils and has only moderate drought resistance. It appears best suited to cooler climate soils with moderate fertility where late season nitrogen additions may be required to maintain leaf condition.

420A Millardet and de Grasset

This rootstock was planted extensively in South Africa but has now been replaced. It is widely planted in Italy on deep, fertile soils however does not have good compatibility with Sangiovese. 420A is also used in France, mainly in the Gironde and Aude regions. It does not root or graft easily and reportedly has poor affinity and incompatibility with other varieties.

420A has low to moderate vigour, a long vegetative cycle and improves scion fertility (Cirami 1999). The root system is shallow and well branched which is suited to poorer, more heavily textured soils however does not like waterlogging. Nematode resistance is

moderate. It is susceptible to drought and is prone to potassium deficiency. Whiting (2003) found 420A had low to moderate vigour and yield in Victorian trials. Despite the low yields, sugar levels were not high and juice pH was low.

V. berlandieri x *V. rupestris*

99 Richter

This rootstock was widely cultivated in France, Algeria, South Africa and California. In Australia a selection of 99R imported from the University of California in the 1960's was later identified as 110 Richter. True 99R has performed well in trials at Wahgunyah, Victoria.

99R cuttings root and graft well to form vigorous and fertile grafted vines. Dry (2006) reports that in a Coonawarra, SA trial 99R displayed moderate vigour and high yield with no evidence of delayed maturity compared to Teleki 5C. High yield was a result of high number of bunches per shoot, bunch weights and berry number. This is consistent with findings by Whiting (2003) in Victorian trials where yields were moderate to high across a range of soil types with no delay in maturity. 99R displayed medium to high vigour particularly in deep, moist soils. In poorly drained soils it is susceptible to *Phytopthera* root rot.

In contrast Cirami (1999) reports that 99R can delay ripening but has a short vegetative cycle and can be grown in cool conditions. The root system is strongly developed and deep growing conferring drought tolerance. It does not tolerate salt, has high resistance to nematodes and performs well in acid soils.

110 Richter

This rootstock is widely grown in the warmer, drier areas of Europe and north Africa and has been a popular replacement for ARG1 in California. Plantings are more widespread than 99 Richter. The root system of 110 R is not as deep growing as 99 R and shows better drought resistance. It is well suited to range of soil types including acid soils and poorly drained, shallow clay soils. Initial vine growth can be slow whilst the root system develops.

Cirami (1999) describes this rootstock as showing moderate to high vigour with a long vegetative cycle and delayed fruit maturity. This agrees with Dry (2006) who reports that 110 R in trial at Langhorne Creek, SA exhibited moderate to high vigour and yield and poor colour. Viticultural and quality performance was similar to an adjacent block of 5BB Kober although water inputs were lower suggesting greater drought tolerance.

In contrast Whiting (2003) found that 110 R showed low to moderate vigour particularly in deep, moist soils. The lower vigour may result from infection with Vein necrosis (M. Walpole pers. comm.) and is associated with comparatively lower yields, low juice pH and potassium and moderate sugar levels. Low sodium and chloride concentrations in the

petioles suggest 110 R may tolerate saline conditions better than other rootstocks. Dry (2006) recommends this rootstock for use in warm-hot climates and suggests it is likely to have lower vigour than 1103 Paulsen or 140 Ruggeri.

1103 Paulsen

Cuttings from this rootstock root and graft easily. 1103 P was bred in Sicily and is widely used in Italy. In the warmer climate of southern Europe and north Africa 1103 P is better adapted to the drier conditions than 140 Ruggeri and 110 Richter. 1103 P was imported into Australia in 1980.

It has a deep growing, strongly developed root system and moderate to vigorous growth (Cirami 1999). The vegetative cycle is long and maturity of the scion can be delayed. 1103 P performs well in acid soils, shows moderate tolerance to salt and moderate resistance to nematodes. Dry (2006) reports this rootstock should be avoided in soils with high root-knot nematode (*Meloidigyne* spp.) populations. Whiting (2003) found in contrast to Cirami and overseas experience that this rootstock showed low to moderate vigour with low yields in Victorian trials (Whitlands, Myrhee and Great Western). 1103 P had consistently fewer berries per bunch, and relatively low or medium berry weights.

Dry (2006) reports that during years of high spring rainfall, controlling early season vigour was a problem. This was later managed by inter row planting of a high water use cover crop. Premium quality shiraz was produced on this rootstock in the Barossa Valley and McLaren Vale, SA in loamy sands and red-brown earths. It is important to manage vigour through low inputs of water and nitrogen as quality is reduced when vigour is not controlled. 1103 P showed excellent drought tolerance enabling water inputs to be reduced.

140 Ruggeri

This Sicilian rootstock is increasing in popularity in France and is widely used in Italy and north Africa. It was first imported into Australia in 1974. 140 Ru cuttings root with some difficulty but graft easily.

The root system is very deep growing and well branched. Cirami (1999) describes vigour and yield as similar to Ramsey. It is very drought tolerant, well adapted to acid soils but moderately susceptible to spring waterlogging. 140 Ru has moderate resistance to nematodes and resistant to soil salinity.

In Victorian trials Whiting (2003) reports moderate to high vigour across a range of sites with correspondingly moderate to high yields. The exception was the Great Western site where yield was low. 140 Ru produces medium size berries with moderate to high juice pH. Dry (2006) found the rootstock well suited to shiraz in the Barossa Valley and McLaren Vale producing wines of premium quality. It does not appear to be sensitive to nitrogen hence vigour is controlled by managing water inputs.

V. champini

Ramsey
This rootstock is primarily used in California, Australia and South Africa for nematode resistance. It is a vigorous rootstock which produces abundant fruit and growth particularly in deep, sandy soils (Cirami 1999). The excess vigour can delay maturity and affect wine quality. Lower anthocyanin levels and reduced phenolics in juice have been reported for red varieties grown on Ramsey.

Whiting (2003) tested Ramsey at a range of sites in Greater Victoria and reported moderate to high vigour in fine textured clay loam duplex soils. Sugar levels at harvest were lower than other rootstocks at similar yields. Berry number per bunch was moderate to high with a medium berry weight. Ramsey is susceptible to spring waterlogging and tolerant to soil salinity.

161-49C x 3309C

Gravesac
This rootstock was bred in Bordeaux for tolerance to acid soils. It has moderate vigour with moderate adaptation to drought conditions. Rooting and grafting quality is good and strong affinity has been shown with scions used to date. Gravesac has very good phylloxera resistance but poor resistance to root knot nematodes (*Meloidigyne* spp.). It is suited to well drained soils with low fertility and has performed well in sandy and sandy-gravelly soils. Gravesac is currently under trial in the United States but not yet widely tested in Australia.

4.3 References

The California Grapevine Nursery Rootstock chart

Cirami, R.M. (1999) Guide to the selection of phylloxera resistant rootstocks. Phylloxera and Grape Industry Board of South Australia, Adelaide, S.A.

Dry, N. (2006) Rootstock Report. Unpublished

May, P. (1994) Using grapevine rootstocks – the Australian perspective. Winetitles, Adelaide, SA.

The Phylloxera & Grape Industry Boards booklet "A Growers Guide to Choosing Rootstocks'

Pongracz, D.P. (1983) Rootstocks for grapevines. David Philip, Capetown.

Whiting, J. (2003) Selection of Grapevine Rootstocks and Clones for Greater Victoria. State of Victoria. Department of Primary Industries. pp8-17

5.0 Vineyard Survey

5.1 Introduction

Interviews were conducted with 13 of the AVV region's 55 grapegrowers representing 159 ha (29%) of the region's 550ha under vine (see Figure 4). Winemakers from six wine companies were also interviewed. Vineyards were selected to represent a range of climate and soils, rootstocks and varieties and a willingness to participate in the survey. Table 1.0 lists the surveyed vineyards in suggested zones. One vineyard (Cavedon) has two distinct soil types and thus appears in two zones.

Table 1 Surveyed vineyards by subregion

Low Terrace	**High Terrace**	**Hills**
Brandellero	Minutello	Walpole
Milne	Dalbosco	Macnamara
Ferraro	Antonello	Browning
Cavedon		Ivone
McGuffie		Holm
		Cavedon

The majority of fruit from these vineyards is sold to major wine companies outside the region although four growers also grow fruit for their own labels.

5.2 Site Descriptions

The Low Terrace vineyards are located on flat to gently undulating terrain at elevations of 200m to 240m. The soil profiles correspond to descriptions of terrace ii to terrace iv soils with good water holding capacity and high fertility. Vine growth is generally described as vigorous particularly after a wet spring resulting in large canopies.

