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VineMAP Report

Customer name:	vinescapes
Email:	vinescapes
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Reference:	
Date:	7 October 2019

Products:

1. Topographic suitability & grading
2. Soil suitability information, landcover suitability and designated 'protected' areas
3. Flood risk and access maps
4. All terrestrial reports (Reports 1 - 3)
5. **Climate (including Frost Risk / Report No.6)**
6. Frost risk
7. All terrestrial and climate suitability reports

Area coverage:	69.0 hectares (ha)
Location:	Stanford le Hope, England, United Kingdom
National Grid reference:	TQ 685 855

Report description:

This report was generated using Vinescapes' Vineyard suitability Mapping and Assessment Program (VineMAP), powered by maploom. Maps, data, scoring and results within this report are provided to assist in viticulture suitability assessments. Where serious consideration is being given to establishing a vineyard on land evaluated within this report professional expertise should be sought from Vinescapes to advise on and undertake additional analysis. This includes detailed soil assessments, site and soil amelioration requirements, vineyard design, variety and planting material recommendations, business planning and project management. This report should not be relied on as the sole determinant for viticulture suitability, vineyard establishment or wine production business ventures.

Site Overview – Stanford le Hope, England, United Kingdom

Variable	Result	Suitability score
Topography	-	-
Elevation	-	-
Aspect	-	-
Slope	-	-
Dominant Soil	Undetermined	Undetermined
Suitable landcover	-	
Area with no protected status	-	
Excellent potential vineyard area	-	
Good potential vineyard area	-	
Low potential vineyard area	-	

	10-year averages	Suitability score
Growing season* average temperature (GST)	14.1°C	15/20
Growing Degree Days (GDD)	951	15/20
15th March - 31st May frost days	4.6	5/20
Average frost temperatures	-1.2°C	10/20
Growing season rainfall	378	15/20
June rainfall	63	10/20
Combined climatic suitability	Good potential	11.7/20

* The growing season in England is roughly April to October

Temperature

Temperature plays a critical role in viticulture viability, grapevine growth and in modulating the final content of compounds in grape berries such as sugars, acids, phenolics, flavour compounds and proteins.

In viticulture temperature suitability is often presented through bioclimatic indices (BCIs), metrics which provide simplistic illustrations and assessments of viticulture or varietal suitability. BCIs place numerical or descriptive envelopes around summed or averaged daily or monthly growing-season temperatures to express suitability ranges. Various indices exist, two of which are used in this suitability assessment report: Growing Season Average Temperature (GST) and Growing Degree Days (GDD).

It is important to note that they do not necessarily resolve the range of climatic processes, intra-annual variability or critical daily or hourly time-scale events which can boost or threaten vineyard productivity and they may not adequately illustrate varietal 'potential' or the adaptive capacity of viticulture through vineyard management techniques. Therefore, whilst they are useful indicators they should not be relied on as the sole determinants of viticulture or varietal suitability.

In this report the employment of GSTs and GDDs is for the purpose of scoring threshold values above which larger bioclimatic values present greater viticulture potential.

GST is calculated as the average daily mean temperatures summed for the growing season (Northern Hemisphere: April–October). GST is easier to calculate than GDD but is functionally identical.

$$\frac{\sum_{d=1}^{n}[Tmax + Tmin]/2}{n}$$

GDDs are calculated as a summation of the daily mean (Tmax + Tmin / 2) temperature above a base of 10°C, for April – October (Northern Hemisphere). The 10°C base temperature is a subjective minimum threshold considered necessary for grapevines to initiate their growing cycle.

$$\sum_{d=1}^{n} \max\left[\frac{Tmax + Tmin}{2} - 10{,}0\right]$$

Frost

Frosts, especially radiation frosts during mid-March – May are amongst the most common detrimental effects of minimum temperature extremes on Vitis vinifera L. grapevines. Notwithstanding frost protection, they pose a significant economic risk to vineyards. Frost events can kill or severely damage emerging buds and shoots and reduce yields and grape quality parameters. Cool-climate wine producing regions are particularly exposed to the risk of early season frost events when the advancement of budburst occurs in response to increased spring air temperatures.

Days of air frost (≤0°C) are provided in this report for the 15th March – 14th April and the 15th April – 31st May. During the latter period buds, inflorescences and young shoots are likely to be at a higher risk of damage as they are more exposed. However, degree of exposure / development will depend on varietal, clone and seasonal weather conditions at the vineyard location as well as vineyard management.

