Executive Summary:
It is noted that the 2019 survey, the second in a series of intended surveys, has drawn submissions from an estimated one-third of the UK planted area. This is an improvement on the initial survey of 2018 but clearly requires a further significant improvement to assure its relevance, validity and value for ongoing industry development.

Future planning and investments in market development and promotions; vineyard, winery, maturation facilities and stock; operational logistics; training and professional development and public policy shall be highly reliant on currently complete and reliable data, so considerable effort is required to secure a substantially universal coverage and return from all commercially active vineyard operations.

Commentary on the data analysis endeavours to explain the possible drivers of vineyard performance as revealed by responses to the survey questions. It entails a synthesis of factors declared via the survey, and a broad review of seasonal conditions in 2018 and 2019 as drivers of underlying vineyard potential. Beyond that, it attempts to integrate and apply knowledge of relevant research and common UK vineyard operations delivering the reported performance in 2019. Recommendations for additions to future surveys are proposed to enhance the value of this survey project.

This Review of Data should be read in conjunction with the ICCWS & WineGB Yield Survey 2019 as prepared by Stephen Skelton MW.

Key Recommendations:
• Recommendation 1: Effort should be maintained in publishing/communicating outcomes of the survey with targeted effort applied to workshopping, in conjunction with appropriate value chain and industry development partners, future industry and business development strategies.

• Recommendation 2: To achieve more stable, reliable, and predictable yields, vineyard managers should take greater account of the prior season’s weather conditions and anticipated or measured fruitfulness to guide pruning and management strategies.

• Recommendation 3: Future surveys should include additional items to define intended end use, degree of management-determined crop reduction and losses arising from abandoned harvest (pest or disease impact, immaturity, inadequate price, no room in winery etc.).
• **Recommendation 4:** Future surveys should include items to allow assessment of the top-yielding 25% compared to the lowest-yielding 25% of vineyards and varieties relative to elevation, all other factors being similar. This may better guide site and variety selection and vineyard configurations adapted to higher altitudes.

• **Recommendation 5:** Future surveys should include data collection on in-row spacings (potentially, spacing X rootstock type) and may be informative regarding production efficiency in terms of productivity; production/vine (kg/vine) or production/m of row (kg/m) and kg/ha along with the influence of rootstock type.

**Introduction:**
This analysis is based on data extracted from the WineGB Yield Survey 2019, being the second year in which such a survey has been undertaken. Analysis and interpretation are directed towards understanding the basis for yield observed and its variation relative to vineyard geographical location and features, vineyard configuration, varieties deployed and the influence of seasonal conditions. Whilst management practices and end use (sparkling or still wine etc) were not surveyed, it might be surmised that these too shall have a significant influence on vineyard performance and related data. As deliberate viticultural interventions are generally imposed to generate a maturity &/or disease management impact for specific product styles but are likely incur a yield penalty, reporting such data would allow more effective analysis and interpretation for different product end-use categories.

**Sample Size, Geographic Coverage, Data Quality and Relevance:**
The data submitted for the 2019 season is considerably greater than that achieved for the inaugural survey in 2018 and has achieved a substantially larger coverage of the estimated planted vineyard area in the UK. Data was submitted for approximately one third of the estimated vineyard area and encouragingly provides a very useful basis of relevant information from which basic performance parameters might be referenced and assessed. Nevertheless, the data set cannot represent the national scale nor regional differentiators needed for effective market planning and promotion, production, industry development, lobbying and influencing of policy, industry support and regional planning mechanisms, nor for engagement with the financial services sector. More effective recruitment of participation is required to generate full value from this national survey which likely constitutes a major plank in securing ongoing support for sound, effective industry development and the ongoing prosperity of industry participants.

Effort should be maintained in publishing/communicating outcomes of the survey\(^1\). Even allowing its limitations, greater and specifically targeted effort, with national and regional data as a core resource, should be directed to workshopping industry and business development activity, optimising scale and operations and planning strategy for rational industry and individual business

\[^1\] Outcomes of the survey could be adapted for PowerPoint or other media as short, sharp messages and potentially for webinar communication and discussion of results.
strategy; such demonstration of value, especially if delivered with and via appropriate value chain and industry development partners, would add considerable impetus to participation in future surveys.

**Yields:**
Yields are rather more aligned with recent mid run (2016-2019) averages although that figure is somewhat influenced by the record 2018 crop, indicating that 2019’s crop was also greater than the usual. Although seasonal conditions, beyond reportage of frost and weather driven disease, were not surveyed, it should be understood that previous seasons’ conditions exert a direct effect on floral initiation and fruiting potential for the subsequent season, and also strongly influence vine health, stored reserves and capacity to carry and mature the crop. Relatively high temperatures and sunlight induce relatively high fruitfulness in buds established under those conditions.