The Hills vineyards are located on the slopes of the Ovens, Kiewa, Buffalo and Buckland Rivers. Elevations range from 240m at Whorouly to 350m at Coral Bank with most vineyards located around 300m. Soils are classed as True Hill soils with gravel evident at less than one metre. Profiles are free draining and vines quickly exhibit signs of stress when water is unavailable. Due to the lower fertility of the soils and lower water holding capacity, vine growth is generally described as balanced or of moderate to high vigour.

The High Terrace vineyards are located on the terrace v and terrace vi soils found at the head of the river valleys. Elevations range from 300m in the Buckland valley above Porepunkah to 550m at Mt. Beauty. Due to the high rainfall in the area and deep soil profiles, vine vigour is described as moderate to high.

Frost is a concern for all vineyards and many growers have installed overhead sprinkler systems for frost protection.

5.3 Planted Rootstocks

From Table 2 it can be seen that ten rootstocks are planted in the surveyed vineyards. Schwarzmann is the most popular rootstock by planted area followed by Teleki 5C, 101-14 and 99 Richter. The remaining rootstocks are planted in small areas amongst several vineyards.

Table 2 Summary of Rootstock by Planted Area

ROOTSTOCK	AREA (ha)
Schwarzman	57.5
101-14	29.9
99 Richter	28.3
Teleki 5C	27.0
Teleki 5A	6.3
SO4	5.8
Kober 5BB	2.6
Ramsey	0.6
Ruggeri 140	0.9
Paulsen	0.4
TOTAL	**159.3**

A wide range of varieties are grown on these rootstocks. Tables 2.1 to 2.3 show rootstock by variety by area (see Appendix B). Of the four most popular rootstocks Schwarzmann and 101-14 are planted in all three subregions with 99 Richter and Teleki 5C not surveyed in the High Terrace subregion. The key varieties planted in all zones are chardonnay, merlot and cabernet sauvignon. Pinot gris was surveyed only in the Low Terrace subregion; sauvignon blanc was not surveyed in the Hills subregion and shiraz was not surveyed in the High Terrace subregion.

5.4 Rootstock Selection

Growers who planted in the early to mid 1990's largely relied on advice from the Victorian Department of Agriculture when seeking suitable rootstocks for the region. Schwarzmann was commonly recommended at this time and widely available from nurseries hence the majority of early plantings were on Schwarzmann stock. Concerns about high potassium levels in red wines and observations of poor drought tolerance saw Schwarzmann replaced by other rootstocks in more recent plantings. Teleki 5C and 99 Richter were also widely available in the early to mid 1990's and in most cases used as default rootstocks when Schwarzmann was unavailable. A King Valley grapegrower recommended 99R for merlot due to his observations of earlier ripening.

In 1996 a rootstock trial was established by John Whiting from the Victorian Department of Agriculture at Dalbosco's vineyard in the High River Terrace zone near Porepunkah. The four rootstocks used in this trial were Ramsey, Riparia Gloire, Kober 5BB and 101-

14 with a pinot noir scion. Data was collected from the trial for 2 years however only one year of results was published in 2003. These show Ramsey to have the highest yield. bunches per vine and bunch and berry weights; and Riparia Gloire to have the lowest of the above parameters but the highest sugar levels.

101-14 was first used in 1999 and in greater quantities by the early 2000's. It was recommended by a local consultant and wine companies sourcing fruit from the area for it's perceived attributes of low vigour and early ripening. One grower selected this rootstock due to observations of improved vigour control in the Dalbosco trial. Vigour control was also the reason given by growers for selections of Kober 5BB and Teleki 5C in the early 2000's. Teleki 5A was chosen by one grower as it was available from a local source. It is unclear whether this is in fact Kober 5BB hence has been referred to as Teleki 5A in this report.

Another grower selected Ruggeri 140 using published trial results as the information source. His site is located on True Hill soils with little water for irrigation hence he sought a rootstock adapted to low pH soils and drought tolerant. Ramsey was also selected for attributes of drought tolerance by another grower on True Hill soils. He also had little water for irrigation and gravel close to the soil surface.

SO4 was specifically chosen by one grower as he believed his site was likely to produce vines with high vigour. Using advice from a wine company he selected SO4 as it had moderate vigour and would not increase potassium levels in red varieties. Another grower used SO4 to bulk up his 99R plantings as it was available at the time.

Very few growers nominated phylloxera resistance as their reason for selecting a particular rootstock however there was an underlying assumption that phylloxera resistance was a given attribute. The main sources of information were the Victorian Department of Agriculture, consultants and wine companies. Interestingly very few growers sourced information from their near neighbours, King Valley vignerons, who already had several years experience growing a variety of rootstocks.

5.5 Vine Growth

5.5.1 Establishment

Growers reported excellent strike rates with all rootstock selections regardless of whether rootlings or potted vines were used. Exceptions include Paulsen which was field grafted to Verdehlo after 1 year in the ground with only 40% of grafts successful. This correlates with other reported experiences. A better result was obtained the following year when vines were regrafted. Experience by the same grower saw a 98% success rate using Schwarzmann in another block. Another grower reported that his Schwarzmann stock experienced a worse strike rate than Teleki 5C although all vines were sourced from the same nursery. Schwarzman was also the rootstock used when severe winds snapped graft unions resulting in the loss of approximately 5% of planted vines.

5.5.2 Capacity and Vigour

All growers characterized their vines as showing moderate to high vigour. Canopy management techniques such as trimming, shoot positioning, leaf plucking, shoot thinning and crop thinning are common to most vineyards. Given the region's high rainfall and free draining soils with deep profiles and natural fertility, high vigour particularly in spring is to be expected. Moderating influences include the proximity of gravel layers to the soil surface and reduced spring rainfall. Growers report lower vigour vines where gravel is located within one metre of the soil surface. There is little capacity to apply irrigation techniques such as Partial Rootzone Drying (PRD) or Regulated Deficit Irrigation (RDI) between fruitset and veraison due to typically high spring rainfall. Not surprisingly, in wet springs growth is very high regardless of rootstock choice.

In Low Terrace vineyards a grower with Merlot on SO4, 1103 Paulsen and R99 has observed a larger trunk and thicker cordon on vines with SO4 stock but no difference between 1103 Paulsen and R99. Merlot on SO4 is described as vigorous with internode lengths of 75-100mm. Shiraz on Schwarzmann is reported to have a very large canopy with shoots up to 4.5m long and very large leaves.

In the Hills subregion a grower with Shiraz on 101-14 and Kober 5BB reported more balanced vines on 101-14 although both rootstocks show only moderate vigour. In the same vineyard Tempranillo on Schwarzmann also shows moderate vigour. Another grower with shiraz on 101-14, R99, Schwarzmann, SO4 and Teleki 5C reported that 101-14 showed lower vigour than the other rootstocks even in a wet year. He commented that R99 has a balanced canopy in drier years and smaller berries.

In a High Terrace vineyard a grower with Merlot on 101-14 and R99 reported longer internode lengths on R99 hence fewer leaves per shoot and higher vigour. Where Pinot noir is grown on Schwarzmann and 101-14 the grower observed more even shoot growth and a more balanced canopy in vines on 101-14 stock.

5.5.3 Phenology

Generally growers reported that the timing and evenness of key phenological events; budburst, flowering, fruitset and veraison; did not appear to be affected by rootstock choice and were dependent on weather conditions.

Only one grower reported differences in timing of harvest due to rootstocks. He found that Merlot on Teleki 5C ripens earlier than Merlot on R99 and shows better quality. Shiraz on Schwarzmann is harvested 1-2 weeks later than Shiraz on other rootstocks (SO4, 101-14, Teleki 5C and R99) in the Hills subregion due to higher yields and larger berries.

5.5.4 Components of Yield

The data shows that superficially at least there is little difference between rootstocks in bunches per shoot with bunch numbers generally high. This is especially true with merlot where growers reported that even shoots arising from basal buds usually carried two bunches. Tempranillo on Schwarzmann has the lowest number of bunches however as it was only surveyed with a single rootstock conclusions cannot be drawn as to rootstock effect. The result may be due to a varietal characteristic.

Bunch weights within a variety varied considerably. The heaviest bunches (>300g) are found on Shiraz vines growing in terrace iii heavy soils where the vines are largely unirrigated. The lightest bunches (60-70g) are found on young Merlot vines growing in True hill soils on the upper slopes of the Kiewa valley at an elevation of 350m. Generally the heavier bunches are found on vines in Low Terrace (LT) vineyards rather than Hills vineyards. This may be a reflection of the higher fertility and higher water holding capacity of the soils in the Low Terrace subregion. No data was available for High Terrace vineyards.

