



The wine industry in the United States has experienced remarkable growth in the past 10 years. In order to support this growth, NRCS Soil Science Division has developed a series of tools that use the soil survey database to locate areas that are amenable to a number of wine grape varieties. These tools quantify the suitability of sites for 12 sets of grape varieties, including European *Vinifera*, French-American hybrids, American, and Muscadine grapes.

Focus Areas

The present discussion focuses on two *Vinifera* varieties, Cabernet Sauvignon and Chardonnay, and site suitabilities in the North Coast of California (Mendocino, Napa, and Sonoma Counties; figure 1) and the Northern Neck of Virginia (Lancaster, Northumberland, Richmond, and Westmoreland Counties; figure 2). Both of these areas have long-standing wine industries.

Identification

The identification of areas suited to wine grapes presents a unique challenge because absolute yield is not the measure of success for a vineyard. Wine grapes do not necessarily require the most productive soils but instead thrive where certain soil, site, and climatic characteristics are met. The interaction of climate, soil, geology, topography, and grape variety results in a *terroir* for a vineyard.

Selection

How are the best sites selected for growing wine grapes? We start with the climate. The more the climate of an area differs from the climate of the area where the variety evolved, the less successfully we can consistently grow high quality wine grapes that reflect the characteristics of the variety. The yearly accumulation of heat, measured as growing degree days (GDD), is used as an indicator of which variety is best adapted to the climate of an area. For example, Chardonnay grapes achieve their best varietal character in a climate supplying up to 2,500 GDD and Cabernet Sauvignon grapes flourish at 3,000 to 3,500 GDD. Figure 3 shows the Winkler-Amerine classification of growing degree days in the North Coast region. Depending on elevation, latitude, and distance to the Pacific, nearly any grape-growing climate can be found in these California counties. The Northern Neck has a much narrower range of heat accumulation: 3,500 to 4,500 GDD, which is hot to very hot on the Winkler-Amerine system. Proximity to Chesapeake Bay and the Rappahannock River provides areas of buffered climates. Interestingly, microclimatic niches can be found in many areas where the larger scale climate is not suitable. Such areas are often sought by vintners.

Additional Considerations

The soil characteristics required for high quality *Vinifera* grapes are related mainly to water. Too much water encourages detrimental fungal growth and excessive vine growth. *Vinifera* prefer a near-neutral soil pH, relatively low general soil fertility, and low water-storage capacity. Table 1 shows soil properties considered important for vineyard site selection in Virginia.

The lay of the land is also a consideration for selecting a vineyard site (figure 4). Sites need to be high enough on the landscape to avoid frost pockets but low enough to avoid wind damage. A slope is desirable as long as it does not interfere with equipment usage. The direction the slope faces can be important when the growing degree days are marginal because it affects the amount of heat received by the landscape.

The soil survey database tools examine site suitability for vineyards on a regional scale. Small areas are not depicted at this scale. Because of the strong influence that microclimate has on the suitability of a specific site, areas that are highly suitable for wine grape cultivation may occur within larger regions that are rated as much less suitable overall. This is particularly true in mountainous regions.



Figure 1.—California wine regions.



Figure 2.—The Northern Neck of Virginia.

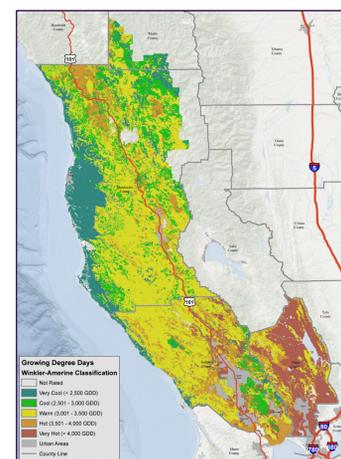


Figure 3.—Growing degree days in the North Coast of California.