Cool conditions in May and June generally result in less fruitful buds on the lower nodes, with more distal nodes likely to express greater fruitfulness as warmer brighter conditions and greater carbohydrate supply allow their better development; pruning to short canes following such cool spring conditions in the previous year might strongly limit potential crop. On the other hand, maintaining the same pruning approach after the recent prior warm springs will establish greater crop potential than might normally be anticipated.

Management decisions relating to pruning and targeting yields, canopy and crop management and regulation (shoot manipulation, thinning, training, crop thinning etc.), as well as the impact of frost, pest and disease all interact to determine yields and maturity in the current season, while carryover effects (stored reserves, underlying fruitfulness etc.) will influence the forthcoming seasonal performance.

Given that yield potential (particularly bunch number and potential size) is established in the year prior to flowering and cropping, it is important to note that relatively warm springs in each of 2017 (Figure 1) and 2018 (Figure 2) shall have aided in the establishment of high fruitfulness (crop potential) for the subsequent seasons, respectively 2018 and 2019.

**Figure 1:** Spring and Summer 2017, Mean Temperature 1981-2010 Anomaly
Obviously, the fruitfulness and crop potential are only translated to actual yield when flowering and fruit-set are completed, these in turn being influenced by conditions leading up to and around the flowering period each cropping season. Good conditions at flowering cannot compensate for low fruitfulness, however high fruitfulness, good vine condition and reserves may offer some compensation for less than optimal conditions leading up to and around flowering. Review of spring conditions in 2015 and 2016 (Figure 3) show each were close to longer term average mean temperatures and were followed by low crops in 2016 and 2017.

Looking ahead, last season’s conditions in late spring/early summer 2019 (Figure 4) shall likely have induced reasonably good, but not exceptional fruitfulness, or underlying potential, for season 2020, given the relatively normal-warm June and July 2019, followed by perhaps a nearer to “normal” mid-late season (see full monthly data June-December 2019 in Annex).
Converting the underlying potential to actual fruit is then dependent upon the seasonal conditions, access to adequate vine reserves for early season growth and development, and quality of vineyard management leading up to and around flowering, to ensure adequate fruit set. It is anticipated that vineyards with poor reserves, or weak growth, especially those which have carried larger than normal crops in previous season(s) may struggle to set and carry large crops this season.

To assist in achieving more stable, reliable, and predictable yields, vineyard managers should take greater account of the prior season’s weather conditions and anticipated or measured fruitfulness (bud-dissection or forced bud techniques). Understanding the fruitfulness along with assessment of vine condition, vines reserves, cane quality, yield and maturity targets, would allow the manager to adapt their pruning regimes accordingly.

**Yield X Region:**

Given the prime driver of vine growth and development along with fruit yield and maturity is directly dependent on energy input from sunlight, and is best represented by temperatures and sunlight hours, the trends of declining yields east to west is understandable. Similarly, picking dates tend to be successively later as tracked east-west, reflecting the generally later start to the season and the slower accumulation of energy inputs to drive vineyard performance. It might be expected that an accumulation of Growing Degree Days (GDD) would demonstrate a clear correlation with vine and fruit development and may warrant further development for its predictive value in scheduling harvest, related labour and winery logistics.

There is some suggestion that on a region by region basis, lighter crops were harvested earlier, and larger crops were picked relatively later but, again, many factors may be contributing to this outcome. The survey did not distinguish between alternative end-uses of the grape crop, for either still or sparkling wine where maturity and style considerations are likely to drive quite different yield targets and management interventions (e.g. shoot thinning, crop reduction) and shall also determine harvest dates; variation in such factors shall also play a significant part in final yields recorded. The impact of frost, especially early season, in degrading yield potential and influence of disease, especially botrytis and downy mildew in wet conditions shall also vary by regions.
Likewise, losses may arise from unpicked fruit as related to immaturity/failure to ripen, influenced by regional conditions and management decisions which could have seen excessive crop retained and unable to ripen under seasonal weather conditions or the pressure of leaf or fruit disease. The most-reported reasons for losses were attributed to Botrytis in approximately 30% of parcels with ‘immature fruit’ and ‘frost’ cited in approximately 15% of parcels reported; actual tonnages lost were not defined.