Table 3 Components of Yield data by variety and rootstock

Subregion	Variety	Rootstock	Bunches/ shoot	Bunch weight (g) G	Berry weight (g)
LT	SAB	Schwarz		100	
LT	SAB	Teleki 5C		180	
LT	CHR	Teleki 5C		225	0.8
LT	CHR	Schwarz	2.5	180	
LT	CHR	Schwarz	2.5	180	
LT	MER	R99	2	200	
LT	MER	R99	2	290-340	
LT	MER	SO4	2-3	150	
LT	MER	Teleki 5C	2	125	0.8
Hills	MER	Schwarz	2		
Hills	MER	Schwarz		60-70	0.8
Hills	MER	Ru 140	2	160	
Hills	MER	Teleki 5A	2	170	
LT	SHI	Schwarz	1.8	300	1.8
Hills	SHI	101-14	1.75	170	
Hills	SHI	Kober 5BB	1.75	170	
LT	CAS	Schwarz	2.5	140	
Hills	CAS	Teleki 5A	2	150	1.5
Hills	CAS	Schwarz	2	150	1.5
Hills	CAS	Schwarz	2	120	
Hills	CAS	Teleki 5C	2	110	0.6
Hills	TEM	Schwarz	1		

Growers reported differences in Merlot grown on 101-14 and 99R in the Low Terrace subregion where 99R vines had a higher yield due to more bunches. Merlot on Schwarzmann grown in the Hills subregion has small berries, open bunches and small bunch size. Also in the Hills subregion, Merlot on Ruggeri 140 has 2 bunches per shoot, fruitful basal buds and average berry size.

From a vineyard in the High Terrace subregion differences were reported for Pinot noir on Schwarzmann and 101-14. Berry weights are similar for the two rootstocks however 101-14 has smaller bunches hence fewer berries per bunch. In particular the shoulders were smaller. Fruit on 101-14 ripens earlier and is approximately 0.5 Be riper at harvest when fruit from both rootstocks is harvested together.

A grower in the Hills subregion found no difference in fruitfulness for shiraz on 101-14, R99, Schwarzman, SO4 and Teleki 5C. However the bunch size is smaller on R99 rootstock compared to Schwarzmann. Berry size for shiraz on Teleki 5C is more responsive to water availability where more water results in larger berries.

5.6 Water use

Irrigation water is readily available from rivers and creeks at most vineyards with the exception of Hills vineyards. These vineyards largely rely on collection of surface runoff stored in dams on site and have limited availability. Water restrictions for river access have occurred in 2006 under extremely dry conditions. Growers reported that in recent years average rainfalls have not occurred with drier conditions prevailing.

Growers from the Hills subregion were more likely to comment on rootstock performance under dry conditions as these soils have a high gravel content and dry out rapidly. Observations include that Merlot on Teleki 5A performs better than Schwarzmann in dry conditions due to a deeper root system. Another grower reported that Teleki 5C vines showed less water stress than Schwarzmann.

A vineyard on terrace iii heavy soils in the Low Terrace subregion was largely unirrigated due to high capacity and vigour in vines. In the High Terrace subregion a grower observed that Pinot noir on Schwarzmann vines showed signs of water stress earlier than the same variety on 101-14 and had a higher water requirement.

Supplementary irrigation is required post veraison in most vineyards due to the large canopies and high evapotranspiration rates.

5.7 Nutrition

Calcium nitrate was applied in some vineyards during the vine establishment phase. One grower uses calcium nitrate in small quantities on vines in low vigour areas within a block to even up growth. Very few growers take petiole samples regularly. Lime is

sometimes applied to correct soil pH which is acidic. Calcium nitrate and boron are applied at flowering via drip in one vineyard. Growers did not report differences in nutrient requirement between rootstocks.

5.8 Pest and Disease

Most growers follow a preventative spray program with fungal diseases observed in typical wet conditions and no variation between rootstocks. Botrytis becomes a problem for some varieties in wet conditions or if fruit is held for too long at the end of the season.

One grower reported that where R99 was planted on soil which had previously been bush, approximately 10% of vines died from *Phytopthera* infection. SO4, 101-14 and Schwarzmann vines in the same block were not affected.

5.9 Pruning and Trellis

All vines are pruned to a 2 bud spur on a single or double cordon. The most common trellis type used is Smart-Dyson usually converted from Scott Henry. Some Scott Henry trellis remains and VSP trellis is also used. The trend is to more relaxed shoot positioning with growers moving away from fully exposed fruit and vertical shoots to dappled shade canopies. These canopies result from less rigorous tucking in of shoots particularly on the western side of the canopy. Leaf plucking is becoming less common also with the desire for more shaded fruit.

The use of these trellis types is in response to high vine capacity and vigour. Capital costs and operating labour requirements are high. All growers expressed a desire to reduce operating costs particularly given the low returns currently offered on fruit purchases.

5.10 Harvest Data

Growers were asked for maturity dates from the 2006 vintage which was an early vintage. This was then compared with predicted maturity dates from the Application for Determination of Alpine Valleys Wine Region as an Australian Geographical Indication (1999). This data originated from Gladstones (1992) with adjustments for elevation and diurnal temperature range. Maturity data was given from load samples taken at harvest in 2006. Please refer to Appendix C for detailed results. The following comments relate to information gathered from only one year, 2006, and may or may not reflect general trends. A cautionary note is also attached to the predicted maturity dates particularly for higher elevations which appear to be more advanced than expected. Information relating to yield was not collected as without corresponding canopy data it cannot be ascertained whether the vines had the capacity to optimally ripen the given fruit load.

In the Low Terrace subregion, all chardonnay fruit is used for sparkling base and therefore harvested two to three weeks earlier than expected for still tablewine. At an elevation of 200m all fruit was harvested at the predicted maturity date regardless of rootstock (Schwarzmann, Teleki 5A and Teleki 5C). However at a higher elevation of 300m the harvest date was 4 weeks earlier than predicted. The rootstock used was Teleki 5C. The vineyard at 200m is located on heavy soil with high fertility and water holding capacity hence resulting vines are very vigorous and this may have impacted on the maturity date.

Sauvignon blanc on Teleki 5C and Schwarzmann at the same elevation was harvested three weeks before the predicted maturity date. Fruit on Schwarzmann was 1 Be riper than that on Teleki 5C but 2mg/L lower in acid. The vines are located in different vineyards with variations in soil type and canopy management.

Merlot on R99 in two different vineyards at the same elevation was harvested four weeks apart. Sugar levels were similar (13.4Be and 13.6Be) however the later picked Merlot had significantly reduced acid levels. The earlier harvested Merlot was picked at the predicted maturity date. Another parcel of Merlot on SO4 was harvested three weeks after predicted maturity but had a lower acid and higher sugar level than the fruit harvested one week later (R99 rootstock).

Shiraz on Schwarzmann was harvested three weeks after predicted maturity but at a very high sugar level (14.7Be). Cabernet sauvignon on Schwarzmann was also harvested three weeks after predicted maturity in the second week of April whilst fruit from Teleki 5C vines was harvested one week before predicted maturity. These vines are located at a higher elevation (280m) and harvested in the first week of May.

In the Hills subregion, one parcel of chardonnay on Teleki 5C was harvested at the predicted maturity date. Verdehlo on Schwarzmann was harvested one week later than predicted but at a very high sugar level (13.9 Be). Viognier on Schwarzmann grown at an elevation of 350m was harvested 2 weeks later than predicted and struggled to achieve ripeness. There may have been insufficient leaf area to ripen the crop which indirectly could be attributed to poor rootstock performance under dry conditions.

Shiraz had a predicted ripening date in the third week of March at an elevation of 250m. When used as the scion on 101-14 and Kober 5BB, harvest was 2 weeks later than predicted however maturity data for both rootstocks was identical. With R99 and Teleki 5C as the rootstock, harvest was 1 week earlier than predicted. Although harvested at the same time, fruit from Teleki 5C had lower acid and slightly lower sugar levels. This may be due to clonal influence (PT23 vs 1654) rather than rootstock.