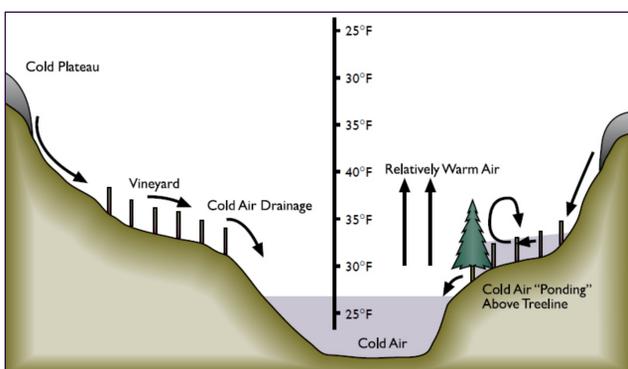


Figure 4.—Topographic characteristics for vineyards. (From "Vineyard Selection", T.K. Wolf and J.D. Boyer.)

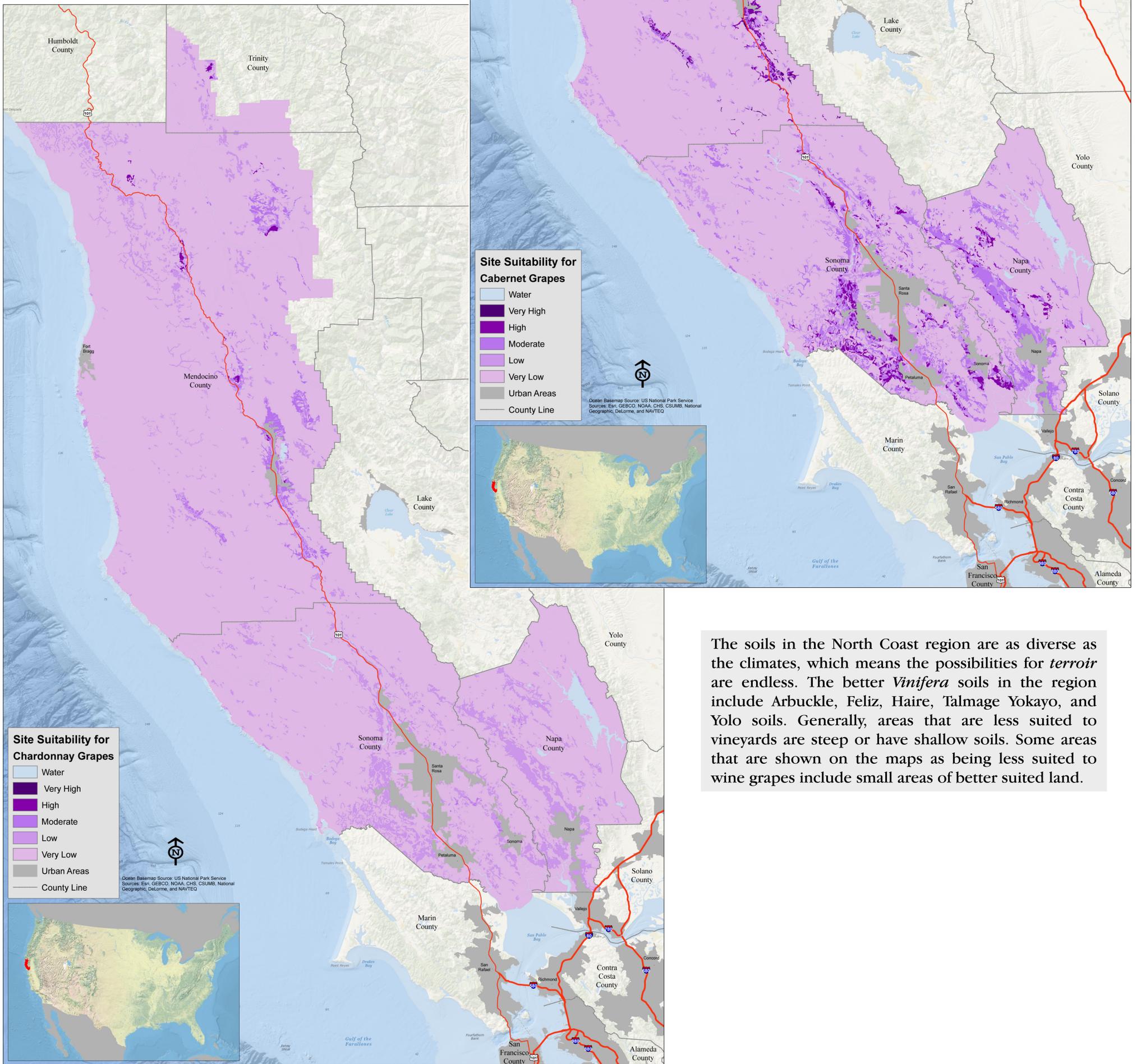
Soil feature	Importance in site selection ^a	Desirable value	Undesirable value	Ability to modify ^b
Internal water drainage	*****	> 2" / hour	< 2" / hour	+ (tile drainage is possible but expensive)
Water holding capacity	****	< 0.10 inch/ inch of soil (?)	> 0.15 inch/ inch of soil (?)	++ (can be increased)
Fertility	****	Low to moderate	Highly fertile	+++ (can be increased)
Effective rooting depth	***	> 3 feet	< 1 foot in the absence of irrigation	-- (deep ripping may increase rooting depth)
Moist bulk density	***	< 1.5 g/cm ³	≥ 1.5 g/cm ³	-- (can be decreased)
Texture (relative proportion of sand, silt and clay)	***	Loam, sandy loam, sandy clay loam, etc.	High proportion of silt (>50% silt)	---
Soil pH	***	6.0 – 6.8	< 5.0	+++ (can be adjusted)
Organic matter	**	1.0 – 3.0%	> 5.0%	+++ (can be increased)
Soil organisms	**	Variable	? <	+++ (can be increased)
Parent material	*	Granite, sandstone	?	---
Surface composition	*	Uncertain	?	---