Future surveys would benefit from inclusion of items to define intended end use, degree of management determined crop reduction and losses arising from abandoned harvest (pest or disease impact, immaturity, inadequate price, no room in winery etc.). There may also be value in reporting estimated yield losses as opposed to simply reporting the incidence of losses, although accurate quantification may be challenging.

**Influence of Altitude:**
In the UK, the general view of the influence of altitude on decisions regarding site selection for viticultural development and the security of production is that a nominal “limit” of 100m should apply. Many of the more-elevated sites are substantially cooler than lower sites and are very exposed to winds and advective (air mass) frost (although they may also incur radiation frosts). On the other hand, low sites commonly risk both early and late season radiation frosts, and although better protected from advective frosts, they risk higher humidity, disease incidence and severity. Lower, better protected sites may also generate greater vigour than desired so creating challenges for crop and canopy management, also generating greater disease risk and if on heavier and wetter soils, may experience issues with access and year-round trafficability for management tasks.

The general trend for the past 2 seasons suggests that yields are greatest for altitudes of 60-100m with yields at less than 60m greater than yields at over 100m altitude. There would be value in determining the performance of say the top-yielding 25% compared to the lowest-yielding 25% of vineyards relative to elevation, all other factors being similar. This may offer indications of the fundamental influence of altitude on vineyard yield performance in the UK and may also suggest varieties and vineyard configurations that could deliver better adaptation to a range of altitudes.
Regarding sugar and acid concentrations achieved at harvest, and recognising that different varieties, seasonal conditions and product type shall dictate the management-determined harvest maturity specification, there appears a trend to slightly lower sugar concentrations in vineyards above 100m elevation. Acidities trend slightly higher for vineyard reporting at greater than 100m although for both sugar and acid reported data there are notable variety outliers; vineyard numbers reporting may be small and harvest timing decisions or regional effects may be obscuring any clear trends associated with or attributable to altitude.

**Influence of Vine Density and Vineyard Configuration:**
As perhaps one of the more contested issues in vineyard design and establishment, the issue of vine density (vines/ha) and configuration (row width X vine spacing), the survey data demonstrates clear indications that low densities, <3000 vine/ha, deliver low yields. On the other hand, there appears to be an upper limit, around 4000 vine/ha beyond which yield ceases to increase and may potentially impact on the subsequent season’s productivity. Actual vineyard configuration, that is row-by-vine spacing, may offer more insight regarding reasons for productivity differences.

Low vine density, either due to wide planted vines in-row, or wide row spacings will present less than optimal canopy area to intercept sunlight and deliver productivity. At wide in-row spacing, vine misses due to death or injury, poor crown configuration and ‘gaps’ in wire fill become increasingly significant in degrading the productive capacity of the vineyard. With increasingly tight rows, say <2.0m, overshadowing of one row upon the neighbour may occur and shall potentially depress the development of fruitful buds, especially in high vigour vineyards and in seasons or localities with low temperatures and sunlight hours.

Issues of aspect, row orientation and specifically attuned management may mitigate the effects of such close row spacings however there appears to be little to gain from sub-2m row spacing. The greater workability of machines in 2:00-2.50m rows may also be an attractive element in determining appropriate spacing. Inter-vine spacing, crown configuration, fruitfulness at each bud position and cane length allowed by the trellis system along with any poor “wire fill” as results from gaps at the crown, non-fruitful canes, weak, short canes etc. all contribute to poor performance. Consequently, in future surveys, the availability of data for in-row spacings may also be informative regarding production efficiency in terms of production/vine (kg/vine) &/or production/m of row (kg/m) and productivity, kg/ha.

**Conclusion:**
Survey data from the 2019 season is more complete than for the initial survey in 2018 but still falls well short of delivering a comprehensive picture of vineyard performance in the UK. Future industry intelligence and strategy development for a sustainably profitable industry, and its individual enterprises, requires that foundation data such as vineyard statistics and its performance characteristics be readily available in de-identified form such as provided by this survey. I strongly urge the WineGB leadership and executive, at both the national and regional level, to actively communicate the results of the current survey.
Perhaps more importantly, they should clearly demonstrate the use and value of such data in guiding strategy, focussing education and training initiatives for vineyard managers and operators, and illustrating a central role for quality data and analysis in workforce planning, rational market development and promotion, industry and governmental planning, and enhancement of the value chain. Such quality data, as is the potential that could be delivered from these surveys, would add markedly to the industry’s image and reputation.

Figure 6: April-November 2019 Mean Temperature 1981-2010 Anomaly