At an elevation of 250m, Merlot is predicted to ripen in the third week of March. When used as the scion for Teleki 5C fruit was harvested one week earlier than predicted compared to fruit on R99 which was harvested at the predicted date. However whilst the fruit had similar acid levels, the fruit from Teleki 5C vines was 1 Be riper. This result

may be due to rootstock influence as the clones are common to both rootstocks. At 350m elevation Merlot on Schwarzmann was harvested two weeks later than predicted and struggled to ripen which may be due to young vines with a poor leaf area to fruit weight ratio. At an elevation of 330m Merlot on Ruggeri 140 was harvested in the third week of March at 14 Be. Merlot on Teleki 5A at 300m elevation was harvested in the first week of April at 13.7 Be whilst Merlot on Teleki 5C at 280m was harvested in the first week of May at 13.4 Be. This discrepancy in harvest dates in the last three examples cannot be explained by rootstock interaction as Ruggeri 140, which was harvested earliest, has a longer vegetative cycle than Teleki 5A or 5C and was grown at a higher elevation. A more likely explanation relates to vine balance and water availability however more detailed information is required for a definitive conclusion.

Cabernet sauvignon on Schwarzmann grown at 250m elevation was harvested four weeks later than predicted in the fourth week of April but at a high sugar level (14.4 Be). When grown on Teleki 5A at 300m elevation, fruit was harvested at 14.2 Be in the second week of April. Again it seems likely that vine balance and water availability had more influence on this result than rootstock. Tempranillo on Schwarzmann was harvested one week earlier than predicted in the first week of March at 13.9 Be.

In the High Terrace subregion, all chardonnay fruit is harvested for sparkling base. At 390m elevation, chardonnay on Schwarzmann is harvested six weeks before predicted maturity. At 300m, chardonnay on Schwarzmann is harvested three weeks before predicted in the fourth week of February. Sauvignon blanc on Schwarzmann at 390m elevation is harvested in the third week of February.

Pinot noir fruit is also grown for sparkling base. At the same vineyard, there was no difference in harvest date and little difference in maturity data between pinot noir on 101-14 and Schwarzmann rootstocks. Pinot noir on R99 at 300m was harvested at the same time as Chardonnay on Schwarzmann, three weeks before predicted maturity and only one week later than Pinot noir on 101-14 and Schwarzmann. This is a surprising result as R99 is generally thought to be far more vigorous although the finding agrees with Victorian trials which found there was no delay in maturity.

Merlot on Schwarzmann at 550m elevation is harvested in the second week of April at 14.3 Be. At the lower elevation of 390m, this rootstock –scion combination is harvested at the same time but at a lower sugar level (13.4 Be). The difference is probably due to vine balance where the vines at 550m ripen a relatively small crop. Merlot on 101-14 and R99 from the same vineyard were harvested at the same time. The fruit from R99 vines was lower in sugar (13.1 Be compared with 13.4 Be) and higher in acid (5.5 g/L to 5.1 g/L). Again this result correlates with Victorian trial results.

Cabernet sauvignon on Schwarzmann at 390m elevation was harvested in the second week of April at 13.7 Be, some 5-6 weeks earlier than predicted.

5.11 Wine Assessment

5.11.1 Rootstock Influence

The majority of fruit from vineyards in this survey is sold to wineries outside the Alpine Valley region. Due to phylloxera protocols most of this fruit is processed locally at Vic Alps winery. Harvest dates are therefore determined not only by optimal fruit ripeness but also by the logistical requirements of transport, processing and tank space. Where several rootstocks with the same scion are found in one vineyard, invariably the rootstocks will be harvested together. Wine data such as tasting notes for different rootstocks from the same vineyard is therefore unavailable. The majority of purchased fruit is destined for commercial labels and batched with similar fruit for winemaking purposes making it difficult to distinguish characteristics of individual parcels. However winemakers have commented on aspects of finished wines and indicated their enduse (see Appendix D).

Winemakers have therefore not observed differences in wine quality due to rootstock selection in this survey. They commented that the impact of rootstock selection on wine quality is more likely to be indirect through the influence on vine balance where unbalanced vines will not develop optimal colour and flavour.

5.11.2 Variety Suitability

Chardonnay

This variety is largely used for sparkling base rather than still tablewine. Winemakers commented that fruit flavours are at the riper end of the spectrum towards melon/peach rather than the leaner, more minerally style with citrus character. Sparkling base quality is good from the Low Terrace subregion but unlikely to ever make very high quality wine. Fruit from the High Terrace subregion has potential for high quality sparkling wine and good tablewine with flavours tending towards citrus. The majority of clones used in the area are I10V1 and I10V5 however one winemaker commented that a Burgundian clone in the High Terrace subregion showed a leaner, lighter, more desirable style. Another comment related to the recent trend to pick at higher sugar levels and hence the more likely expression of riper flavours. One winemaker found that harvesting at a lower sugar level delivered more desirable fruit character.

Sauvignon blanc

All winemakers agreed that this variety has the potential to become a flagship variety for the region. The better quality fruit came from lower vigour vines in the Low Terrace subregion. The variety produces a good range of flavours in this region.

Viognier

This variety is found in maturity group 5. The High Terrace subregion is believed to be too cool to produce desired aromas and palate weight compared to fruit from the Moyhu area which ripens 2-3 weeks earlier. May be more suited to Low Terrace subregion.

Pinot gris
All winemakers agreed that this variety is well suited to the region. One winemaker commented that with known new plantings and grafting, supply will come into balance with demand shortly.

Pinot noir
Fruit from this variety is only taken for sparkling base rather than still tablewine. Fruit from the High Terrace subregion is very well suited but flavour is towards the fruity end of the spectrum.

Shiraz
One winemaker commented that this variety is suited to the Hills and Low Terrace subregions, producing very good wine in warmer years. Colours are vibrant and intense. In cooler areas tannins can be green.

Merlot
Several winemakers believe this could be the red flagship variety for the region. All commented that colour intensity and ripeness are very good. One winemaker commented that the best fruit came from vineyards in the Low Terrace subregion at elevations between 250m and 350m. Another winemaker believes the potential for this variety is held back by a lack of marketing. This is exacerbated by the restrictions on processing outside the area due to the presence of phylloxera. The variety has a tendency to be too vigorous and better fruit is seen from lower vigour, balanced vines. The wines are medium bodied and elegant with few green tannins and good acid balance.

Cabernet sauvignon
The best parcels of fruit are grown in the Low Terrace and Hills subregions. One winemaker compared the region to Coonawarra and Padthaway in quality with very good colour.

Other varietals

Riesling :	Winemakers have seen good quality fruit from the Hills subregion but the austere flavours are suited to a niche market.
Tempranillo:	With it's shorter vegetative cycle it is well suited to the Low Terrace and Hills subregions but can be very tannic. It has a tendency to grow weedy and requires a low vigour rootstock.
Barbera:	This variety is grown in the Low Terrace subregion. It appears well suited to the region because it holds it's acid and has good intensity of flavour.
Traminer :	This variety could do well in the area but is limited by low demand.
Saporavi :	Winemakers have seen extremely high colour scores for this variety from the region and it grows well.

5.12 Conclusion

When selecting rootstocks growers did attempt to obtain reliable recommendations for suitable rootstocks. The primary source of information was the Victorian Department of Agriculture, largely due to former State Viticulturist John Whiting's expertise in this field. In the early 1990's when planting recommenced in this region, the rootstock trial at Porepunkah was yet to be planted and an extensive survey of the soils and climate was not available. It is therefore not surprising that earlier rootstock selections have had varying degrees of success.

Clearly high vine vigour is of concern to most growers surveyed. These concerns relate to the high capital and operating costs associated with vigorous vines particularly at a time when grape prices are very low. They also relate to the impact of vigorous growth on vine balance and resultant wine quality. Vigorous shoots with long internodes result in fewer leaves per shoot and reduced leaf area for ripening due to the constraints of trellis height which require shoot trimming to a specified length. Fewer leaves also reduces the dappled shade effect which most growers believe is desirable to optimize flavour in aromatic white varietals and reduce sunburn. Large canopies increase evapotranspiration losses post veraison at a time when rainfall is reduced hence water must be available for irrigation. Unbalanced vines increase labour requirements for shoot and bunch thinning which most vineyards regard as a necessity. Rootstocks which are better matched to the terroir would assist to bring vines into balance with resultant cost reductions and improved fruit quality.

All rootstocks appeared to confer high fertility on scion wood with an average of two bunches per shoot across all varietals except tempranillo. It was not possible to determine in this survey whether heavier bunch weights were due to increased berry size or increased berry number. The former result could be from rootstock or clonal influence, water uptake or pruning regime and particularly in red varietals will impact on potential quality whereas the latter may be due to rootstock influence alone.