Climatic suitability criteria for cool-climate viticulture

Rainfall

Wine grape quality and quantity are affected by precipitation and water availability. High levels of rainfall, usually accompanied by reduced sunlight can negatively affect vine growth, berry quality and quantity through associated issues such as increased disease pressure, overstimulated vegetative growth, reduced flowering, millerandage (where grape bunches contain berries that differ greatly in size and maturity, sometimes referred to as 'chicken and hen'), coulure (flowers fail to set and are shed at or after flowering) and a sugar/acidity imbalance. In England areas with lower growing season (April – October) rainfall are favoured as a shortage of rainfall is not presently deemed to be a significant risk to viticulture.

High rainfall during June, when grapevine flowering commonly occurs in England, can have a negative impact on flowering and subsequent grape yield. As such, areas within England with lower average June rainfall are awarded higher levels of viticulture suitability within VineMAP.

Sunshine

Sunshine and more specifically solar radiation at the earth's surface: insolation, provides energy through photosynthetic processes for grapevine growth and plays a particularly beneficial role during berry ripening and maturation when sugar and phenolic contents are determined. A solar radiation map for your selected area can be purchased as part of the Topography report (Report 1).

Wind

A breeze is considered favourable within a vineyard environment to aid in drying out vines and reducing disease pressure, through a reduction in humidity. However, wind can reduce flowering success, damage vine canopy structures and reduce meso- and micro-scale temperatures within a vineyard. Wind / exposure also makes spraying more challenging and may limit the number of available spray days.

In-site wind speed and direction can be a result of local topography and site exposure so the VineMAP topography report and amelioration considerations such as windbreaks should be examined to more fully determine suitability from both prevailing winds and local scale wind directions and speed.

Data and coverage

This report includes historic temperature, frost and rainfall information relevant to the UK grape growing season, for the selected area. Climate data used in VineMAP for 2008–2017 is provided through a 2.5 x 2.5km gridded re-analysis of interpolated weather station data covering England (Source: Irish Meteorological Service reanalysis, powered by Weatherquest Ltd.). Unless explicitly presented as otherwise, the results data provided below is for the 10-year average.

Climatic suitability criteria for cool-climate viticulture

Climatic variable	Result	Classification	Score	Notes
GST(°C)	**14.1°C**	<13°C (unsuitable)	0/20	The classifications and scores provided relate to cool-climate suitability for growing varietals commonly found in southern and south-eastern England. *Varietal dependant. Contact Vinescapes to discuss viticulture and varietal suitability. **Many vineyards in south-east and south-central England operate within this range.
		13–14°C (marginal)*	10/20	
		14–15°C (suitable)**	**15/20**	
		15–16°C (very suitable)	20/20	
		≥ 16°C (Exceptional)	20/20	
GDD	**951**	< 750 (unsuitable)	0/20	* Similar to Chablis (950), the Loire (980) and many vineyards in south and south- central England. ** Similar to Champagne (1050) and many vineyards in south-east and eastern England. Early ripening varieties and appropriate clones can achieve high quality. *** Similar to the Rheingau (1100) and Burgundy (1140).
		750 – 900 (marginal)	10/20	
		900–1000*	**15/20**	
		1000–1100**	20/20	
		≥ 1100***	20/20	
Growing season rainfall (mm)	**378**	>500	0/20	
		450-500	5/20	
		400-450	10/20	
		350-400	**15/20**	
		<350	20/20	
June rainfall (mm)	**63**	>70	0/20	
		65-70	5/20	
		60-65	**10/20**	
		55-60	15/20	
		<55	20/20	
Frost days (15th March - 31st May)	**4.6**	>5 (extreme risk)	0/20	For results showing moderate risk or above please view the Cold Air Flow and Cold Air Accumulation maps for an indication of in-site risk locations and contact Vinescapes for frost protection advice.
		3-5 (high risk)	**5/20**	
		1-3 (moderate risk)	10/20	
		0-1 (low risk)	15/20	
		0	20/20	
Average frost temperatures (15th March – 31st May)	**-1.2**	< -3 (extreme risk)	0/20	For results showing moderate risk or above please view the Cold Air Flow and Cold Air Accumulation maps for an indication of in-site risk locations and contact Vinescapes for frost protection advice.
		-2 - -3 (high risk)	5/20	
		-1 - -2 (moderate risk)	**10/20**	
		0 - -1 (low risk)	15/20	
		0	20/20	
Combined climatic suitability				Grading matrix 0-5 = Unsuitable 11.7/20 5.1-10 = Low potential 10.1-15 = Good potential 15.1-20 = Excellent potential