Table 1.—Soil characteristics for vineyards. (From "Vineyard Selection", T.K. Wolf and J.D. Boyer.)



THE NORTH COAST OF California

Vinifera culture was started in California in the eighteenth century and was established in the North Coast region by the mid-nineteenth century. The region has a diversity of climates due to the ocean, mountains, and bays. Gradients of temperature are found moving up and down the mountains. The degree to which an area has a Mediterranean climate or Marine West Coast climate varies by the area's distance from a large body of water. The better areas for Chardonnay culture are either farther north or at higher elevations than the areas where Cabernet Sauvignon grapes are grown.



The soils in the North Coast region are as diverse as the climates, which means the possibilities for *terroir* are endless. The better *Vinifera* soils in the region include Arbuckle, Feliz, Haire, Talmage Yokayo, and Yolo soils. Generally, areas that are less suited to vineyards are steep or have shallow soils. Some areas that are shown on the maps as being less suited to wine grapes include small areas of better suited land.

THE NORTHERN NECK OF Virginia

Traditionally, the Northern Neck of Virginia is considered to be the counties of Lancaster, Northumberland, Richmond, and Westmoreland. For the purposes of this study, King George and Stafford Counties are also included. This region is rich in American history and has been a site of wine production since the seventeenth century. Currently, 11 wineries are in the area. The Northern Neck is bordered on three sides by bodies of water that buffer the local climate. Temperature extremes are reduced, and the number of growing degree days is lower than typical for the region. These factors are important for grape culture. Except near water, the climate of eastern Virginia in general is not conducive to *Vinifera* because of the heat. The climate works against the best varietal expression of Cabernet and Chardonnay, so the vintner must work harder to produce consistently high quality wines.

The best soils for vineyards in the Northern Neck include sandy coastal plain soils (Rumford, Sassafras, and Suffolk soils) in the east and a strip of clayey piedmont soils (Cecil and Appling soils) in western Stafford County. These soils are very deep and well drained. Their main natural limitation for *Vinifera* culture is low pH in the subsoil, which can be modified. Some soils would need to be artificially drained to remove excess water. Some areas that are shown on the maps as being less suited to wine grapes include small areas of well suited land.