In relation to water use, although growers gave average rainfall figures for their vineyards, nearly all commented that they hadn't received that amount of rain for some years. This suggests that in future growers may be planning for dry years and managing wet years. If the effect of climate change in this region is to reduce winter rainfall the impact will be felt by both growers reliant on surface collected water and those pumping from creeks and dams. Concerns were expressed about the capacity of the most widely planted rootstock, Schwarzmann, to withstand dry conditions. Growers in all subregions commented that in comparison to other rootstocks, Schwarzmann appears to have a higher water requirement and shows signs of stress earlier than other rootstocks. In the Hills subregion particularly growers who selected rootstocks from the *V. berlandieri* x *V. rupestris* group made positive comments regarding the drought tolerance of these stocks given the prevailing drier conditions.

Disparities between predicted and actual ripening dates cannot be explained by the mismatch of rootstock to terroir alone. Rootstocks with a common scion in the same

subregion have shown profound differences in ripening which must be related to vineyard management practices. In particular, cultural practices which control early season vigour and promote optimum leaf area to fruit weight ratios will have a positive impact on rootstock performance and resulting fruit quality.

Winemakers had difficulty commenting on the impact of rootstocks on wine quality due to the logistics of vintage resulting in batching of individual parcels of fruit. Generally, there appears to be no difficulty in achieving desired sugar levels for all varieties in this region. Red varieties showed very good colour and soft, ripe tannins in most parcels. The general trend of comments related to observations of some high quality parcels of fruit with the potential for greater quality if vigour can be managed. Rootstock selections which are better matched to the soils of the region will contribute to improvements in wine quality with economic and environmental benefits.

6.0 Recommendations

6.1 Further investigation of soil types on individual vineyards is required. When surveyed, most growers did not know their soil type which is a basic prerequisite for rootstock selection. More detailed knowledge of soil type locations will enable selection of rootstocks which are site specific.

6.2 The effect of climate change on vine growth and water availability in the region may be profound. More information is required on potential scenarios to assist with planning for future water resources and likely impacts on rootstock selection and cultural practices.

6.3 The parameters for suggested subregions should be tested by the grower community. These subregions are likely to produce different winestyles and may be required in future for fruit batching or marketing purposes. The parameters should therefore be vigorously debated before adoption of these subregions.

6.4 Further planting of SO4 is not recommended. SO4 is a vigorous rootstock with high yields and low juice pH. The excessive vigour can cause poor fruit set and delayed maturity. Inflorescense necrosis may result when used with merlot or cabernet sauvignon. Problems have also been encountered with snapping of the slender trunk during mechanical harvesting.

6.5 Continued use of Schwarzmann should be undertaken only in conjunction with water availability which enables post veraison irrigation. Schwarzmann is the most widely planted rootstock in the region hence grower experience is extensive. Most growers expressed concern about it's lack of drought tolerance. Although winemakers did not comment specifically on high juice pH levels in the fruit of red varietals, this finding was confirmed in Victorian rootstock trials and impacts on wine colour.

6.6 The Hills subregion appears to be the most vulnerable to restricted water availability given the reliance on surface water collection and rapidity with which these soils dry out. It is likely that the best options for rootstock selections will come from the *V. berlandieri* x *V. rupestris* group, namely 99 Richter, 1103 Paulsen and 140 Ruggeri. In addition Ramsey should be considered in light of good results from South Australian trials (Blieschke, pers. comm.) and satisfactory performance in a vineyard in this subregion. Difficulties experienced with field grafting 1103 P in this region have not been experienced elsewhere (Blieschke, pers. comm.). Merlot on 140 Ru is producing balanced vines and high quality fruit. 99R is consistently rated a good performer by growers in this subregion.

Whilst 110 Richter also belongs to this group it is not recommended given poor trial results at Langhorne Creek, SA. Gravesac has not been tested under

Australian conditions but is suited to acid soils of lower fertility and may be suitable for this subregion.

6.7 The Low Terrace subregion is divided by heavier soils downstream of Rocky Point Bridge and lighter soils upstream. Vines on heavier soils are vigorous and produce heavy bunches even in unirrigated conditions. It is suggested that 101-14 and Riparia gloire be considered on these soils. Schwarzmann may also be considered although it shows vigorous growth in these conditions and elevated potassium levels which may affect colour in red varieties. Riparia gloire has not been widely evaluated under Australian conditions although results from the Porepunkah trial showed it to have low yield and low vigour. These rootstocks do not tolerate drought and should only be used if irrigation water is available during the ripening season.

On the lighter soils upstream of the RPB, growers reported good performance from Teleki 5C, 99R and 101-14. 420A and 3309C both require more testing but may be suited to this subregion as they showed low to moderate vigour and yield in Victorian trials.

6.8 The High Terrace subregion has high rainfall and deep, fertile soils with good RAW values hence rootstocks with shallower root systems and shorter growing cycles would be suitable providing supplementary water is available post veraison. Growers reported good results with 101-14 and surprisingly 99R. Other rootstocks which may be suitable include 3309C, 420A and Riparia gloire. 3309C is no longer used extensively in Australia but was assessed in the Victorian trials where it showed moderate vigour and yield but did not significantly advance maturity. 420A also showed low to moderate vigour in Victorian trials however the vegetative cycle is longer. Untried rootstocks should only be planted in small quantities.

6.8 Winemakers suggest sauvignon blanc and merlot may be flagship varieties for the region. Additionally pinot gris, barbera and tempranillo also show promise and have shorter vegetative cycles which are suited to the region. Although Merlot is planted to six different rootstocks across the subregions, little is known about rootstock influence on the remaining varieties. It is recommended that rootstock trials be established in all subregions to investigate the growth habit and wine quality from these and other varietals using rootstocks best suited to those subregions.

Acknowledgements

The author wishes to thank the following people for their generosity in sharing their time, wisdom and experience:

Bob MacNamara
Bruce Holm
Frank Ivone
Ezio Minutello
Alan McGuffie
Malcolm Milne
Loris Brandellero
Nigel Blieschke
Andrew Vasey
Alan Kennett
Tim Walpole
David Browning
Mick Dalbosco
Steph Antonello
Tony Ferraro
Enio Cavedon
Natalie Fryar
Emma Wood
Nick Dry
Mark Walpole.

7.0 Appendices

Appendix A – Average maturity data for dry or semi-sweet table wines^

Lower Ovens (LO)*

Elevation	200m	250m	300m	350m	380m
Group 3	2/3	6/3	9/3	-	-
Group 4	8/3	12/3	15/3	-	-
Group 5	14/3	18/3	22/3	-	-
Group 6	20/3	24/3	28/3	-	-

Ovens and Buffalo (OB)*

Elevation	200m	250m	300m	350m	380m
Group 3	8/3	13/3	16/3	21/3	-
Group 4	14/3	20/3	23/3	28/3	-
Group 5	20/3	26/3	30/3	9/4	-
Group 6	27/3	4/4	11/4	24/4	-

Upper Ovens and Buckland (UOB)*

Elevation	200m	250m	300m	350m	380m
Group 3	-	21/3	27/3	10/4	
Group 4	-	28/3	10/4	4/5	
Group 5	-	13/4	2/5	30/5	-
Group 6	-	3/5	23/5	-	-

Mt Beauty (MB)

Elevation	200m	250m	300m	350m	380m
Group 3	-	6/3	9/3	17/3	-
Group 4	-	13/3	16/3	24/3	-
Group 5	-	19/3	22/3	30/3	-
Group 6	-	26/3	28/3	13/4	-

^After Gladstones 1992

*Adjusted using corrections of 0.25 C for every 1 C over the 13 C diurnal range and less 0.6 C per 100m higher or plus 0.6 C per 100m lower than the particular station's data. (extract from Application for the determination of Alpine Valleys Wine Region as an Australian Geographical Indication).