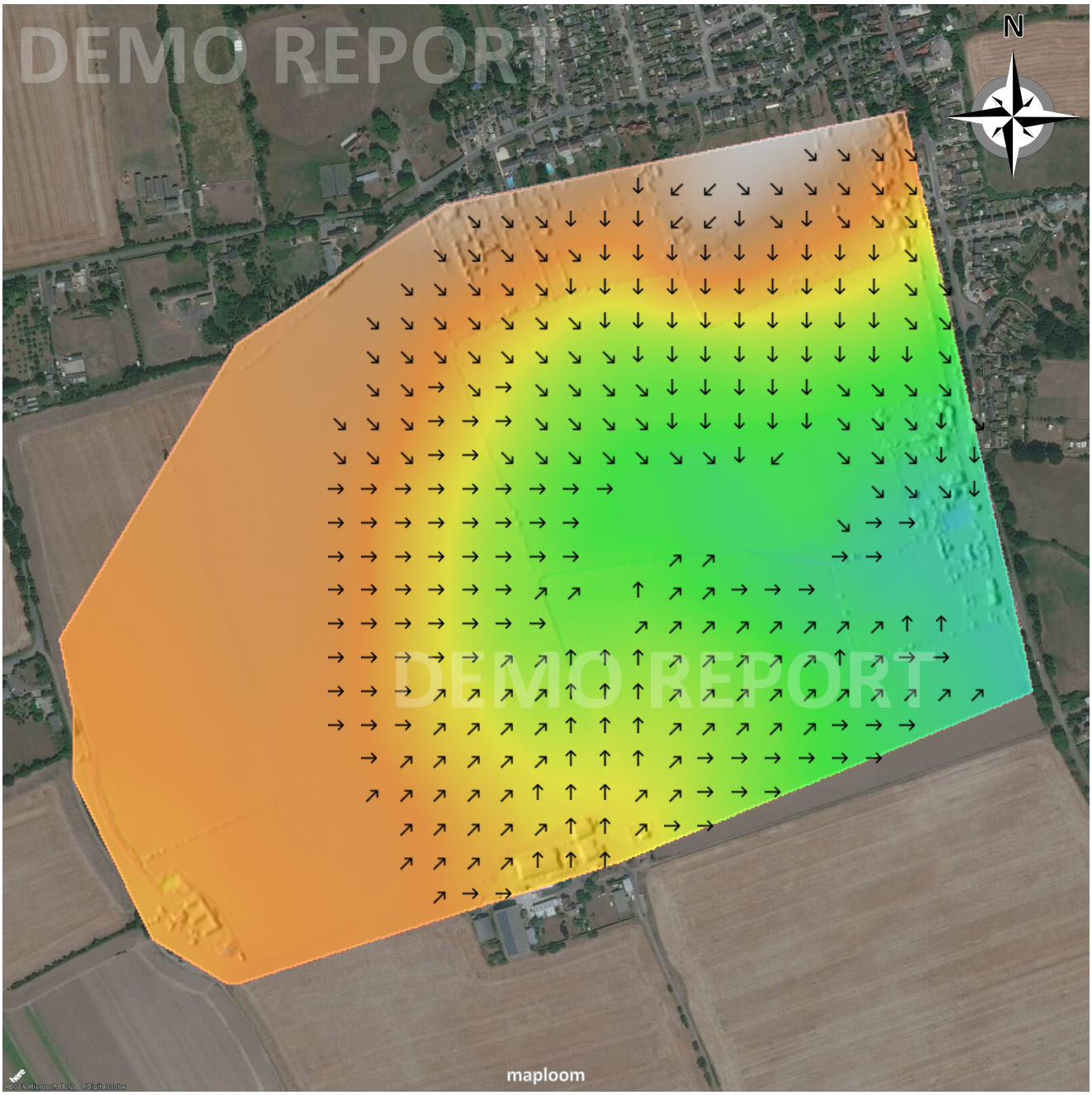
Climatic suitability criteria for cool-climate viticulture

Additional monthly climate data (10-year average)	Time period	Variable	Variable	Variable
Temperature	**Month**	**Minimum (°C)**	**Max (°C)**	
	April	4.3	14.2	
	May	7.5	16.8	
	June	10.4	19.8	
	July	13.1	22.4	
	August	13.2	22.0	
	September	10.8	19.2	
	October	8.3	15.3	
Frost	**Year**	**15/03 – 14/04**	**15/04 – 31/05**	**Minimum temperatures (°C)**
		(Days < 0°C)	(Days < 0°C)	
	2017	0	1	-1
	2016	1	3	-0.6,-0.3,-0.3,-0.3
	2015	2	0	-0.1,-2.3
	2014	1	0	-1
	2013	15	3	-0.7,-1.1,-0.5,-0.8,-2.1,-2.9,-2.6,-3.1,-1.6,-2.7,-0.5, -0.8,-0.4,-0.8,-4.8,-1.2,-0.6,-0.1
	2012	1	1	-1.9,-1.3
	2011	2	0	-1.7,-0.6
	2010	0	4	-0.4,-0.8,-0.2,-0.6
	2009	3	0	-1.4,-1,-0.5
	2008	8	1	-0,-1.7,-1.7,-1.4,-1,-1.2,-2.2,-0.3
	Average	3.3	1.3	-1.2
Growing season rainfall	**Month**	**Mean (mm)**		
	April	40.7		
	May	51.9		
	June	63.3		
	July	64.9		
	August	58.6		
	September	40.7		
	October	58.1		
	Growing season total	378.2		