Appendix B - Rootstock by variety by area

Table 1 Low Terrace

Rootstock	Variety	Area (ha)	Total Area (ha)
Schwarzmann	CHR	2.5	13.0
	SHI	4	
	CAS	3	
	DIF	1	
	SAB	2.5	
101-14	VIO	2	18.4
	PNG	3.9	
	SAB	4.6	
	CHR	5.6	
Teleki 5C	CHR	5.8	19.7
	MER	6.8	
	CAS	3.1	
	SAB	4	
Teleki 5A	CHR	1.8	1.8
99 Richter	MER	12.2	16.2
	PNG	4	
SO4	MER	4.6	5.7
	BAR	0.5	
	SAN	0.5	
	PNG	0.1	
Paulsen	MER	0.2	0.4
	PNG	0.2	

Table 2 High Terrace

Rootstock	Variety	Area (ha)	Total Area (ha)
Schwarzmann	MER	5.5	27.6
	CHR	13.4	
	CAS	5.5	
	PIN	2.2	
	SAB	1	
101-14	MER	3	5.3
	PIN	2.3	
Ramsey	CHR	0.1	0.1
Ruggeri 140	CHR	0.1	0.1

Table 3 Hills

Rootstock	Variety	Area (ha)	Total Area (ha)
Schwarzmann	MER	3	16.9
	SHI	0.4	
	CAS	4.7	
	TEM	3.2	
	VED	2.2	
	PVR	0.4	
	VIO	3	
101-14	SHI	1.7	6.2
	MER	4.5	
Teleki 5C	CHR	2.2	7.2
	MER	1	
	SHI	4	
Teleki 5A	TEM	0.5	4.5
	CAS	2	
	MER	2	
Richter 99	MER	2.4	5.1
	SHI	2.1	
	CAS	0.6	
SO4	SHI	0.1	0.1
Ruggeri 140	MER	0.8	0.8
Kober 5BB	SHI	2.6	2.6
Ramsey	RIE	0.5	0.5

Appendix C - Harvest data

Table 1 High Terrace

Variety	Area	Elevation M	Predicted Maturity	Rootstock	Actual maturity	Sugar Be	pH	Ta g/L
CHR	UOB	300	27/3	Schwarz	wk4-Feb	10.4	3.30	8.7
	OB	390	27/3	Schwarz	wk2-Feb	10.8	3.27	8.7
SAB	OB	390	27/3	Schwarz	wk3-Feb	10.9	3.17	12
PIN	UOB	300	21/3	99R	wk4-Feb	10.6	3.25	11.2
	OB	390	27/3	101-14	wk3 Feb	10.8	3.24	9.9
	OB	390	27/3	Schwarz	wk3 Feb	10.1	3.26	9.4
MER	MB	550	no data	Schwarz	wk2-April	14.3	3.72	5.25
	OB	390	2/5	Schwarz	wk2-April	13.4	4.01	4.3
	UOB	300	2/5	101-14	wk3-March	13.4	3.50	5.1
	UOB	300	2/5	R99	wk3-March	13.1	3.48	5.5
CAS	OB	390	23/5	Schwarz	wk2-April	13.7	4.08	4.3

Table 2 Low Terrace

Variety	Area	Elev'n (m)	Predict Maturity	Rootstock	Actual maturity	Sugar Be	pH	Ta g/L
CHR	LO	200	2/3	Schwarz	wk1-March			
	LO	200	2/3	Teleki 5A	wk1-March			
	LO	200	2/3	Teleki 5C	wk1-March			
	OB	300	16/3	Teleki 5C	wk2-Feb	10.4	3.29	7.8
PNG	OB	300	Group 2 no data	R99	wk2-March	12.5	3.55	5.4
SAB	OB	300	16/3	Teleki 5C	wk4-Feb	10.7	3.49	7.3
	OB	300	16/3	Schwarz	wk4-Feb	11.7	3.41	5.3
MER	OB	300	30/3	R99	wk4-April	13.6	3.7	4.5
	OB	300	30/3	R99	wk4-March	13.4	3.49	5.9
	OB	300	30/3	SO4	wk3-April	13.8	3.75	4.0
SHI	LO	200	14/3	Schwarz	wk1-April	14.7	4.1	5.0
CAS	LO	200	20/3	Schwarz	wk2-April			
	UOB	280	15/5	Teleki 5C	wk1-May	13.5	3.76	5.3

Table 3 Hills

Variety	Area	Elevat'n	Predict Maturity	Rootstock	Actual maturity	Sugar Be	pH	Ta g/L
CHR	LO	250	6/3	Teleki 5C	wk1-March			
VER	LO	250	6/3	Schwarz	wk2-March	13.9	3.35	6.1
VIO	MB	350	30/3	Schwarz	wk2-April	12.8	3.76	3.5
SHI	LO	250	18/3	101-14	wk1-April	14.1	3.8	5.4
	LO	250	18/3	Kober5BB	wk1-April	14.1	3.8	5.4
	LO	250	18/3	R99	wk2-March	14.0	3.71	5.5
	LO	250	18/3	Teleki 5C	wk2-March	13.8	3.77	4.7
MER	LO	250	18/3	Teleki 5C	wk2-March	14.2	3.73	4.4
	LO	250	18/3	R99	wk3-March	13.2	3.74	4.8
	MB	350	30/3	Schwarz	wk2-April	12.8	3.76	3.5
	UOB	330	18/5	Ru140	wk3-March	14	3.7	4.0
	UOB	300	2/5	Teleki 5A	wk1-April	13.7	3.43	6.3
	UOB	280	25/4	Teleki 5C	wk1-May	13.4	3.78	3.8
CAS	LO	250	24/3	Schwarz	wk4-April	14.4	3.7	5.5
	UOB	300	23/5	Teleki 5A	wk2-April	14.2	3.5	5.6
TEM	LO	250	12/3	Schwarz	wk1-March	13.9	3.76	4.1

Appendix D - Winemaker comments

Table 1 Low Terrace

Variety	Rootstock	Comments	Enduse
CHR	Teleki 5C	Used for sparkling; grapefruit, citrus, ripe lemon characters – towards riper end of spectrum; good acid and sugar balance	$12 (limited by product range)
SAB	Teleki 5C	Rich mid palate, tropical fruit flavours, very good	$12 (limited by product range)
	Schwarz	Looking for green bean and passionfruit style but fruit is blended with other regions	$10
PNG	R99	First crop, clean sound fruit	$10
MER	R99	Very good colour	$14
	R99	Bright colour but stability an issue when high crop; pH balance good; berry flavours with some tobacco leaf as they age; supple tannins, not green	$12
	SO4	Good purple colour, middle of range for area	$10
	Teleki 5C	Very good colour, good fruit	$10
CAS	Teleki 5C	Good colour	$10

Table 2 High Terrace

Variety	Rootstock	Comments	Enduse
CHR	Schwarz	Fruity; lacks lean, citrus character; used for sparkling	$10-$12
	Schwarz	Used for sparkling;fruity, more melon spectrum than citrus, not enough fruit concentration	$10-$12
SAB	Schwarz	Lean style with cut grass aroma, very good fruit, potential for top end	$12 (limited by product range)
PIN	101-14/ Schwarz	Used for sparkling; good sugar/acid balance; strawberry, white pepper, citrus flavours	$12 (limited by product range)
	99R	Used for sparkling; good, fine structure but too fruity for top end	$10-$12
MER	Schwarz	Tannin structure very good, fruit weight very good, potential to do better	$15
	Schwarz	Intense blood plum colour, soft tannins with good mouthfeel and long length of palate	$20
	101-14/ 99R	Vibrant, good colour; lighter tannins, not green;balanced; fruit flavours ripe and fresh	$15
CAS	Schwarz	Good palate weight and colour, lacks mid palate so good for blending, no green tannins	$15

Table 3 Hills

Variety	Rootstock	Comments	Enduse
CHR	101-14	Used for still; peach, tropical flavours; riper end of spectrum	$10
VIO	Schwarz	Palate is thin, austere, low nose and no weight. Little varietal character.	Bulk
PNG	101-14	Grigio style; flinty with some floral character	$14
VER	Schwarz	Very good fruit intensity with more tropical flavour spectrum. Good acids resulting in some citrus and stonefruit characters.	$15-$20
MER	Schwarz	Hilltop fruit has better colour and flavour with more plum and tighter tannins; bottom section green tannins, minty	$10 (potential for hilltop to $20)
	R99	Good colour with lighter, ripe tannins. Limited fruit flavour, flavours diluted.	$8-$10
	Ruggeri 140	Very good colour, aim to improve tannin structure; hand picked so some whole berries	$24
	Teleki 5A	Very good colour	$17
SHI	R99/ Teleki 5C	Very good colour, vibrant. Tannins have good weight and are not drying. Fruit flavours include spice and pepper.	$15-$17
CAS	Teleki 5A/ Schwarz	Excellent colour; tannins ripe, not green. Well balanced with good fruit character, good acid	$17

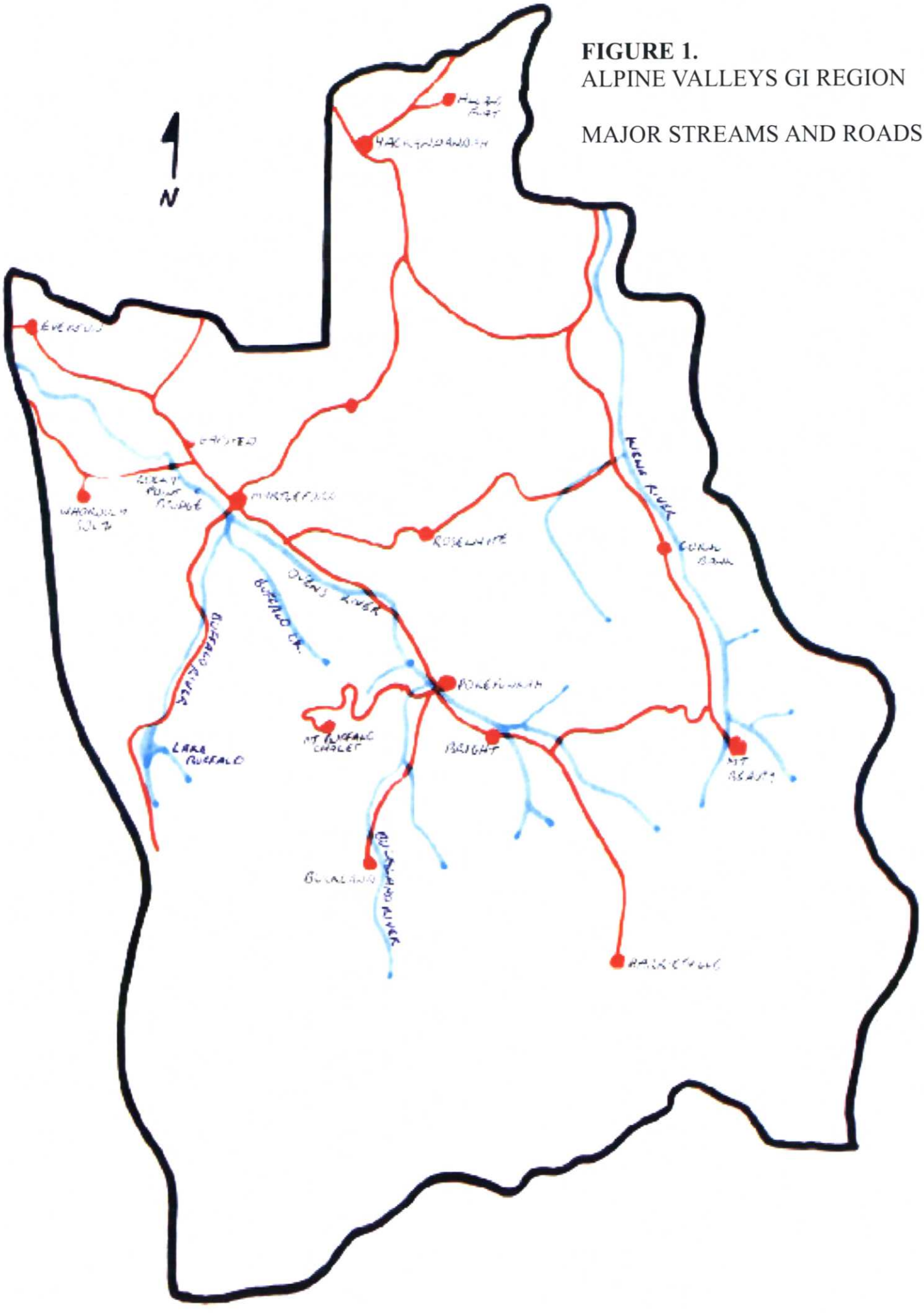


FIGURE 1.
ALPINE VALLEYS GI REGION

MAJOR STREAMS AND ROADS

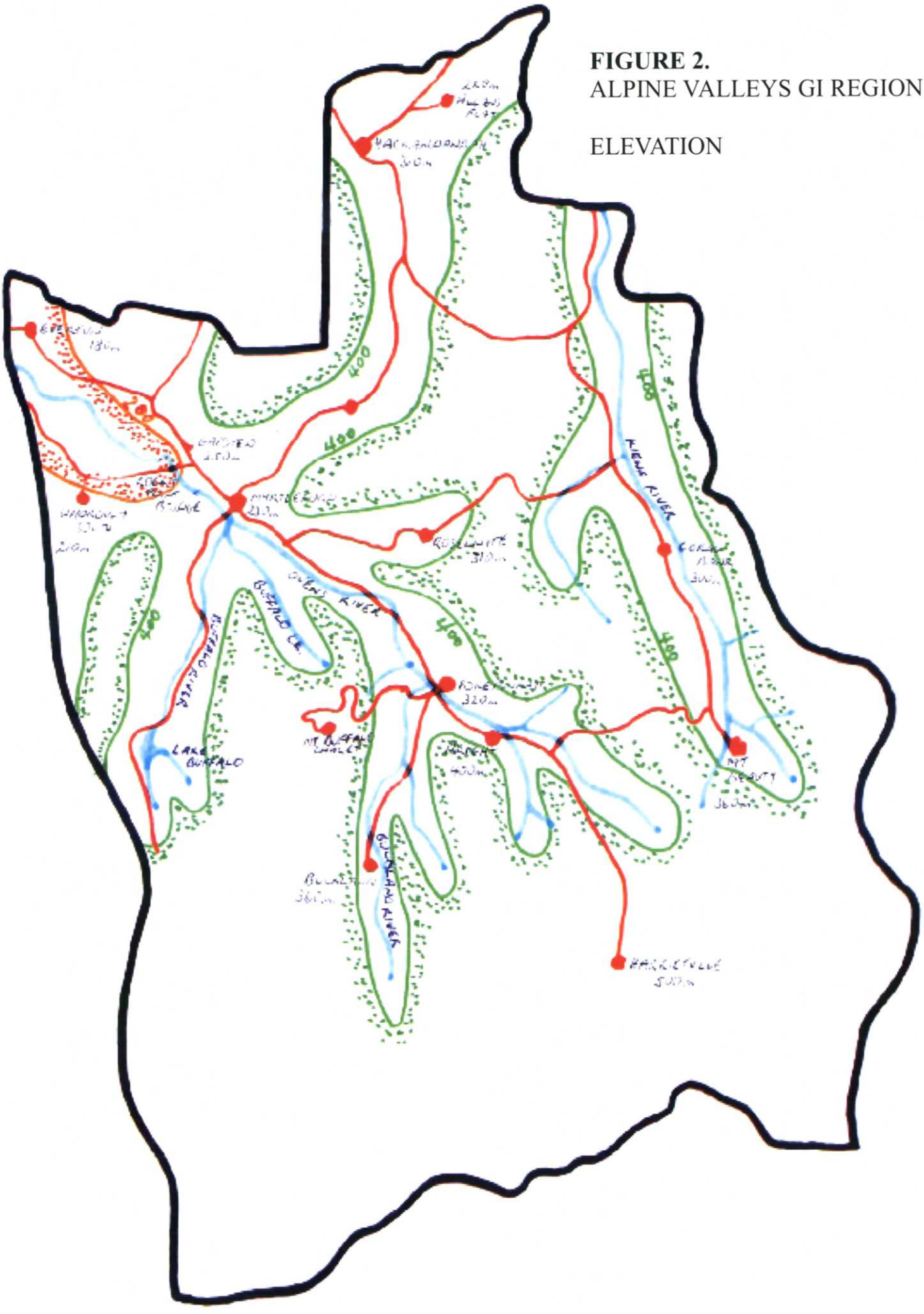


FIGURE 2.
ALPINE VALLEYS GI REGION

ELEVATION

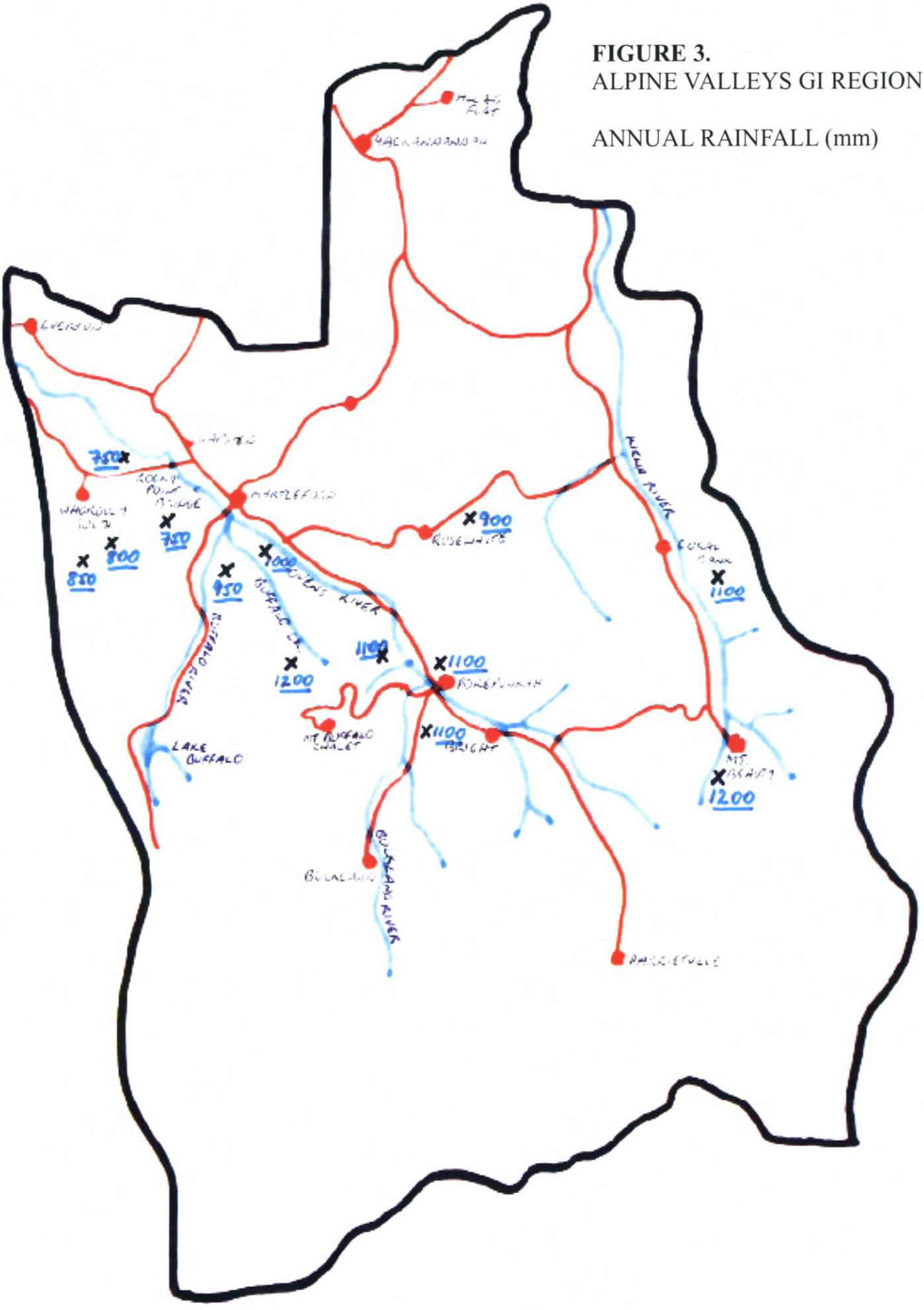


FIGURE 3.
ALPINE VALLEYS GI REGION

ANNUAL RAINFALL (mm)

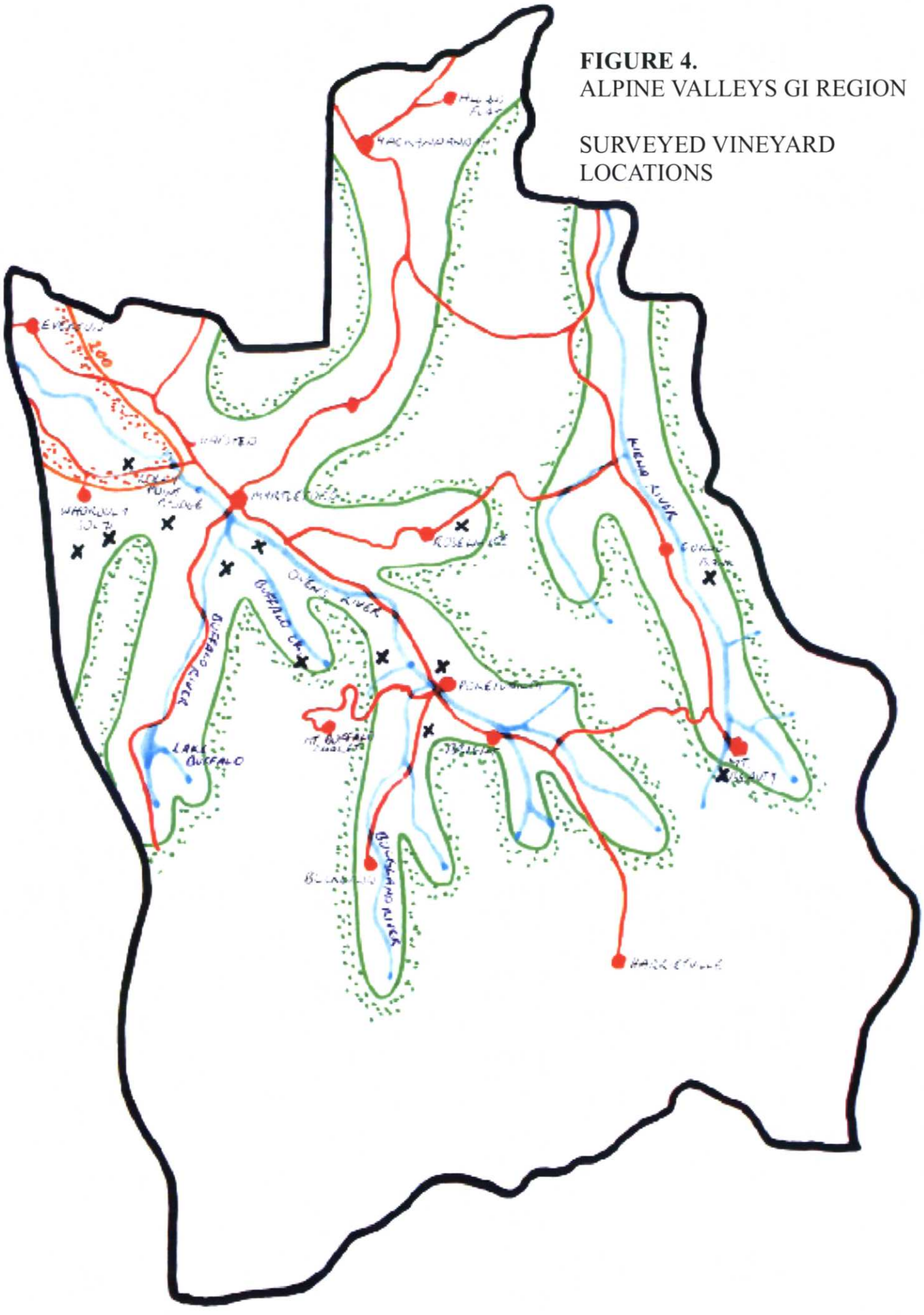


FIGURE 4.
ALPINE VALLEYS GI REGION

SURVEYED VINEYARD LOCATIONS

Appendix E

Rootstock Survey

1.0 General Data

Vineyard Name	Location
Contact Person	Phone no.

Vine Data

VARIETY	CLONE	ROOTSTOCK	YEAR PLANTED	AREA (ha)	TOTAL YIELD (tons)	YIELD (tons/ha)

2.0 Site Description

Elevation	Terrain
Aspect	Rainfall
Soil Type	Frost frequency
Trellis system	Irrigation system

3.0 Vine Growth

Reason for rootstock selection:
Strike rate:

Average Phenology Dates

VARIETY/ ROOTSTOCK	BUDBURST	FLOWER/ FRUITSET	VERAISON	COMMENTS

Average Harvest Dates

VARIETY/ ROOTSTOCK	HARVEST	COMMENTS

Shoot Vigour and Components of Yield

VARIETY/ ROOTSTOCK	SHOOT VIGOUR	BUNCHES/ SHOOT	BUNCH WEIGHT (g)	BERRIES/ BUNCH	BERRY WEIGHT (g)

Vineyard Practices

Nutrition
Pest and Disease
Pruning
Irrigation
Canopy Management

4.0 Wine Quality

Fruit Destination

Current Vintage Data

VARIETY/ ROOTSTOCK	SOURCE (load/tank)	BAUME	pH	Ta	COLOUR

Winemaker Comments

VARIETY/ ROOTSTOCK	COLOUR	TANNINS	GENERAL	GRADE/ PRODUCT

5.0 General Comments

Vineyard Manager/Viticulturist:
Winemaker:

Interviewed by:	**Date:**