Cold air flow

Resolution: 2m
Data source: LiDAR Digital Terrain Model

0 m 500 m



Cold air flow. This map shows the terrain and slope direction of the selected area. Under radiation frost conditions cold air flows down slope and has the potential to be trapped where surface features (e.g. trees, hedges or buildings) form barriers to prevent the cold air from dispersing. Areas where arrows converge or the flow meets natural barriers have the potential for frost risk as cold air may accumulate and engulf planted areas.

Elevation legend

- 10.9-15.4 m
- 16.3-20.9 m
- 21.8-26.4 m
- 27.3-31.8 m
- 32.7-37.3 m
- 38.2-42.7 m
- → flow direction

Cold air accumulation

Resolution: 2m
Data source: LiDAR Digital Terrain Model

0 m 500 m

Potential cold air accumulation / radiation frost risk areas. In addition to the cold air flow map, this cold air accumulation map provides some indication of the potential for areas where cold air could converge. This is based on a hydrological metric (topographic index) which calculates "wetness" per grid cell based on modelled water flow from the contributing "upstream" area. The light green areas show higher accumulation from a larger contributing up-slope area (and therefore have a greater potential frost risk) than the darker areas. While water and cold air do not behave exactly the same (and cold air sits above the surface), this map is a proxy for where cold air is likely to accumulate and present a radiation frost risk.

Cold air legend

Greatest cold air accumulation / radiation frost risk areas

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Mapping Overview

Mapping for this report was generated using the maploom platform. This is a cloud based geospatial analysis and modelling platform that uses open standards and open source analysis tools to deliver a wide range of location-based insights to non-specialist users. Further details can be found at www.maploom.com.

Mapping Datasets

The geospatial datasets used within the report are predominantly drawn from open source datasets. For each map, the data sources and relevant citations are provided.

Further details are summarised below:

Dataset	Map In report	Source	Credit / Disclaimer
Aerial Photography	Extensive use throughout the report	HERE	© HERE, 2019
LiDAR	Extensive use throughout the report	Environment Agency	© Environment Agency copyright and/or database right 2019. All rights reserved.
SSSI - Sites of Special Scientific Interest LNR - Local Nature Reserves NNR – National Nature Reserves SAC – Special Areas of Conservation SPA – Special Protection Areas	Environmental designations	Natural England	© Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2019.
Registered Battlefields Registered Parks and Gardens Listed Buildings Scheduled Monuments Building Preservation Notices Certificates of Immunity	Historical Designations	Historic England	© Historic England 2019. Contains Ordnance Survey data © Crown copyright and database right 2019.
World Heritage Sites	Historical Designations	UNESCO	© Historic England 2019 / UNESCO. Contains Ordnance Survey data © Crown copyright and database right 2019.
OpenMap Local	Site Overview: Access	Ordnance Survey	Contains OS data © Crown copyright and database right 2019.
Flood zones 2 and 3	Flood Risk	Environment Agency	© Environment Agency copyright and/or database right 2019. All rights reserved.
LandIS, National Soil Map	Soil type	Cranfield Uni. LandIS	Soils Data © Cranfield University (NSRI) and for the Controller of HMSO 2019
CEH Land Cover Map 2015	Land Cover	Centre for Ecology and Hydrology	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (25m raster, GB). NERC Environmental Information Data Centre. https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7

Vinescapes provide wine production services, knowledge and innovation to the English viticulture sector. Vinescapes work with prospective, new and established wine producers to achieve outstanding wine quality and successful business ventures. We can take your vineyard idea from conception to delivery starting from business planning & site selection through to the successful establishment of a vineyard & winery.

Our staff and partners are trusted experts with international acclaim and years of experience delivering the highest quality grape growing and winemaking. We combine to bring our knowledge, expertise and passion to wine businesses across the UK. We provide vineyard assessments (land & climate), vineyard project management & consultancy, winery design & construction, business planning and innovative research & training services.

Aware of the opportunities and risks in English wine production we bring a considered but enthusiastic approach to our work and provide a friendly, high-quality service.

Please contact us at info@vinescapes.com for more information or call us on 07967602670.